

LONDON
SCHOOL of
HYGIENE
& TROPICAL
MEDICINE



LSHTM Research Online

Patouillard, E; (2012) An economic analysis of the market for malaria treatment in Cambodia. PhD thesis, London School of Hygiene & Tropical Medicine. DOI: <https://doi.org/10.17037/PUBS.04646548>

Downloaded from: <https://researchonline.lshtm.ac.uk/id/eprint/4646548/>

DOI: <https://doi.org/10.17037/PUBS.04646548>

Usage Guidelines:

Please refer to usage guidelines at <https://researchonline.lshtm.ac.uk/policies.html> or alternatively contact researchonline@lshtm.ac.uk.

Available under license. To note, 3rd party material is not necessarily covered under this license: <http://creativecommons.org/licenses/by-nc-nd/3.0/>

<https://researchonline.lshtm.ac.uk>



An Economic Analysis of the Market for Malaria Treatment in Cambodia

Edith Patouillard

March 2012

Thesis submitted to the University of London
for the Degree of Doctor of Philosophy

Department of Global Health and Development
London School of Hygiene and Tropical Medicine
University of London

ABSTRACT

In developing countries, malaria treatment is often inadequate, notably in retail shops where the majority of people seek care. Shopkeepers are the last link in a chain of wholesalers who have an influence on treatment availability, price and quality. Evidence on competition in retail and wholesale markets is scarce, partly due to the methodological challenges of studying healthcare markets in poor countries. The thesis investigates how market structure, provider conduct, customer demand and regulation affect malaria treatment outcomes in Cambodia. In addition the thesis contributes to the development of methods for studying private drug markets.

Cross-sectional surveys and semi-structured interviews of representative samples of antimalarial retailers and wholesalers were conducted to collect data on provider practices and perceptions. The contribution of different empirical methods for identifying and sampling wholesalers and measuring sales volumes was also assessed.

Private commercial providers supplied the majority of antimalarial drugs, reflecting the relative proximity, long opening hours, reliable drug stock and friendliness of private retailers. Retail and wholesale competition increased accessibility to malaria treatment but did not lead to optimal supply of affordable quality treatment. Several market failures were evident: intense product differentiation, high concentration, and imperfect consumer information on treatment quality. These provided opportunities for higher mark-ups, although not in all market segments. With high market heterogeneity, higher retail mark-ups did not necessarily translate into higher consumer prices, highlighting the influence of distribution chain structure and wholesaler's price setting decisions. Government failures were also frequent, with poor public sector treatment accessibility and ineffective regulation.

Recommendations include widening distribution networks for artemisinin combination therapy and rapid diagnostic tests; improving product stock reliability; decreasing wholesale and retail product prices; intensifying providers' training; diffusing information to consumers on what constitutes appropriate management of malaria fever; and strengthening regulation and the potential to extend its supportive role.

DECLARATION BY CANDIDATE

'I, Edith Patouillard, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.'

Signed:

Date: 28 March 2012

Full name: Edith Patouillard

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to my supervisors, Catherine Goodman and Kara Hanson for their support and guidance throughout my research. It has been an honour to be their PhD student. In particular, I am extremely grateful to Catherine for her excellent and timely feedback and for the inspiration she offered me during my studies. I am also indebted to Benjamin Palafox and Sarah Tougher for their inputs and enthusiasm during the development of the supply chain study protocol and analysis of the survey data. Many thanks also to my PhD advisory committee members, Sian Clarke and Colin Poulton, and Immo Kleinschmidt for his guidance during the design and analysis of the sales level survey.

This study was conducted within the ACTwatch project, a collaboration between the London School of Hygiene and Tropical Medicine and Population Services International (PSI). I received financial support from the UK Medical Research Council through a PhD studentship and the Bill & Melinda Gates Foundation through the ACTwatch project within which I conducted fieldwork. Many thanks to Kathryn O'Connell and Tanya Shewchuk for sharing the outlet survey data. Thanks also go to PSI Cambodia, especially Chris Jones, Mary Warsh, Henrietta Allen and Sochea Phok for offering me and my team office space and practical assistance. Many thanks to Shunmay Yeung for sharing her knowledge of the malaria situation in Cambodia, and Prashant Yadav and Rik Bosman for their expertise on distribution chains. Special thanks to Paul Newton for his knowledge of malaria control challenges in South-East Asia and continuous interest in my research. Grateful thanks to Sophea for all the translations, and for her friendship and empathy during our field trips, to fieldworkers for their hard work, and antimalarial providers for the time they spent answering all our questions! Many thanks also to the Health Economics and Systems Analysis administrative office.

I am immensely grateful to my friends and fellow students who have made the completion of this research possible. In particular, Nicola for rescuing me and offering me a home, Mylène for listening and boosting my morale, Andreia for the coaching, Johanna for the inspiration and Ruth, Andy, Altynay, Catherine and Leslie for their companionship. Many thanks also to Virginie, Sharon, Sonja, Anne, Nathalie, Feryel, Nath and Bern for being there for me.

Lastly, énorme merci to my parents and brother for their support and, most of all, to Jef for his love, endless patience and encouragements to focus on my studies whilst keeping me smiling.

TABLE OF CONTENTS

ABSTRACT	2
DECLARATION BY CANDIDATE	3
ACKNOWLEDGEMENTS	4
TABLE OF CONTENTS	5
INDEX OF TABLES	11
INDEX OF FIGURES	14
LIST OF ACRONYMS AND ABBREVIATIONS	15
CHAPTER 1 INTRODUCTION	17
CHAPTER 2 CAMBODIA COUNTRY BACKGROUND	20
2.1 Introduction	20
2.2 Country socio-economic situation	20
2.3 Malaria burden	21
2.4 Cambodia's health system	23
2.5 Regulation of the pharmaceutical drug sector	24
2.6 Malaria Control	27
2.7 Summary	33
CHAPTER 3 LITERATURE REVIEWS	34
3.1 Introduction	34
3.2 A review of the economic theory literature on markets and competition	34
3.2.1 Standard models of markets and competition	35
3.2.2 Sources of market power	38
3.2.3 Strategies for increasing market power	41
3.3 A review of empirical methods for studying markets	48
3.3.1 Identifying providers	49
3.3.2 Sampling providers	54
3.3.3 Identifying the range of products	56
3.3.4 Measuring sales volumes and values	59

3.3.5	Defining economic markets	62
3.3.6	Measuring market concentration.....	64
3.3.7	Assessing market contestability	67
3.3.8	Measuring price mark-ups	68
3.3.9	Analysing price setting decisions.....	69
3.4	A review of the empirical literature on markets for malaria treatment.....	71
3.4.1	Retail markets for malaria treatment.....	72
3.4.2	Distribution chains and wholesale markets for antimalarial drugs.....	77
3.4.3	Price setting in private commercial sector distribution chains.....	82
3.5	Summary	84
CHAPTER 4	STUDY DESIGN & METHODS	85
4.1	Introduction.....	85
4.2	Study design	85
4.2.1	Aims and objectives.....	85
4.2.2	Analytical framework.....	86
4.2.3	Scope of research and data sources	89
4.3	Institutional setting and intellectual ownership.....	91
4.4	Ethical clearance and informed consent	92
4.5	Methods for data collection and data analysis.....	93
4.5.1	Outlet survey.....	93
4.5.2	Supply chain survey	101
4.5.3	Semi-structured interviews.....	104
4.6	Summary	107
CHAPTER 5	RETAIL MARKETS FOR MALARIA TREATMENT	108
5.1	Introduction.....	108
5.2	Structure of retail markets	108
5.2.1	Providers stocking antimalarial drugs.....	108
5.2.2	Antimalarial drug sales volumes and values	109
5.2.3	Market shares of different antimalarial categories and provider types.....	111

5.2.4	Defining the market.....	118
5.2.5	Market accessibility and malaria transmission risk.....	121
5.2.6	Retail market concentration	123
5.2.7	Perceived barriers to entry and exit	125
5.3	Provider conduct: product differentiation and non-price competition.....	130
5.3.1	Location choice.....	130
5.3.2	Outlet's opening hours	131
5.3.3	Stock reliability and range of drugs available	131
5.3.4	Perceived drug quality.....	132
5.3.5	Personal relationship, providers' expertise and reputation	135
5.3.6	Provision of cocktail therapy.....	138
5.3.7	Provision of blood testing services.....	139
5.3.8	Offering credit	141
5.4	Summary	143
CHAPTER 6	THE PRIVATE COMMERCIAL SECTOR DISTRIBUTION CHAIN FOR ANTIMALARIAL	
DRUGS	144
6.1	Introduction.....	144
6.2	Structure of the distribution chain	144
6.2.1	Identifying wholesale suppliers.....	144
6.2.2	Mapping the distribution chain for antimalarial drugs.....	146
6.2.3	Wholesalers' characteristics	148
6.2.4	Range of antimalarials and RDT stocked	151
6.2.5	Antimalarial and RDT sales volumes.....	152
6.2.6	Concentration in the distribution chain.....	154
6.2.7	Barriers to market entry and exit	158
6.3	Provider conduct: product differentiation and non-price competition.....	162
6.3.1	Delivery services.....	162
6.3.2	Credit facilities.....	165
6.3.3	Drug availability and stock reliability.....	166

6.3.4	Perceived drug quality	167
6.3.5	Product promotion	167
6.3.6	Suppliers' expertise and reputation and suppliers as sources of information	169
6.4	Summary	169
CHAPTER 7	PRICING AND PRICE COMPETITION	170
7.1	Introduction.....	170
7.2	Price setting behaviours.....	171
7.3	Purchase prices and price mark-ups	174
7.3.1	Wholesale purchase prices and price mark-ups	174
7.3.2	Retail purchase prices and price mark-ups	179
7.4	Determinants of antimalarial retail price mark-ups	185
7.4.1	Hypotheses on antimalarial retail percent mark-ups.....	185
7.4.2	Methods for hypothesis testing	186
7.4.3	Results.....	187
7.5	Summary	206
CHAPTER 8	COMPARATIVE ANALYSES OF DIFFERENT METHODS FOR STUDYING ANTIMALARIAL RETAILERS AND WHOLESALERS	207
8.1	Introduction.....	207
8.2	Comparing four methods for identifying and sampling wholesalers.....	208
8.2.1	Introduction	208
8.2.2	Methods for data collection and analysis	208
8.2.3	Results.....	211
8.2.4	Conclusion.....	227
8.3	Comparing two methods for measuring retail and wholesale sales volumes....	227
8.3.1	Introduction	227
8.3.2	Methods for data collection and analysis	228
8.3.3	Results.....	239
8.3.4	Conclusion.....	246

CHAPTER 9	DISCUSSION & RECOMMENDATIONS	250
9.1	Introduction.....	250
9.2	Methodological strengths and weaknesses	250
9.2.1	Obtaining a representative sample of providers.....	250
9.2.2	Obtaining high participation and response rates.....	251
9.2.3	Measuring market structure and provider conduct	253
9.2.4	Measuring market accessibility and risk of malaria transmission.....	258
9.3	Discussion of findings in light of the theoretical and empirical literatures...258	
9.3.1	Key features and outcomes of the market for malaria treatment.....	258
9.3.2	Factors affecting the relative role of private and public providers	262
9.3.3	Factors affecting price setting for antimalarial drugs.....	263
9.3.4	Factors influencing treatment quality	269
9.4	Recommendations for policy and future research	273
9.5	Conclusion	280
REFERENCES	282
APPENDICES	296
APPENDIX 1	Methods for reviewing the range of approaches used for studying markets for pharmaceutical drugs in low and middle income countries	296
APPENDIX 2	Methods for reviewing the empirical evidence on private commercial sector distribution chains.....	298
APPENDIX 3	Malaria Journal manuscript.....	299
APPENDIX 4	Ethics approvals and data collection tools	313
APPENDIX 5	Calculating antimalarial adult equivalent treatment dose.....	359
APPENDIX 6	Weights used in the analysis of ACTwatch Outlet Survey data	360
APPENDIX 7	Factors for scaling-up monthly sales volumes to the whole year	361
APPENDIX 8	Procurement costs of antimalarials in the public sector.....	362
APPENDIX 9	Sample of 20 sub-districts sampled for the ACTwatch Supply Chain Study..	363
APPENDIX 10	Coding scheme for qualitative data analysis	364
APPENDIX 11	HHI on antimalarial sales values and volumes by market.....	365

APPENDIX 12	Correlations between predictor variables.....	367
APPENDIX 13	Calculation of interaction coefficients	368
APPENDIX 14	Identifying antimalarial wholesalers through two different methods.....	373
APPENDIX 15	Performance ranking of four methods for identifying and sampling antimalarial wholesalers.....	374
APPENDIX 16	Sample of antimalarial wholesalers for comparing two different methods for measuring sales volumes.....	375
APPENDIX 17	Sample of antimalarial retailers for comparing two different methods for measuring sales volumes.....	376

INDEX OF TABLES

Table 2-1: ACT availability	31
Table 2-2: RDT and microscopy availability	31
Table 2-3: Retail median prices of antimalarial drugs and blood tests	32
Table 3-1: Summary of approaches used for identifying different provider types	54
Table 4-1: Data sources	90
Table 4-2: Overview of the author’s participation and responsibilities	91
Table 4-3: Overview of the characteristics of retailers who participated in semi-structured interviews	106
Table 4-4: Overview of the characteristics of wholesalers who participated in semi-structured interviews	107
Table 5-1: Retail providers stocking antimalarials in the 38 surveyed sub-districts.....	109
Table 5-2: Estimated total antimalarial sales volumes and values in malaria-endemic areas..	111
Table 5-3: Top two antimalarial retail outlet categories by stratum	116
Table 5-4: Market characteristics by stratum.....	122
Table 5-5: Median HHI across all markets and by stratum	123
Table 5-6: Retailers who reported operating without a MOH drug outlet license	127
Table 5-7: Antimalarial dosage forms by outlet type.....	132
Table 5-8: Country of manufacture of antimalarial drugs surveyed.....	134
Table 5-9: Private providers reporting deciding which antimalarial customers receive.....	136
Table 5-10: Retailers reporting having a staff member with completed primary and secondary education and with health qualifications	138
Table 5-11: Retailers reporting selling antimalarial drugs as part of cocktail therapies for treating malaria symptoms	139
Table 5-12: Retail availability of blood testing services	139
Table 5-13: Retailers who reported offering credit to antimalarial customers.....	142
Table 6-1: Supply chain survey data collection process	145
Table 6-2: Relationship between mutually exclusive and analytical categories of wholesalers	146
Table 6-3: Wholesalers’ buying practices.....	147
Table 6-4: Years in operation, wholesale outlet size and range of products sold	148
Table 6-5: Wholesalers’ customers for antimalarial drugs.....	149
Table 6-6: Wholesalers’ knowledge, qualifications and training	150

Table 6-7: Antimalarial and RDT wholesale availability	151
Table 6-8: Sales volumes amongst all wholesalers	153
Table 6-9: Sales volumes amongst wholesalers with antimalarials in stock	154
Table 6-10: Concentration in the distribution chain for antimalarial drugs.....	157
Table 6-11: Wholesale licensing & inspection	159
Table 6-12: Wholesalers' delivery activities	162
Table 6-13: Characteristics of retailers supplied by a wholesaler with delivery services	164
Table 6-14: Wholesalers' credit facilities	166
Table 7-1: Wholesale purchase prices.....	175
Table 7-2: Wholesale percent price mark-ups.....	177
Table 7-3: Wholesale absolute price mark-ups	178
Table 7-4: Retail purchase prices	181
Table 7-5: Retail percent price mark-ups	183
Table 7-6: Retail absolute price mark ups	184
Table 7-7: Hypotheses about retail percent mark-up variations.....	186
Table 7-8: Relationships between retail mark-ups and market, outlet and product characteristics.....	188
Table 7-9: Relationships between retail mark-ups, market concentration, sales volume and outlet's length of time in operation.....	188
Table 7-10: Description of the regression model for all antimalarial price percent mark-ups .	190
Table 7-11: OLS log-linear regression model of antimalarial retail price percent mark-ups.....	192
Table 7-12: OLS log-linear regression model of antimalarial retail price percent mark-ups, considering interactions between predictor variables	195
Table 7-13: Effect of HHI on retail percent mark-ups across accessibility levels.....	196
Table 7-14: Effect of strata on retail percent mark-ups across market accessibility levels	197
Table 7-15: Effects of accessibility on retail percent mark-ups across malaria risk levels.....	198
Table 7-16: Effects of malaria transmission risk on retail mark-ups across market accessibility levels	199
Table 7-17: Description of the regression model of ASMQ retail percent price mark-ups only	200
Table 7-18: OLS log-linear regression of ASMQ retail price percent mark-ups, considering interactions between predictor variables	201
Table 7-19: Effects of accessibility on ASMQ retail percent mark-ups across strata.....	202
Table 7-20: Summary of the effects of market, outlet and product characteristics on retail percent mark-ups.....	205

Table 8-1: Registered drug outlets in lists collected at Provincial Health Departments213

Table 8-2: Overview of key informant interviews.....215

Table 8-3: Sample size calculations for the Sales Level Survey231

Table 8-4: From initial to final samples: overview of the SLS at wholesale and retail outlets ..232

Table 8-5: Data collected on wholesale sales volumes using recall and retail audit methods..234

Table 8-6: Data collected on retail sales volumes using recall and retail audit methods.235

Table 8-7: Results from the Bland – Altman approach241

Table 8-8: Products for which interviewers effectively counted the quantities in stock.....244

Table 8-9: Costs of implementing retail audit technique and recall methods246

Table 8-10: Problems encountered when measuring sales volumes.....249

INDEX OF FIGURES

Figure 2-1: Incidence of cases treated for confirmed malaria per 1000 inhabitants in 2009	22
Figure 4-1: Analytical framework.....	88
Figure 4-2: Map of 38 sub-districts sampled for the ACTwatch Outlet Survey	94
Figure 5-1: Antimalarial market shares in volume terms	112
Figure 5-2: Provider market shares in volume terms.....	114
Figure 5-3: Market shares in volume terms of each provider type by antimalarial drug category and stratum	115
Figure 5-4: Provider market shares in value terms.....	117
Figure 6-1: Representation of the antimalarial distribution chain showing interactions between levels by mutually exclusive wholesaler category	146
Figure 6-2: Representation of the antimalarial distribution chain showing the overlap between wholesaler categories used for analysis.....	146
Figure 6-3: Retailers and wholesalers' supply sources for antimalarials	156
Figure 8-1: Using official lists: a SWOT analysis.....	214
Figure 8-2: The private commercial sector distribution chain for pharmaceutical drugs in Cambodia: findings from key informant interviews.	216
Figure 8-3: Key informant interviews: a SWOT analysis.....	219
Figure 8-4: The bottom-up approach: a SWOT analysis.....	220
Figure 8-5: Snowball census: a SWOT analysis	223
Figure 8-6: Relative performance of 4 different methods for identifying and sampling antimalarial wholesalers.	225
Figure 8-7: Relative performance of 2 different combinations of methods	226
Figure 8-8: Design of the Sales Level Survey	228
Figure 8-9: Scatter plots of the between-method differences against volumes of sales measured.....	240

LIST OF ACRONYMS AND ABBREVIATIONS

ACT	Artemisinin-Based Combination Therapy
AETD	Adult Equivalent Treatment Dose
AMT	Artemisinin Monotherapy
ASMQ	ACT Artesunate and Mefloquine
CHAI	Clinton Health Access Initiative
CNM	National Centre of Entomology, Parasitology and Malaria Control
CR	Concentration Ratio
DDF	Department of Drugs and Food
HAI	Health Action International
HHI	Herfindahl-Hirschman Index
IO	Industrial Organization
IOM	Institute Of Medicine Of The National Academies
IQR	Inter-Quartile Range
IRP	International Reference Price
KIIs	Key Informant Interviews
MDG	Millennium Development Goal
MDR	Multi Drug Resistance
MDRF	Multi Drug Resistance Free
MDRSC	Multi Drug Resistance Suspected or Confirmed
MEC	Mutually Exclusive Categories
MMV	Medicines for Malaria Venture
MOH	Ministry Of Health
MOP	Ministry Of Planning
nAMT	Non-Artemisinin Monotherapy
NIS	National Institute Of Statistics
OD	Operational District
OS	Outlet Survey
OTC	Over-The-Counter
PSI	Population Services International
PHD	Provincial Health Department
RDT	Rapid Diagnostic Test for malaria
RRP	Recommended Retail Price

SCP	Structure Conduct Performance
SCS	Supply Chain Survey
SLS	Sales Level Survey
SSIs	Semi-Structured Interviews
WHO	World Health Organization
<i>P.f</i>	<i>Plasmodium falciparum</i>
<i>P.v</i>	<i>Plasmodium vivax</i>
VAT	Value Added Tax
VMW	Village Malaria Worker

CHAPTER 1 INTRODUCTION

In 2009, 225 million cases of malaria were reported worldwide, resulting in 781 000 deaths. About 85% of these deaths were children under 5 years of age, with the majority occurring in Africa. Malaria control is the 6th Millennium Development Goal (MDG6), which aims for a decline of malaria incidence by 2015 (UN Millennium Project, 2005). Unless effective preventive and treatment methods reach high levels of coverage, it is unlikely that countries at the highest risk of malaria will achieve MDG6 within the given timeset, which will also have important implications for reaching MDG4 to reduce child mortality. Furthermore, malaria places a considerable burden on the social and economic development of malaria-endemic countries that also tend to have lower economic growth rates (Sachs and Malaney, 2002).

Malaria is caused by a parasite called *Plasmodium*, which is transmitted to humans via the bites of infected female mosquitoes. Different types of *Plasmodium* species exist, with *Plasmodium falciparum* (*P.f*) and *Plasmodium vivax* (*P.v*) being the most common parasite types and *P.f* the cause of most malaria infections and death (WHO, 2010c).

One of the cornerstones of malaria control is parasitological confirmation of all suspected malaria cases by either microscopy or rapid diagnostic tests (RDTs) and treatment of confirmed *P.f* cases with artemisinin-based combination therapy (ACT). By 2009, most countries with *P.f* had switched to ACT as their first line medicine, with the choice of combination drugs based on their efficacy in specific countries. The therapeutic life of ACT is however threatened by the spread of multi-drug resistance (MDR) that has emerged in Western Cambodia. This is of great concern to the international community because prolonged parasite clearance may spread to other parts of Asia and Africa, as has been the case in the past for older antimalarial drugs (Roper et al., 2004, Verdrager, 1986, Noedl, 2005, Dondorp et al., 2009). The loss of ACT to resistance would be catastrophic for malaria control strategies as no other treatment with the same efficacy and tolerability is currently available (WHO, 2010a). Containing resistance to areas where it exists is therefore urgent.

Factors believed to encourage MDR development and spread include inadequate drug prescribing, poor consumer adherence to duration or dose of treatment and poor quality drug (WHO, 2010a). In addition, the consumption of artemisinin monotherapies (AMT) is argued to have fuelled the emergence of MDR (Maude et al., 2010). A key issue for containment strategies is therefore improving access to prompt and appropriate management of malaria

fevers through increase of ACT availability and decrease of ACT price in relation to other antimalarials; withdrawal of artemisinin monotherapies, substandard and fake drugs; targeting ACT to those actually in need of the therapy (i.e. parasitological confirmation of malaria cases prior treatment) (Whitty et al., 2008b, Whitty et al., 2008a) and better adherence to treatment regimens. These issues are relevant to both the public and private commercial sectors as the latter plays an important role in the provision of malaria treatment.

Private commercial providers can be pharmacies, drug shops, grocery stores, market stalls or itinerant hawkers that are often preferred to public health facilities as they tend to operate closer to homes and offer a more reliable source of drugs. However the quality of care they provide is often poor, with retailers often lacking relevant qualifications and adequate knowledge of drugs and dosages. MDR containment strategies for improving access to prompt and appropriate management of fevers are therefore particularly relevant in the private commercial sector. The private sector is not limited to providers that serve consumers directly. Retailers are the last link in a chain of wholesalers and their business practices are likely to be influenced by what happens at higher levels of the distribution chain. There is a need therefore to understand private retailers and wholesalers' stocking and pricing decisions, as they are likely to have a profound impact on the availability, price and use of different antimalarial medicines and diagnostics. There is however a lack of evidence on the structure and functioning of the supply-side of the market for malaria treatment, partly reflecting the challenges of studying private commercial providers. Retail and wholesale providers are commercial businesses and their operations are likely to be affected by both the competitive and regulatory environment in which they operate and by customer demand. Theories and concepts from the field of economics are therefore likely to provide useful insights for such study.

The main aim of this thesis is to analyse the market for malaria treatment in Cambodia, including the retail market and its distribution chain, with a focus on the private commercial sector, and to draw public health recommendations for improved access to effective malaria treatment and MDR containment. A further aim is to conduct a comparative analysis of different empirical methods for studying markets for pharmaceutical drugs in general in developing countries. The thesis has five specific objectives:

- To describe the structure of retail markets for malaria treatment and assess product differentiation and non-price competition

- To describe the structure of the private commercial sector distribution chain for antimalarial drugs and assess product differentiation and non-price competition
- To assess the intensity of price competition in retail markets and in the private commercial sector distribution chain
- To compare different empirical methods for identifying and sampling private commercial providers for antimalarial drugs, and measuring their sales volumes
- To analyse the implications of the interplay between market structure and provider conduct in the context of consumer demand and government intervention on the availability, quality and price of malaria treatment and draw recommendations for public policy and future research.

The thesis is structured as follows. In Chapter 2, the institutional context in which the study is taking place is described including Cambodia's socio-economic situation, malaria situation, health care system, pharmaceutical drug sector regulations and malaria control interventions. In Chapter 3, three different literatures relevant to this thesis are reviewed: first, the literature on standard models of markets and competition because it provides several concepts of potential relevance to the study of the supply-side of the market for malaria treatment, including, for example, product and geographical definitions of the market, market concentration, vertical integration and restrictions, product differentiation, imperfect consumer information and regulatory failures; second, the literature on the range of data collection and data analysis methods that have been used for studying retail and wholesale markets for pharmaceutical products in low and middle income countries in order to inform the design of this study; and third, the available empirical evidence on private commercial sector distribution chains for antimalarial drugs in the developing world in order to identify the key knowledge gaps at the time of our study. Chapter 4 presents the aims and objectives of the thesis, the study design and methods for data collection and data analysis. Results on market structure and non-price competition in retail markets are presented in Chapter 5 and in the private commercial sector distribution chain in Chapter 6, followed by results on price competition in retail markets and at different levels of the distribution chain in Chapter 7. Chapter 8 gives the results of the comparative analysis of different methods for studying retail and wholesale markets in developing countries. The thesis ends by assessing the strengths and weaknesses of the research before discussing the results and drawing recommendations for public policy and future research in Chapter 9.

CHAPTER 2 CAMBODIA COUNTRY BACKGROUND

2.1 Introduction

This chapter describes the country setting in which the PhD research took place. It gives an overview of Cambodia's socio-economic situation, malaria burden, health system, pharmaceutical drug regulations and malaria control interventions.

2.2 Country socio-economic situation

Cambodia is located in South-East Asia and borders Thailand, Vietnam and Laos. It has a population of 13.4 million inhabitants, predominantly rural and a quarter of whom are considered migrant (NIS, 2008). Cambodia has the lowest literacy rate in the South East Asian region, with one quarter of the rural population and one tenth of the urban population being illiterate (NIS, 2008). The gross domestic product (GDP) per capita is US\$ 739 and 40% of Cambodians live on less than US\$ 1.25 per day (CIA, 2009, World Bank, 2010).

The agriculture, forestry and fishing sector accounts for 72% of the employed population but, still being narrowly focused on paddy productions, accounts for only 32% of GDP. By contrast, the wholesale and retail trade sector, which accounts for only 8% of the employed population contributes nearly 39% of GDP (NIS, 2008). Most of the labour force is self-employed, working in small private commercial enterprises, indicating the importance of '*the informal or unorganized sector*' (NIS, 2008).

The importance of the private commercial sector is relatively recent. From 1975 to 1979, the Khmer Rouge regime implemented a form of agrarian socialism, characterized by the abolition of money and private property, and after the fall of the regime, a socialist economic model was implemented. In 1993, the UN-supervised first elections marked the start of progress towards recovery, and from 1998, after a second round of elections, economic and political stability returned. Several reforms were then implemented, including market liberalisation, complete dollarization of the economy and administrative decentralisation (Grundy et al., 2009). In 2009, there were 24 provinces (23+Phnom Penh), which included a total of 167 districts, 1621 communes and 14,119 villages (NIS, 2008).

2.3 Malaria burden

Malaria transmission in Cambodia is seasonal and takes place during the monsoon season from May to November. *Anopheles dirus* and *Anopheles minimus* are the main malaria vectors¹ as they breed in thick forests, which cover 62% of the country landmass (CNM, 2009a). Forested areas are thinly populated and around 85% of the population actually lives in areas without malaria transmission risk (CNM, 2009a). Based on official statistics there has been a downward trend in malaria morbidity in the last decade, with 83,777 outpatient and 4,045 inpatient cases reported in 2009 (CNM, 2009a). The official Health Information System reports that malaria accounts for 0.6% of outpatient cases and 3.5% of inpatient cases (MOH, 2009).

As opposed to most African malaria endemic countries, the malaria burden in Cambodia falls predominantly on male adults who account for 51% of all confirmed malaria cases. Female adults, children aged 5 to 14 years old and those aged less than 5 years account each for around 16% of all confirmed malaria cases (CNM, 2009b). The 1.8 million of inhabitants at risk of malaria are however very heterogeneous populations, that can be broadly categorised in four categories (CNM, 2009b), including:

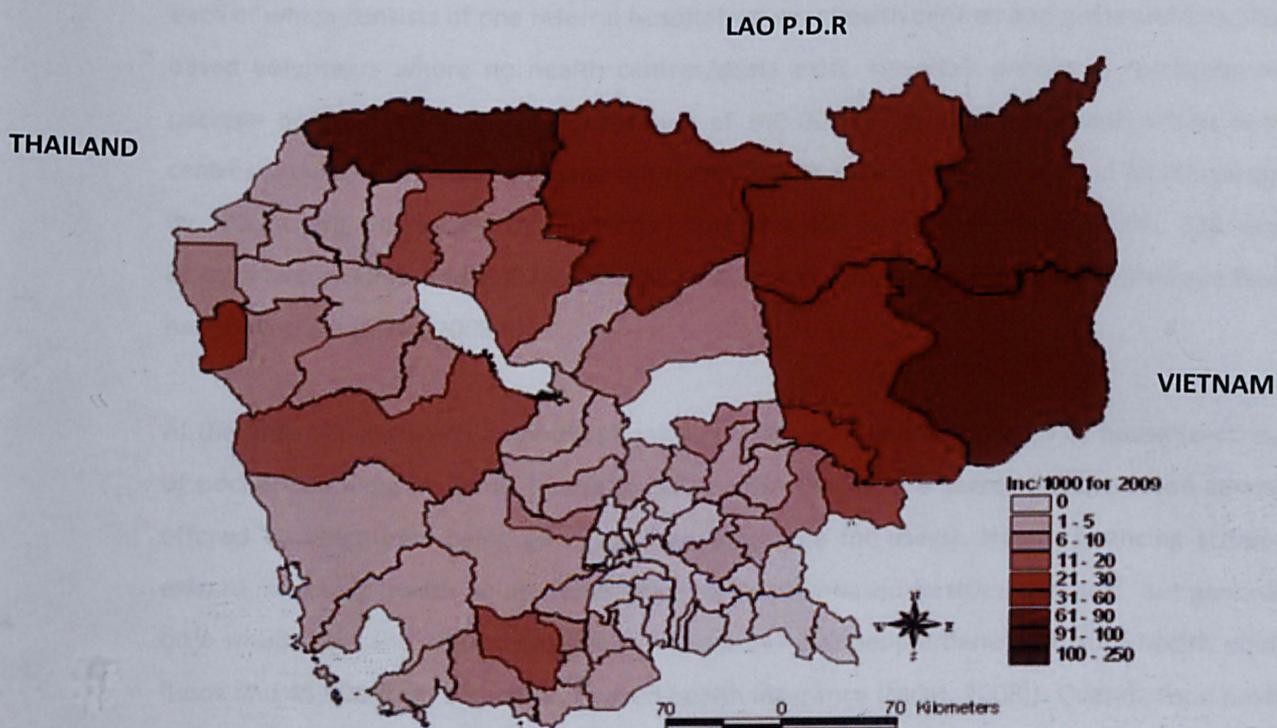
- **Forest fringe inhabitants** (around half of the population at risk). Rice growing communities living in or close to forested areas. Adult males who make overnight visits to the forest to hunt and collect construction wood and other products are the primary population risk group. Malaria infected men who return from the forest can infect anopheles mosquitoes breeding outside the forest leading to local transmission, putting all age group at risks.
- **Cross-borders and temporary migrant workers** (around 400,000 people, although the actual size of this group is hard to estimate (CNM, 2009a)). Mostly adult males with little or no immunity to malaria, working in the forest for extended periods (e.g. construction workers, agricultural farm workers, sandal wood collectors and soldiers) (CNM, 2009a). Timely health facility attendance is low as many delay treatment until they return home (CNM, 2009a, URC-MCC, 2009).

¹ *Anopheles aconitus* and *Anapholes maculates* are considered secondary vectors, although their role in malaria transmission has been reported to increase following changing in biting habits (CNM, Annual Report 2009)

- **Ethnic minority groups** (around 200,000 people). Traditional forest inhabitants living mainly in the northeast of the country. All age groups are exposed seasonally to intense transmission. Children and pregnant women bear the highest risk. Remoteness of these provinces and differences in language, culture and beliefs are the main challenges in reaching these populations with effective malaria control interventions.
- **New forest settlers** (around 100,000 people). New settlements are continuously established by populations with generally low immunity to malaria infections.

Malaria transmission is the highest in the North and North-East of Cambodia where *Plasmodium falciparum* (*P.f*) predominates and remains drug-sensitive. By contrast, in the West, *P.f* malaria transmission is generally lower and *Plasmodium vivax* (*P.v*) predominates in some parts (Shunmay Yeung, personal communication) (Figure 2-1).

Figure 2-1: Incidence of cases treated for confirmed malaria per 1000 inhabitants in 2009



Source: CNM, personal communication

The Western area is also known as the epicentre for multi-drug resistance (MDR) (Noedl, 2005, Dondorp et al., 2009), with MDR defined as reduced in vivo or in vitro parasite responses or detected using measures of parasite clearance. Cambodia can therefore be roughly divided into two parts: one where MDR is confirmed or suspected (North/North-East) and one without MDR (West/South-West).

2.4 Cambodia's health system

During the Khmer Rouge regime, Cambodia lost the majority of its public health infrastructure and human resources (Chandler, 2000, Dubois et al., 2004). After the fall of the regime, significant reforms were implemented in order to rebuild the public health system (Grundy et al., 2009).

A Health Coverage Plan was designed to improve primary health care coverage, by allocating resources and decentralising responsibilities to provincial health departments (PHDs) and creating operational districts (ODs). PHDs oversee and support the functioning of their ODs, each of which consists of one referral hospital, several health centres and posts and/or village-based volunteers where no health centres/posts exist. Hospitals provide a comprehensive package of health services to a population of 100 000 to 200 000 inhabitants whilst health centres provide a minimum package of primary health care services to around 10,000 people. By 2009, there was a total of 77 referral hospitals, 992 health centres (of which, 828 newly built between 1995 and 2007) and 107 health posts, supplemented by 6140 village-based health workers (CNM, 2009a).

At the time of our study, Cambodia's health care financing was dominated by households' out-of-pocket spending in public health facilities or in the private sector (village-based services offered by volunteers being generally free of charge for users). Health financing schemes existed, including health equity funds² and community-based health insurance³, but generally on a small scale and ad-hoc basis (e.g. around 247,000 people benefited from health equity funds and 45,000 from community-based health insurance (MOH, 2008)). Overall, total health expenditure was estimated to amount to US\$ 37 per capita of which US\$ 25 (68%) was out of

² A social-transfer mechanism or third-party payer scheme designed to provide targeted income transfers to the poor to pay for health care services in the public sector through facilities contracted by the equity fund.

³ A micro-assurance scheme managed independently by community members, whereby the term community may be defined as members of a professional group, residents of a particular location, etc.

pocket, with the remainder covered by donor organisations (22%) and the Ministry of Health (MOH) (10%) (MOH, 2008).

Improvements in coverage of basic health services have been reported but mostly in areas covered by village-based services (Schwartz and Bhushan, 2004). Access to public health facilities was limited and inequitable (Grundy et al., 2009, Bigdeli and Annear, 2009). For instance, it was estimated that around 670 health centres needed to be built for complete coverage of populations, with the further implication that around 6640 health centre staff members would need to be recruited (MOH, 2008). Limited geographical accessibility and poor drug stock reliability, as commonly experienced in public health sectors in other low income settings (Kangwana et al., 2009, Zurovac et al., 2008, Zurovac et al., 2007), combined in Cambodia with a lack of trust in government health workers, were reported as the most important factors affecting treatment seeking decisions (Ozawa and Walker, 2011, Van Damme et al., 2004), with most health care visits taking place in the private commercial sector, notably at drug retailers (Meesen et al 2011).

2.5 Regulation of the pharmaceutical drug sector

The private commercial pharmaceutical sector is regulated by the 2007 Pharmaceutical Law, which is formed by the 1996 Pharmaceutical Law and the series of law amendments that took place until November 2007. Another set of important legal texts are gathered in the Drug Law Profile, which includes all *Preah Reach Krom* (Royal decree), *Anukrit* (Prime Minister's sub-decree), *Praka* (Ministerial decision), *joint Praka* (Interministerial decision), *Sarachor* ("circulaire") and announcements. Other documents include the Good Pharmacy Practice 2005-2010 that contains standards and guidelines for pharmacy practices, the Pharmaceutical Sector Strategy plan 2005-2010 and guidelines on the management and supply of drugs for sexually transmitted diseases, HIV/AIDS, tuberculosis and malaria.

The regulation of the private commercial pharmaceutical sector is overseen and implemented by the Department of Drug & Food (DDF) of the MOH, in collaboration with the Phnom Penh municipality health department and PHDs to which some tasks have been delegated, including licensing and inspections of retail and wholesale drug outlets (except that of wholesale drug outlets that import pharmaceutical drugs, which remain under the direct regulation of the DDF).

There are three categories of drug outlet license:

- pharmacy license for businesses managed by a pharmacist (including drug importers)
- depot A license for businesses managed by an assistant pharmacist
- depot B license for businesses managed by retired health staff, with a minimum qualification at nurse or midwife level

Pharmacies can engage in both wholesale and retail activities and can serve depots, private and public facilities, and end-users. Pharmacies are authorised to purchase supplies from pharmaceutical drug manufacturers and import companies only. Depots can engage in retail activities only and purchase only from pharmacies and import companies. There are also additional regulations about the size and signage of pharmacy and depot outlets.

Drug outlet licenses are valid for 2 years, with the exception of pharmacy licenses delivered to civil servants with a pharmacist qualification that are valid for 1 year. There was no legally fixed license fee at the time of this study. Instead, licensing authorities were advised to charge a small fee to cover the costs of undertaking this task and the overall functioning of their office (DDF, personal communication).

The number of registered pharmacy outlet in each commune is capped at 1 outlet for 2,000 inhabitants so once this ratio is reached no new licenses should be issued. New depot 'A' licenses should only be issued if there is less than 1 pharmacy per 2,000 inhabitants in a given commune. No new depot 'B' licenses have been issued since 2005 though those issued before 2005 can be renewed.

Pharmacy and depot license holders are authorised to change the location of their outlet within the same commune after 6 months of operation. They are also authorised to pass on their license to a different person with the relevant qualifications (again after 6 months of operation). These changes need to be notified to and agreed by the relevant municipal or provincial health department. License holders are authorised to open one outlet only, implying that pharmacy and depot (horizontal and vertical) chains are not authorized. Registered outlets are authorised to sell registered pharmaceutical drugs, hygienic and cosmetic products with preventive and curative properties, and dental, laboratory and medical equipment. The sale of other consumer goods, such as household products and food is forbidden. Inspections of drug outlets are conducted before licenses are issued and theoretically once a month at each outlet by the municipal or PHD authorities (DDF, personal communication).

Pharmaceutical drugs must be registered at the DDF. The process generally takes between 4-5 months, including 3 months for drug quality control activities and 1 to 2 months for processing the registration. Drugs procured by the MOH including antimalarials, tuberculosis and HIV/AIDS medicines can be registered through a fast track registration process, which takes 2-3 weeks. Drugs are registered for 5 years, unless the World Health Organization (WHO) recommends that the drug should be banned for public health reasons, in which case the MOH registration is annulled and the import, distribution and sales of the drug are banned (DDF, personal communication). Registered pharmaceutical drugs are classified as prescription-drug or over-the-counter medicines.

Before registered drugs can be distributed, importers or local manufacturers should place a sticker on each drug pack stating the drug registration number and their company name. Distribution and sale of packs containing more than 100 tablets or bottles above 300 millilitres to pharmacies, depots and private facilities are forbidden. Distribution is regulated at municipal and PHD level though in some provinces drug companies might have to obtain additional authorisation from OD authorities before conducting any distribution activities within the OD. Finally, drug prices and mark-ups are not regulated.

It is estimated that a total of 519 outlets are managed by registered pharmacists (pharmacy outlets), 126 by registered assistant pharmacists (depots A) and 568 by registered nurses or midwives (depots B) (DDF, personal communication). In addition, aside from these outlets, there are other medicine sellers that operate illegally (DDF, personal communication). These include unlicensed pharmacies and drug shops that sell medicines, cosmetics and household goods; private clinics (sometime referred as cabinet or clinical pharmacies) that sell medicines and also provide outpatient and/or inpatient clinical services; mobile providers who travel to patients' home to provide clinical services, and at times who offer outpatient and/or inpatient care at fixed outlets; and, grocery and village shops that sell medicines alongside food, soft drinks and other consumer goods (PSI, 2007, ACTwatch Group, 2009b). These providers who operate without relevant licenses are estimated to account for 70-80% of all private commercial outlets in Cambodia (MOH, 2003, Tawfik, 2006).

2.6 Malaria Control

Since 2000, the national treatment guidelines state that malaria cases should be confirmed through blood tests, either using microscopy or rapid diagnostic tests (RDTs) (CNM, 2000). Confirmed uncomplicated adult *P.f* cases should be treated with the artemisinin-based combination therapy (ACT) artesunate and mefloquine (ASMQ) for 3 days and *P.v* cases with chloroquine also for 3 days (CNM, 2000). For mixed infections, ASMQ should be used (CNM, 2000). Severe adult cases are managed using quinine and tetracycline for 7 days (CNM, 2000).

However, there is evidence that these treatment guidelines are often not followed, notably in the private commercial sector where the majority seek care (Meesen et al., 2011, DHS 2005, CMS 2007). Malaria infection is often diagnosed presumptively on the basis of clinical symptoms rather than by blood tests and is often poorly treated with inadequate antimalarial regimens, including artemisinin monotherapies (AMT) or cocktail medicines composed of inappropriate or unnecessary drugs (Yeung et al., 2008, CDUS, 2002). Particularly, the use of AMT is argued to have fuelled the emergence of MDR and contributed to its spread (Maude et al., 2010). Evidence also shows that substandard and fake antimalarial drugs⁴ are available in Cambodia and in the Mekong region more generally, with in the latter 33% to 53% of artesunate⁵ samples estimated to be counterfeits or containing either no or sub-therapeutic quantities of the active ingredient (Newton et al., 2008, Lon et al., 2006, MOH, 2004b, MOH, 2001). Specifically, in Cambodia in 1999, 71% of 133 private drug outlets sold either fake or substandard artesunate and 60% fake or substandard mefloquine⁶ (Rozendaal, 2001). The same year, 25% of 26 samples of artesunate tablets collected in shops operating in Phnom Penh and Siem Reap towns contained no active ingredients (Newton et al., 2001), with little change in 2004 (Dondorp et al., 2004). In 2006, of 451 antimalarial drug samples collected at 171 private drug outlets operating in four provinces with suspected or confirmed MDR, 27% were substandard products or counterfeits (Lon et al., 2006). Worryingly, the literature highlights an increased difficulty for investigators to visually differentiate counterfeits from

⁴ The World Health Organization (WHO) defines substandard medicines as “*pharmaceutical products that do not meet their quality standards and specifications*” (45th WHO expert committee on specifications for pharmaceutical preparations, 2010)

⁵ An artemisinin-based monotherapy (AMT)

⁶ A non-artemisinin-based monotherapy (nAMT)

genuine products with 80% of fake products collected in Cambodia being almost indistinguishable from the genuine product (Dondorp et al., 2004, Lon et al., 2006).

To address these challenges and in the context of the importance of the private commercial sector, there have been five main interventions for improving the quality of malaria treatment obtained in Cambodia.

First, a national ban on the sale and distribution of oral AMTs was announced in 2008, combined with a public campaign, including television spots and leaflets distributed in private drug outlets. Second, a public campaign was implemented about the availability and risks of counterfeit medicines at private commercial shops in 2009⁷.

Third, in areas at high risk of malaria (i.e. villages within 2 kms of the forest), free malaria diagnostics using RDT and treatment with co-blistered ASMQ in public health facilities and, in particularly remote villages, from trained village malaria workers (two volunteers per village referred to as VMWs) (Yeung et al., 2008).

Fourth, in areas where MDR is confirmed, the ACT dihydroartemisinin+piperaquine (DHA+PP) replaces ASMQ for treating uncomplicated *P.f* and mixed infections.

Fifth, in the private commercial sector, a nationwide social marketing programme of RDT and co-blistered ASMQ implemented by the non-governmental organisation (NGO) Population Services International (PSI Cambodia) in collaboration with the National Malaria Control Programme (commonly known in Cambodia as CNM (National Malaria Centre)), and with the financial support of the Global Fund. The social marketing programme was initiated in 1999 by the European Commission Cambodia Malaria Control Project in partnership with the CNM and the WHO, and handed over to PSI Cambodia in 2003.

At the time of the study, PSI Cambodia provided one-day group training sessions to all their private commercial drug customers (regardless of their license status) for ACT and RDT and operated a “medical detailing” programme, in which clinically or pharmacy trained sales representatives visited shopkeepers at their place of work in order to provide advice and

⁷ Including the “Pharmacide” public service announcement, a collaboration between the United States Agency for International Development, the United States Pharmacopeial Convention and Cambodia’s government authorities. Available at <http://www.youtube.com/watch?v=BõyPjDzosM>

support (PSI Cambodia, personal communication). PSI Cambodia also conducted behaviour change communications, including mass media advertising through television and radio spots, distribution of point-of-sale materials such as posters and job aids, and community educational activities through mobile video units (PSI Cambodia, personal communication).

The co-blistered ACT ASMQ was procured from an overseas manufacturer in age-specific packs under the name of Malarine and the *P.f* specific RDT under the name Malacheck⁸. The products were stocked at PSI Cambodia's warehouse in Phnom Penh and stocks for around two months were distributed to three regional depots from where PSI Cambodia's sales representatives got their monthly supplies (PSI Cambodia, personal communication).

ACT and RDT were distributed to any private commercial outlet type, although with a focus on pharmacies, clinical pharmacies, drug shops and mobile providers (PSI, 2007), at a subsidized prices. At the time of our study, PSI Cambodia sold one pack of Malarine adult at a price of US\$ 0.42 and a box of 10 RDT units at US\$ 0.50 (equivalent to US\$ 0.05 per test), regardless of whether providers were retailers or wholesalers (PSI Cambodia, personal communication). PSI Cambodia recommended private shopkeepers to sell the adult pack of Malarine at US\$ 0.61, with the recommended retail price (RRP) being printed on packs, and one RDT test unit at US\$ 0.24 (RRP not printed on packs nor on test units).

Despite this multi-pronged approach to malaria control, prompt access to effective malaria treatment was, at the time of the PhD research, limited as shown by the findings of a household survey conducted in 2009 by the ACTwatch Study Group in a representative sample of malaria-endemic areas in Cambodia.

Whilst almost all (96%) of the 1617 respondents reported seeking care for malaria fever in the 2 weeks preceding the survey, 46% reported treating at home, 42% at private commercial outlets, 7% at government-owned outlets, including public health facility (6%) and VMWs (1%) and 1% at other outlets⁹ (ACTwatch Group, 2009a). Overall, 12% of respondents visited a mobile provider, 11% a pharmacy/clinical pharmacy, 10% a drug shop and 9% a grocery or

⁸ In 2010, the socially-marketed RDT was changed to a test that diagnoses *P.f*, *P.v* and mixed infections. The RDT was still marketed under the name Malacheck.

⁹ Information on outlet type included under the "other" category was not available from the ACTwatch Household Survey report.

village shop (ACTwatch Group, 2009a). Less than half of respondents¹⁰ said they had received a diagnostic test, with 27% receiving a RDT and 14% microscopy (ACTwatch Group, 2009a). Of those who reported testing positive to malaria (around 87% of those who had received a test), 47% said they received an antimalarial drug and 35% an ACT whilst cocktail therapies containing no antimalarial were received by 53% of respondents. The percentage of those testing positive who received ACT promptly¹¹ was 21% (ACTwatch Group, 2009a). Furthermore, of those who reported testing negative to malaria, 11% said they received an antimalarial drug and 7% an ACT. Finally, of those who did not receive a test or were unsure of the test results, 11% reported receiving an antimalarial and 5% an ACT (ACTwatch Group, 2009a).

The same year, the ACTwatch Study Group also conducted a census of all public and private outlets with the potential of selling antimalarial drugs in the household survey's study areas. Antimalarial drugs were found to be available from a wide range of outlets, including government-owned outlets (i.e. public referral hospitals, health centres and posts and VMWs), pharmacies and clinical pharmacies, drug shops, mobile providers, grocery stores and village shops. Antimalarial availability amongst censused outlets was variable across outlet types, with around two-thirds of all government-owned outlets, half of all pharmacies/clinical pharmacies, one third of all mobile providers and less than one tenth of all grocery and village shops censused stocking any antimalarial drug (ACTwatch Group, 2009b).

ACT availability amongst outlets stocking antimalarial drugs was also variable across retail outlet types and overall low, notably in the private commercial sector, with ACT availability ranging between 19 to 50% (Table 2-1). ACT availability was found to be significantly higher at pharmacies/clinical pharmacies and drug shops than at other private commercial outlet types (ACTwatch Group, 2009b). Stock-outs of the first line ACT ASMQ were also common with around 40% of outlets that stocked ASMQ at any point in time during the 3 months preceding the survey reporting disruption in stock (ACTwatch Group, 2009b).

Other antimalarials stocked included non-artemisinin monotherapies (nAMT) and AMT. The nAMT chloroquine, the first line treatment for *P.v*, was available at 20% of government-owned outlets and at between 23% and 33% of private commercial outlets stocking antimalarials at

¹⁰ Of 1,551 respondents for whom the information was available. ACTWATCH GROUP 2009a. *Household Survey Report, Kingdom of Cambodia*.

¹¹ the same day or next day of fever onset

the time of the survey (Table 2-1) (ACTwatch Group, 2009b). Finally, AMT in tablet form, which were banned at the time of the study, was found in 18% of pharmacies/clinical pharmacies, 26% of drug shops, 13% of mobile providers, 25% of grocery stores and 21% of village shops (ACTwatch Group, 2009b) (Table 2-1).

Table 2-1: ACT availability

As percentage of outlets with antimalarial drugs in stock at the time of interview
(n=number of outlets)

Antimalarial drug category	Government outlets ¹ (n=369)	Pharmacies/ clinical pharmacies (n=85)	Drug shops (n=86)	Mobile providers (n=122)	Grocery stores (n=79)	Village shops (n=127)
ACT ASMQ	90.9%	50.2%	45.6%	29.1%	28.3%	19.0%
nAMT	56.4%	27.8%	31.1%	43.5%	52.2%	63.6%
Chloroquine	20.0%	24.2%	26.5%	23.2%	33.5%	29.7%
AMT	55.2%	28.9%	32.8%	26.8%	29.8%	25.4%
AMT tablet	2.3%	17.6%	26.5%	12.9%	25.3%	21.3%

¹Included public referral hospitals, health centres and posts and Village Malaria Workers.

ACT is artemisinin-combination therapy; ASMQ is artesunate and mefloquine; nAMT is non artemisinin monotherapy; AMT is artemisinin monotherapy.

Source: adapted from ACTWATCH GROUP 2009. *Outlet Survey Report, Kingdom of Cambodia*

Blood testing services, either microscopy or RDT, at outlets stocking antimalarial drugs were available at both government outlets and private shops, with RDT availability being generally higher than microscopy services (Table 2-2). Availability of blood testing services was however lower than that of antimalarial drugs (Table 2-2). In the private sector, RDT availability was significantly higher at pharmacy/clinical pharmacy, drug shops and mobile providers than at grocery and village shops (ACTwatch Group, 2009b).

Table 2-2: RDT and microscopy availability

As percentage of outlets stocking antimalarial drugs on the day of interview or in preceding 3 months
(n=number of outlets reporting stocking an antimalarial in last 3 months)

Blood test type	Government outlets ¹ (n=376)	Pharmacies/ clinical pharmacies (n=96)	Drug shops (n=103)	Mobile providers (n=202)	Grocery stores (n=91)	Village shops (n=151)
RDT	75.3%	57.9%	38.5%	41.5%	33.6%	8.6%
Microscopy	16.7%	37.9%	32.3%	45.2%	3.6%	3.7%

RDT is rapid diagnostic test for malaria.

Source: adapted from ACTWATCH GROUP 2009. *Outlet Survey Report, Kingdom of Cambodia*

In terms of the cost of malaria treatment at private commercial outlets, one adult equivalent treatment dose (AETD) of ASMQ was sold at a median price 2 to 3 times higher than the RRP for Malarine (US\$ 0.61): pharmacies/clinical pharmacies and drug shops reported selling one AETD at US\$ 1.18, mobile providers at US\$ 1.88, grocery stores at US\$ 1.61 and village shops at US\$ 1.64 (ACTwatch Group, 2009b) (Table 2-3). For comparative purposes, ASMQ was between 3.5 to 5 times more expensive than chloroquine (Table 2-3). The median price of AMT in all dosage forms was between 2 to 3 times higher than that of ASMQ. When monotherapies in injectable form only were considered, the median price of AMT and nAMT was respectively 12 to 17 times and 4 to 12 times higher than that of ASMQ in tablet form. By contrast, antimalarials were reported to be available free of charge at government outlets (ACTwatch Group, 2009b).

As for blood testing services, the median price of RDT at private commercial outlets was lower than that of microscopy, with prices ranging between US\$ 0.35 and US\$ 0.47 for the former and US\$ 0.71 and US\$ 0.94 for the latter across outlet types (author's own calculations) (Table 2-3). In the public sector, RDT were reported to be available free of charge whilst the median price of microscopy testing was US\$ 0.35 (author's own calculations, data not shown)

Table 2-3: Retail median prices of antimalarial drugs and blood tests
Median retail prices of one adult equivalent treatment dose or test unit (US\$) ^(n=number of observations)

	Pharmacies /Clinical pharmacies	Drug shops	Mobile providers	Grocery stores	Village shops
Antimalarial drug category (dosage form)					
ACT ASMQ (all were tablets)	1.18 ⁽⁵⁹⁾	1.18 ⁽⁵⁴⁾	1.88 ⁽⁵¹⁾	1.61 ⁽²⁶⁾	1.65 ⁽³⁴⁾
nAMT (all forms)	0.23 ⁽²²⁾	0.23 ⁽¹⁶⁾	1.98 ⁽²⁸⁾	0.46 ⁽¹³⁾	1.13 ⁽¹⁷⁾
nAMT chloroquine (all were tablets)	0.23 ⁽²⁰⁾	0.23 ⁽¹²⁾	0.46 ⁽⁸⁾	0.46 ⁽⁹⁾	0.35 ⁽⁹⁾
nAMT (injectables only)	-	14.83 ⁽³⁾	9.89 ⁽¹²⁾	5.93 ⁽³⁾	17.30 ⁽²⁾
AMT (all forms ¹)	3.61 ⁽³⁴⁾	3.16 ⁽³¹⁾	3.77 ⁽²⁶⁾	3.61 ⁽²⁹⁾	4.52 ⁽³⁷⁾
AMT (tablets only)	2.64 ⁽¹⁴⁾	3.62 ⁽³⁰⁾	3.77 ⁽²¹⁾	3.62 ⁽²⁵⁾	4.52 ⁽³²⁾
AMT (injectables only)	15.10 ⁽¹⁹⁾	19.80 ⁽⁹⁾	22.60 ⁽²⁰⁾	22.60 ⁽⁴⁾	28.25 ⁽⁵⁾
Blood test type					
RDT	0.35 ⁽⁵⁹⁾	0.47 ⁽⁴⁰⁾	0.47 ⁽⁶²⁾	0.33 ⁽²⁵⁾	0.47 ⁽²⁰⁾
Microscopy	0.71 ⁽³⁷⁾	0.71 ⁽²⁷⁾	0.94 ⁽⁹⁷⁾	0.71 ⁽⁵⁾	0.71 ⁽⁶⁾

ACT is artemisinin combination therapy; RDT is rapid diagnostic test for malaria. ASMQ is the ACT artesunate and mefloquine; nAMT is non artemisinin monotherapy; AMT is artemisinin monotherapy; “-” drug category not stocked; ¹includes one observation for AMT in suppository sold in a drug shop at a median price of US\$ 15.1 (author's own calculations). Source: adapted from ACTWATCH GROUP 2009. *Outlet Survey Report, Kingdom of Cambodia* and author's own calculations for RDT and AMT and nAMT in injectable form and AMT in all forms.

On the basis of this evidence, the cost of appropriate treatment of confirmed *P.f* malaria – RDT followed by ASMQ - in the private commercial sector in 2009 ranged between US\$ 1.53 and US\$ 2.35 across the different private commercial outlet types.

2.7 Summary

At the time of our study, RDT and ACT availability was low in Cambodia's malaria endemic areas, and where available, the cost of appropriate treatment for *P.f* malaria was relatively high. The aim of the thesis is to describe the supply of antimalarial drugs from an economic lens and investigate how it affects the availability, price and quality of malaria treatment.

The next chapter will review three literatures that are relevant to this aim, including the Industrial Organization (IO) field of economic theory, the range of methods that have been used for collecting data on pharmaceutical drug markets in low and middle income countries and finally the empirical evidence available on the structure and functioning of the supply-side of markets for antimalarial drugs in developing countries.

CHAPTER 3 LITERATURE REVIEWS

3.1 Introduction

In this chapter, three different literatures relevant to the thesis are reviewed. The first draws on the Industrial Organization (IO) field of economic theory, which provides many concepts of potential relevance to the study of the market for malaria treatment in Cambodia, including market product and geographical definition, market concentration, contestability, product differentiation, price competition, etc. The second literature reviews and discusses the range of methods that have been used for collecting data on pharmaceutical drug markets in low and middle income countries in order to inform the design of our study on the supply of malaria treatment in Cambodia. Finally, the third and last literature review covers the empirical evidence available on the structure and functioning of the supply-side of markets for antimalarial drugs in developing countries, with a focus on private commercial sector distribution chains for antimalarial drugs in low and middle income countries.

The range of methods for studying pharmaceutical drug markets and the evidence available on private commercial sector distribution chains for antimalarial drugs have been reviewed using systematic search and review methods described in Appendix 1 and Appendix 2 respectively. The review of the IO literature relied on a more informal approach, which consisted of reading recommended texts and references within this field of economic theory.

3.2 A review of the economic theory literature on markets and competition

Economic theory and the IO literature provide benchmark models against which markets can be studied. A market can be defined as the set of sellers and buyers whose interactions determine the price, quantity and quality of a good or service (Dranove and White, 1998), or the group of sellers and buyers of a set of products who are in sufficiently close contact for their transactions to affect the terms on which the others buy or sell (Tirole, 1988).

Under the structure-conduct-performance (SCP) paradigm, the structure of a market determines the way firms behave in that market, which in turn affects market performance (Scherer and Ross, 1990). Performance is generally assessed in terms of the price and quality of the product or service in the market, with lower consumer prices and higher quality being associated with higher market performance.

Later refinements of the SCP paradigm recognized however that the SCP sequence was far from being linear and that the direction of causation between structure and conduct was two-way (Tirole, 1988) with attempts from firms to shape market structure in order to increase their profitability.

This section starts by reviewing the standard model structures and their implications in terms of market performance (Section 3.2.1). Structural factors that affect the functioning of markets are then described (Section 3.2.2), followed by the strategies used by providers to shape market structure (Section 3.2.3).

3.2.1 Standard models of markets and competition

Four models of market and competition are traditionally used, namely perfect competition, monopoly, oligopoly and monopolistic competition. The models are all based on the assumption that each firm is interested in maximising profit by supplying a quantity of products at the level at which marginal cost (i.e. the cost of supplying one extra unit) equals marginal revenue (i.e. the change in total revenue from selling one extra unit).

The key difference between these models lies in the extent to which firms can influence the price at which they are paid, which is referred to as market power. Market power depends on the extent to which consumers can substitute to other suppliers of the same product (supply-side substitution under homogenous product) or to other products (demand-side substitution under differentiated products). Market concentration is generally used as a measure of market power, with more concentrated markets, that is few large firms with relatively large market shares, being associated with higher consumer prices and profits and, as a result, lower market performance (Demsetz, 1973).

In the model of perfect competition, many firms operate, each selling a small quantity of the same product relative to the total quantity sold on the market. Consumers have perfect information about the product and firms are said to be price-takers as they have no influence over the price at which they can sell their product: if a firm decides to sell at a price higher than the market price, consumers will switch to other providers and the firm will lose all its consumers whilst if a firm decreases its price, it will make a loss. Under perfect competition, firms face a horizontal demand curve that is perfectly price elastic and each maximises profit

by supplying a level of output at which price equals marginal cost implying zero economic profit¹². Under this equilibrium, the optimal level of market performance or efficiency is achieved.

At the other extreme, the monopoly model describes a market in which a single firm supplies a product with no close substitutes. The monopolist can therefore influence the price at which he is paid without losing his consumers (he faces a downward sloping demand curve). Other things being equal, the monopoly price will be higher than under perfect competition, creating economic profits for the monopoly whilst the quantity supplied will be lower, yielding to reduced market performance as some consumers will not buy the products at the monopoly price whilst others will pay a price higher than they would have under perfect competition.

In-between perfect competition and monopoly, there are different models of imperfect competition. The basic oligopoly competition model describes a market with few firms competing on how much quantity to supply or on price, either under static or strategic competition.

- Under static competition, firms make their decision about their action variables simultaneously given their expectations about other firms' decisions while recognising that other firms are going through the same process. They may decide to cooperate and act as a monopolist in order to raise price and increase profit. However, given that each firm has an incentive to deviate or cheat (e.g. by decreasing price to gain market share) collusion is not sustainable. Under the assumption of a homogenous product, the basic Cournot model describes a market in which two firms compete on quantity whilst in the Bertrand model firms compete on price¹³

¹² The market price equals the minimum average cost of the least efficient firm such that firms with lower average costs earn a rent, sometimes referred to as Ricardian profits. Economic profits occur where the market price is higher than average cost and profits can be made on each unit supplied.

¹³ For illustration purposes, the basic Cournot model describes 2 firms competing simultaneously over quantity, each maximising profit given the output of its rival: if firm 1 expects firm 2 output to be zero, firm 1 will act as a monopoly and maximise profit at marginal revenue equals marginal cost; as firm 2 output increases, the profit maximising output for firm 1 will decrease; then if firm 2 supplies such a large quantity that price equals marginal cost then firm 1 will shut down. Conversely, if firm 1 were to produce nothing then firm 2 output will determine the market price and as firm 1 increases its output, price decreases to attract customers to buy the additional supplies.

- In the Cournot model, as the number of firms increases, each firm's market share decreases and so does their market power (the elasticity of demand increases as consumers can switch to other suppliers) and profits¹⁴. An extreme scenario considers the number of firms increasing to infinity with output supplied at the level where marginal cost equals marginal revenue and price (or average cost) driving profit to zero.

Whilst a higher number of firms is associated with higher competition and market efficiency (from the perfect competition perspective), in the presence of economies of scale (i.e. a situation where average total cost falls as the quantity supplied increases) each firm would supply a smaller quantity at a higher average cost. This implies a loss in market efficiency, although from a consumer perspective welfare increases following a price decrease. A higher number of firms may therefore not lead to improved market performance from a societal perspective.

- As for the basic Bertrand model, it describes few firms supplying a homogenous product with no capacity constraints (firms can expand their supplies without production constraints). Each firm has the incentive to undercut other firms by decreasing its price and regardless of the number of firms price will equal marginal cost, implying zero profit.
- Under strategic competition, firms operate in more than one time period and the implications of repeated interactions are considered.
 - The Stackelberg model is similar to Cournot with firms competing on quantities, but the timing of supply decision differs: firms choose quantities sequentially with a "leader" moving first as it chooses quantity whilst its competitor or "follower" observes the leader's decision before choosing its own quantity. In the Dominant Firm theory or Price Leadership model, the

¹⁴ Increasing the number of firms has the following effects: the output of each firm decreases because their residual demand and marginal revenue decreases, total output increases because the decrease in output by the existing firm as they accommodate entry is less than the output of the entrant, price falls because total output increases and the profits of each firm decrease because of lower price and lower output per firm.

leader acts on price rather than on quantity. As under Cournot, Price Leadership and Stackelberg predict price and profits in-between those under perfect competition and monopoly.

- Finally, the kinked demand curve model predicts rigid prices if firms believe that their rivals will match price cuts but will not react to price increases: beyond a certain quantity supplied the marginal revenue lost from cutting back supply (to match the price increase) is much greater than the extra revenue gained from increasing supply (to cut prices). The implications in terms of market efficiency are unclear.

The model of monopolistic competition is described as an oligopoly market where there are enough firms that their actions have no effect on the actions of their competitors and in which products are differentiated, providing firms with some market power (Chamberlin, 1933). Price will therefore be above marginal cost as consumers may not find close enough substitutes to switch to (Chamberlin, 1933).

Market power may also be exercised on the part of the buyer. A monopsony model describes a market with a single buyer who influences the market price by purchasing a lower quantity than in a competitive setting therefore leading the market price to decrease and his profit to increase. In health care, concerns about monopsony power have been highlighted in relation to the exercise of market power by insurers who purchase health care services from hospitals or physicians, and by hospitals purchasing nursing labour (Gaynor and Vogt, 2000).

The next section describes some key structural sources of market power and is followed by the strategies used by providers to exercise, maintain and increase market power.

3.2.2 Sources of market power

3.2.2.1 Entry and exit barriers

As one would expect profits to attract entry of new firms, it is initially unclear why firms continue to make profits. Different elements of market structure have been suggested to prevent entry and therefore the erosion of profit and market power: economies of scale, sunk expenditures, product differentiation and absolute cost advantages (Bain, 1956). It is also possible for entry barriers to be created by government or by providers aiming to limit

competition. The former are presented in this section after the structural barriers whilst the latter are described in the section on strategies for increasing market power (Section 3.2.3).

Economies of scale. Economies of scale occur when the average total cost of supply falls as the quantity supplied increases. Firms that enjoy economies of scale have an incentive to maintain or expand supplies. This may deter new firms to enter the market if they think that they cannot gain the minimum market share required to become profitable.

Sunk costs are expenditures or investments that cannot be recovered after market entry and that provide a signal to potential entrants about the need to operate at a large scale to make a profit (Gilbert, 1989). Many sunk expenditures are fixed costs that create scale economies.

Absolute cost advantages occur where potential entrants have higher average costs than the established firms at any scale of operation. For example, an established firm may own a patent on a particular technology or be able to access capital on more favourable terms than entrants (Church and Ware, 2000).

Product differentiation can prevent entry if consumers have preferences for the products of established firms. Entrants may be required to convince consumers to switch to their products by charging lower prices, advertising more and/or providing higher quality – strategies that reduce the profitability of entry. Some customers may also be better off continuing to purchase the same product at a higher price than switching to another if there are costs associated with switching from one provider or brand to another, with costs being economic or related to personal taste (Gilbert, 1989).

Other entry barriers can be created by **government intervention**. For example, government may grant exclusive rights to a firm to supply a product or service in order to minimise costs (Noll, 1989). In health care, government intervention aims to signal quality and promote minimum quality levels. Regulations can cover market entry (e.g. physician licenses, import permits, outlet regulation), product registration and pricing (e.g. pharmaceutical drug price regulation, insurance premium regulation). The time required to complete government paperwork may also create additional entry barriers and restrict the number of alternatives available to consumers and therefore competition (Stiglitz and Walsh, 2002).

Despite the appearance that entry barriers are structural factors that undermine competition, their presence may not be synonymous with market inefficiency. For example, there may be a limited number of firms in a market because of the presence of economies of scale. In addition, market concentration may be a sign of market power but not necessarily a sign of economic profits because the threat of entry may lead firms to charge less to discourage potential entrants (Baumol et al., 1982).

Finally, although more rarely researched, there may also be exit barriers, such as, for example, sunk expenditures, which may lead firms to stay in the market even if it means operating at a loss.

3.2.2.2 Informational issues on product characteristics

A shortage of information on the characteristics of a product or service on the part of consumers is an important source of market power. For some products, consumers have sufficient knowledge or can easily discern the true quality of a product before purchase. Such products are called search goods. Providers have therefore no opportunities to lie about the quality of their product, although they may attempt to manipulate it (see Section 3.2.3.2).

With other groups of products, consumers do not have complete information and their quality can only be determined after purchase by use or experience (Nelson, 1970). These products are called experience goods.

For some products, the experience of consumers can be passed across to other consumers (or other markets) through word of mouth for example. Such products are referred to as reputation goods.

For other products called credence goods for which quality can never be observed or the technical attributes are not well understood, consumers will tend to rely on the advice provided by a more informed agent, which may lead to potential agency problems where the decision to purchase the product is influenced by the seller himself (see Section 3.2.3.6).

The structural characteristics of markets described above are important sources of market power. Providers may also attempt to shape these structural characteristics to maintain or gain market power. These attempts are the subject of the next section.

3.2.3 Strategies for increasing market power

3.2.3.1 Price discrimination

Firms with market power have the opportunity to increase their profitability by selling the same product at different prices to different customers. Three types of price discrimination can be distinguished.

The first type is “first-degree” or perfect price discrimination under which a seller sells each unit of a product at the maximum price that anyone is willing to pay for that unit of the product. This strategy is sometimes referred to as “take-it-or-leave-it” offer to each customer (Varian, 1989).

The second type of price discrimination is “second-degree” price discrimination under which a seller varies the price of a product for different units sold but not for different customers (e.g. quantity discounts).

The third type is “third-degree” price discrimination under which a seller varies the price from customer to customer but not for different units of the product sold (e.g. airline business and economy tickets).

For price discrimination to be maintained, customers charged a lower price must be prevented from reselling the product to those offered a higher price (arbitrage). Another prerequisite for price discrimination is to find a means to categorise customers according to their willingness to pay. A provider may be able to separate customers on the basis of easily observable characteristics, including for example age, income or geographical location. When the provider cannot easily observe which characteristics distinguish customers with different price elasticities, he may be able to segment the market by structuring its pricing in a way that consumers “self select” into appropriate categories according to their valuation of the product offered (e.g. charging a lower price for airline tickets including a Saturday overnight stay in a city) (Varian, 1989).

The most common form of price discrimination is third degree (Varian, 1989). In health care markets, it has been reported through providers charging lower fees to different patients. Although it has often been interpreted as an act of charity (Folland et al., 2004), it is also

considered to be a common strategy used for increasing profits by charging more to those with greater ability to pay (Kessel, 1958).

3.2.3.2 Product differentiation

Product differentiation exists whenever consumers do not view products as perfect substitutes. It arises as a consequence of differences in physical attributes of a product or in the quality of a service offered, or for reasons related to the reputation of a provider or preferences or perception of consumers for a particular product. Product differentiation allows providers to raise their price without losing all their customers.

Product differentiation can be horizontal when it reflects different consumer tastes and one product is not superior to another (concept of product variety), or vertical when some product characteristics are more desirable than others and all consumers agree over the ordering of the characteristics (concept of product quality) (Gaynor, 2006).

Hotelling (1929) described a model in which products are differentiated on a single attribute that is the location of the outlet at which they are sold (Hotelling, 1929). Consumers are uniformly distributed on a main street. Prices are fixed and each consumer assesses the total cost of buying from each outlet, considering the product price and transport cost to travel between their location and each outlet. Consumers purchase from the outlet whose location is the closest to theirs. The boundary of the market for each provider is defined by the location of the customer to whom the total cost to buy from the next provider on the street is the same. If a provider raises its price, consumers on and close to the market boundaries will shift to the neighbouring provider. Hotelling showed that under duopoly providers would locate close to each other in the centre of the street, leading to minimum product differentiation. The geographical clustering of stores may however be the result of search cost and imperfect information (Lancaster, 1990). Providers may have an incentive to locate in close proximity to create positive externalities by decreasing search costs for customers or choose to locate where the demand is in order to increase the volumes they sell, even though this will increase price competition.

For search goods for which quality is easily observed by consumers, there are no opportunities for providers to deceive consumers about the quality of their product. Consumer will be relatively quality sensitive but price insensitive, creating incentives for providers to compete

on quality. Increasing quality levels may lead to increasing prices through higher costs of higher quality. Quality competition may also lead to excess quality being offered on attributes that are more easily observable (e.g. patient amenities) and too little quality on less observable elements. Providers may also attempt to discriminate customers on quality by offering products or services with different quality levels to different consumers (analogous to price discrimination).

For goods for which the quality cannot be ascertained until after the purchase, consumers may be relatively price sensitive but quality insensitive (e.g. they know they cannot observe the true quality of a product, therefore quality plays a more limited role in their decision function than if quality was easily observable) (Dranove and Satterthwaite, 1992). The quality offered will be too low as providers will have little incentive to provide high quality services, and a market for “lemons” may emerge: consumers will be willing to purchase products at an average price, leading sellers of high quality products to exit the market, with quality and price decreasing until a potential collapse of the market (Akerlof, 1970). The problem of “lemons” creates an incentive for providers of high quality products to communicate the level of quality they offer to potential consumers.

Different strategies can be used to attract customers. The first is to build a reputation of providing quality to make repeat sales and potentially attract new customers through word of mouth. Second, investment in advertising can be used to communicate information about quality or simply signal quality, regardless of the information content (Nelson, 1974). Product warranties can also be used to signal quality, as well as a quality discrimination strategy (e.g. reduced warranty provision for lower quality products).

3.2.3.3 Entry deterrence and accommodation

Deterrence strategies are used to prevent entry of new competitors or drive established competitors outside the market. To prevent entry, firms may make large plant investments to signal to potential entrants that it will be profitable for them to respond aggressively post entry by increasing the amount they supply. Established firms may also decide to sacrifice current profits by limiting pricing as an indication to potential entrants that entry will not be profitable.

Accommodating strategies are used when entry cannot be deterred by incumbents or if it is more costly for firms to use deterrence strategies than to let new firms enter the market. In this situation, accommodating may involve disadvantaging competitors, for example by overbuying a scarce input in order to increase their rivals' costs (Church and Ware, 2000).

3.2.3.4 Horizontal mergers and collusion

Horizontal mergers between 2 firms increase the market power of the merged firms and facilitate price increases. In addition, mergers facilitate collusion by increasing market concentration.

Collusion can be defined as a cooperative arrangement between firm to coordinate their actions in terms of the quantity they supply and price they charge. Collusion is facilitated in markets for homogenous goods with high levels of concentration and entry barriers and where sellers can easily monitor each other's behaviours. Firms have an incentive to cheat so for collusion to be sustainable means of monitoring the behaviour of collusive firms are required as well as sanction methods for those deviating. Tacit collusion occurs when firms are able to coordinate their activities by simply observing and anticipating their rivals' behaviour. In this context, tacit collusion can also be referred to as oligopolistic coordination.

3.2.3.5 Vertical integration and vertical restraints

Economic theory is also relevant to the vertical dimension of markets, in terms of structure and relationships between firms operating at successive stages of a chain of production or distribution. Vertical integration may be treated as an aspect of market structure or provider conduct. Firms are faced with a 'make or buy' decision which depends on the relative costs of making transactions through the firm or through the market (Coase, 1937) and integration may be the result of the existence of transaction economies (Williamson, 1979). Alternatively contractual arrangements may be used to reduce the costs of transactions within the market, although these arrangements may create additional challenges (e.g. loss of flexibility to adapt to a change in technology).

Vertical integration can be employed by a supplier to maximize his profit by mitigating the double marginalization phenomenon, through which each firm at two successive levels of the chain adds its own mark-up (Spengler, 1950) leading to a quantity of products sold by a supplier lower than that achieved through a vertically integrated structure (because of higher

prices resulting from mark-ups added at each level of the chain). In this model, the retailer is seen as the economic agent of the supplier (Tirole, 1988) because the latter will maximise his profit only if he can control the retailer's pricing decisions. Integration of the retailer into the supplier is considered as a socially optimal model compared to the non-integrated structure as the supplier maximizes profit by supplying larger quantities at lower prices.

Another benchmark model considers a monopolist supplier who sells a product to a perfectly competitive market in which firms use a variable proportion of the monopolist's product and also purchase another product from perfectly competitive suppliers. The model predicts that downstream firms will shift away from the monopoly product (because of its price) to the competitively supplied product, resulting in inefficiencies in the downstream market (too little of the monopoly product) and creating an incentive for the monopolist supplier to integrate with the downstream firms (to avoid substitution towards other products and capture profits). The implications in terms of market efficiency are unclear: by integrating, inefficiencies in the downstream market are eliminated (i.e. efficient level of monopoly product is used) and the monopoly maximizes profits. However, the monopoly may decide to increase the consumer price. Market performance will therefore depend on the gain in efficiency in the downstream market and the level of the retail price after integration (Perry, 1989).

Incentives to integrate also exist on the buyer's side. Market foreclosure may occur when a firm integrates with an upstream firm in order to control the supplies of inputs and exclude a (horizontal) rival from the supplies (or increase the input price) (Church and Ware, 2000). A monopsony buying a product from perfectly competitive suppliers may also choose to integrate with one of the upstream firms following an increase in the price of the product at which suppliers purchase the product, in order to access supplies at lower cost (i.e. avoid double marginalization).

Other vertical strategies may be used to increase market power, including advertising and restraints. Advertising may be used to force sellers to stock the advertised product or they will suffer a loss of customers to competitors who carry the product. Large advertisement campaigns may also influence sellers to stock the well-known brand given that advertised products may have higher shelf turnover than others, yielding to higher profit per unit of shelf space with a given price-cost mark-ups (Vickers and Waterson, 1991). Furthermore, carrying advertised products may attract customers who may also buy other higher-margin items (Vickers and Waterson, 1991).

Vertical restraints are strategies generally used by manufacturers or wholesalers to restrict the flexibility of retailers' decisions in terms of price, customers and location. In addition, retailers are expected to provide a point of sale service (e.g. advertising, trained sales teams) (Church and Ware, 2000) that upstream firms may want to influence in order to increase their sales and profits. Various types of restraints exist, including resale price maintenance, territorial restriction, exclusive dealing, tying or bundling and quantity fixing contracts.

- Resale-price maintenance (RPM) contracts specify at which price the retailer can resell the product. Alternative contracts of this type are price floor and price ceiling contracts. "Softer" (non-contractual) restraints can also be used such as for example recommended retail prices (RRP).
- Exclusive territorial restrictions aim to limit intra-brand competition by assigning a market to a single retailer therefore creating a retail monopoly (Church and Ware, 2000) (e.g. McDonalds franchise operating under an agreement defining an area within which no other franchise will open).
- Exclusive dealing aims to limit inter-brand competition by forbidding retailers to handle brands that compete directly with the products of the supplier (Church and Ware, 2000).
- Tying is a restriction placed by upstream firms on customers that 2 products are bought from the same provider – these products may be complements (e.g. printers and toners) but not necessarily.
- Quantity fixing contracts stipulate the amount to be purchased by the retailer.

Through these different arrangements, suppliers may effectively control the actions of retailers. The welfare implications of vertical restraints are however complex. They are said to be efficient for the vertical structure, but may fail to account for consumers' interests (Tirole, 1988) and call for government intervention. In addition their effect on retailers' actions may be limited and/or perverse, notably in the context of imperfect and/or asymmetric information and/or risk aversion from the side of the retailers (e.g. in terms of demand or cost of handling the product). Retailers may decide to sell at a price higher than the RPM or RRP or may provide

lower quality at a given RPM/RRP if for example the RPM/RRP is set too low to provide an incentive for retailers to bind to the agreement.

3.2.3.6 Agency and supplier induced demand

Under perfect competition, information is assumed to be perfect with all consumers and sellers having complete information about the products available. Information is assumed to be symmetric with consumers being as informed as sellers.

Information is however generally not perfect nor symmetric, notably in the health sector where providers may be uncertain or uninformed about the outcomes of treatment whilst patients are often poorly informed about their own condition, treatment availability, expected outcomes and prices charged by other providers.

In situations where information is asymmetric, a principal-agent relationship may arise where the consumer recognizes he does not possess all the information necessary to decide on the most appropriate treatment, and delegates his decision to a relatively more informed agent, generally a health care provider. Whilst a perfect agent would choose as the patient himself if the patient possessed the same information as the provider does, the agent may try to influence demand for their own self interest, a situation referred to as supplier induced demand (SID) (Folland et al., 2004). SID may be mitigated by various mechanisms including licensing, ethical constraints, and the establishment of long-term relationship between patients and providers (Folland et al., 2004).

3.2.3.7 Regulatory capture

Regulation is government intervention to control or change market structure, provider conduct and ultimately market performance. The effect of regulation will depend on the structure of the market, conduct of providers and capacity of authorities to enforce regulatory policies. The impact of government intervention on the intended objectives may be limited in markets where providers have the potential to influence government policy, primarily through lobbying activities. In the health sector, for example, qualified health care professional organisations may try to influence regulatory authorities to tighten entry requirements in order to reinforce market power. Regulation may be inefficient if policies are captured by interest groups for the purpose of acquiring monopoly rent or redistributing wealth in ways

that create inefficiencies or if authorities have limited capacities for enforcing regulatory policies.

This section has reviewed the key models of markets and competition offered by the IO literature, and has shown the complexity of the interplay between market structure, provider conduct and government and of the implications of this interplay for market performance. The IO literature suggests a range of measurement methods for studying economic markets. These methods alongside those used in studies of retail and wholesale sectors for pharmaceutical drugs in developing countries are the subject of the next section.

3.3 A review of empirical methods for studying markets

In this section, the methods that have been used for studying health care markets are reviewed, with a focus on those used in empirical studies of markets for pharmaceutical drugs in low and middle income countries. By methods, we refer to the range of approaches used for collecting data on key aspects of market structure and provider conduct and for analyzing these data. The literature on markets for hospital services has not been formerly searched because these markets differ in important ways from markets for pharmaceutical drugs (Scherer, 2000, Gaynor and Vogt, 2000). However, the analytical methods they used are likely to be of some relevance to the analysis of competition in markets for pharmaceutical drugs. Therefore these methods are reviewed, drawing mainly on two relatively recent reviews on that subject (Gaynor, 2006, Moriya et al., 2010). The methods used to search and review the literature are described in Appendix 1.

The section starts by reviewing methods for identifying and sampling private commercial providers of antimalarial and pharmaceutical drugs in general in developing countries (Sections 3.3.1 and 3.3.2). It then turns to a review of methods used for identifying the range of products sold (Section 3.3.3) and measuring sales volumes and values (Section 3.3.4). The section continues by reviewing methods used in studies of market competition, including those for defining the market, measuring market concentration, assessing market contestability and analysing providers' conduct, with a focus on their price setting behaviour (Sections 3.3.5 to 3.3.9).

3.3.1 Identifying providers

3.3.1.1 Existing lists of providers

Lists of registered outlets available from National Health Authorities have been used to estimate the number of wholesale and retail providers operating in different settings. During a training intervention that aimed to improve the quality of malaria treatment in the Kenyan retail sector, mobile vendors and wholesale shopkeepers registered to operate in the district were identified using official records (Tavrow et al., 2003). In a study of malaria treatment in the Tanzanian private sector, the number of registered manufacturers, wholesalers and drug stores was calculated using official listings available from the National Pharmacy Board (Battersby et al., 2003). In another study that looked at the antimalarial retail market in 6 regions of Tanzania, the number of outlets registered to wholesale medicines was identified using a list available from the Tanzanian Food and Drug Authorities (TFDA) (Clinton Health Access Initiative (CHAI), personal communication 2007). Another study obtained from the TFDA the list of pharmacies authorised to handle prescription only medicines in Dar es Salaam (Kachur et al., 2006). More recently, a study conducted in Uganda used the list of registered drug wholesalers and pharmacies operating within the capital city, Kampala, and the Entebbe municipality (Nakyanzi J et al., 2009).

Official lists provide an easy way of estimating the number of providers. This approach has however several limitations. The first limitation is that only the number of registered providers can be calculated. Other providers who are not captured in official lists might exist, including those awaiting official registration and informal providers operating without authorisation. The second limitation is that official lists might simply be outdated and omit registered providers.

An alternative has therefore been to use other lists available from private sources. In a study of the Kenyan retail market for malaria treatment conducted in 4 districts, the number of retail providers was estimated from a list of retail outlets purchased from a commercial market research agency that had undertaken a national retail outlet census a few years before the study (Amin and Snow, 2005). In their study of access to malaria treatment in the Tanzanian districts of Ulanga and Kilombero conducted in 2004, Hetzel and colleagues used a list of all retail sources for antimalarial drugs developed during an earlier study of the retail market for malaria treatment in the same districts (Hetzel, 2007). More recently, a similar approach was used by a study on the provision of antimalarial drugs in private outlets operating in districts

alongside the Cambodian-Thai border. The study sampled all retailers operating in the study districts that had been identified to stock antimalarial drugs during an earlier outlet census (URC-MCC, 2009). During the study, however, over 40% of outlets could not be found and were “conveniently” replaced by other outlets found to stock antimalarials at the time of the study (URC-MCC, 2009).

Using other lists offers the opportunity to identify informal providers not captured by official lists. For instance, in the Kenyan study the list purchased from the commercial market research agency provided data on shops stocking antimalarial drugs that were not legally registered as drug outlets and therefore not included in official lists (Amin and Snow, 2005). The use of other lists has however some limitations: such lists may not systematically be available across settings, or if available they may be outdated, and there may also be a financial charge for such data if they are held by commercial organisations.

Overall, despite the above mentioned limitations, lists of outlets, either from official or other sources are a useful frame to start measuring the number of providers operating in a given area and they can be used in combination with other approaches.

3.3.1.2 Interviews with key informants

A range of studies have conducted key informant interviews to estimate the number of providers who operated at different levels of the distribution chain. Face to face interviews with various stakeholders including policy makers, manufacturers, importers and pharmacists were carried out in Zambia in a study that explored public, private and mission distribution chains for essential medicines (MMV, 2007). In another study conducted in five sub-Saharan countries, local antimalarial drug manufacturers and importers were identified in collaboration with national public health and pharmaceutical “authorities (Kindermans et al., 2007) Interviews with Ministry of Health officials, coordinators of National Malaria Control Programmes and informants in professional pharmaceutical organisations were carried out to identify the number of providers at each stage of the distribution chain for antimalarial drugs in Senegal, Cambodia and Zambia (Shretta and Guimier, 2003).

One advantage of interviewing central-level informants is that insights into the structure of distribution chains can also be collected (MMV, 2007, Russo, 2007). The relative importance of suppliers within and across levels can also be investigated. For example, the Medicines

Transparency Alliance (MeTA) found that whilst respondents reported that the number of importers could range between 50 and 60, interviewees all agreed that 6 importers handled almost 80% of the volume of essential medicines in the country (MeTA 2007). One limitation is however that those outlets at lower levels of the chain are likely to be more numerous and it might be difficult to obtain accurate estimates about their number from central-level informants.

As a result a preferred approach has been to interview local key informants, including people living and working in the study area, community and village leaders and local administrative councils. In a study of the retail market for malaria treatment in the Tanzanian rural districts of Rufiji, Ulanga and Kilombero field researchers who worked and lived in the communities were asked to list all the outlets that might be selling drugs categorised by outlet type (Goodman et al., 2004). In the absence of field staff in the district of Morogoro, the same study asked local village leaders to identify all potential drug sources (Goodman et al., 2004). In the Hung Yen Province, Vietnam all private commercial providers were identified by interviewing community leaders and a sample of households (Tuan et al., 2005). In Uganda, the Ministry of Health interviewed village leaders and other informants to update existing lists of health facilities, pharmacies and drug shops in 3 geographic areas where interventions to improve access to subsidised Artemisinin Combination Therapy (ACT) were to be piloted (MMV, 2007).

The weakness of interviewing key informants is that they may not know the accurate number of outlets stocking antimalarials nor which shops stock antimalarials. In the Tanzanian study, out of the 834 retail outlets that had been initially identified by local informants, 20 had closed including 14 on a permanent basis and 90 did not actually stock drugs (Goodman et al., 2004). Visiting outlets provides therefore a relatively more accurate estimation of the number of providers. This approach is reviewed in the next section.

3.3.1.3 Providers' census

A census consists of visiting all outlets operating in a given area in order to record their identifiers (e.g. name, address, GPS coordinates) and the range of products they stock. This method was implemented in 3 rural sub-districts of Northern Bangladesh (Ahmed and Hossain, 2007) and 3 districts of the Eastern Region of Uganda (MMV, 2007). In the Tanzanian study of the retail sector for malaria treatment, a census of all potential outlets stocking antimalarial drugs was conducted using the preliminary lists of outlets drawn by field researchers and

village leaders (Goodman et al., 2004). In another study on malaria treatment conducted in Tanzania, a census was used to identify every Part II drug shop and every government and non-governmental organisation (NGO) owned facility situated within a 10 km radius of a Part II drug shop (CHAI, 2007).

Overall, a census appears to be the most reliable approach for measuring the number of providers in a given area. In her study of the retail market for malaria treatment, Goodman assessed the completeness of her approach by comparing the census data with treatment sources identified during a household survey conducted in the same areas over the same period. She found that less than 7% of shops mentioned by householders could not be matched with those listed in the census and that in some cases this discrepancy may have reflected the use of different names for a given shop (Goodman, 2004). Goodman concluded that nearly all retail outlets that sold pharmaceutical drugs and that were used by the population at the time of the census had been captured (Goodman, 2004).

Through a census, both formal and informal providers operating at the time of the census can be captured. Furthermore, a census offers the opportunity to collect data on the range of products stocked and for each product its price and volume sold over a given period. However, it may be difficult to conduct a census for identifying providers operating at higher levels of the chain, such as wholesalers for instance, because wholesale outlets may not be signposted and would therefore be more difficult to identify.

Another important disadvantage is that a census requires more resources – time, human, financial - than the previous two approaches (i.e. lists and key informant interviews). As a result censuses are rarely carried out at regional or national level where wholesalers may operate.

3.3.1.4 Sales receipts

To identify retailers, retail sales receipts of all registered wholesalers were collected during a study that evaluated the impact of a vendor-to-vendor training programme implemented in the rural district of Bungoma, Kenya (Tavrow et al., 2003). This method has however been rarely used, notably because of the relatively low availability of sales records at private commercial outlets operating in developing countries especially in remote towns and villages.

3.3.1.5 Household survey

In 12 villages of West Bengal State, India, private drug retailers were identified by visiting all the households with under-five children, asking mothers if any child had been sick in the past two weeks and if so, which providers they first visited to treat the child (Chakraborty et al., 2000, Chakraborty and Frick, 2002). The main advantage of a household survey is that informal and mobile providers who might not be captured in lists or during an outlet census can be identified. However, it can be difficult to identify outlets precisely from household's information and the survey will only capture providers visited by sampled households over a given time period.

3.3.1.6 Bottom-up approach: interviews with retailers and wholesalers

To identify wholesalers, interviews with their customers have been conducted. In the study of the retail market for malaria treatment in rural Tanzania, antimalarial wholesalers were identified by asking drug and general shopkeepers to name their 2 top suppliers for antimalarial drugs (Goodman, 2004). Then, the 5 most frequently mentioned wholesale sources for each drug and general outlet category were visited and asked about their top 2 supply sources for antimalarial drugs. This process was repeated until local manufacturers or importers were identified (Goodman, 2004). An alternative approach is to focus on each retailer's main supply source for all drugs as has been done in Zambia (MMV, 2007) and Nigeria (Adikwu, 1996). Another approach recommended by the WHO/HAI consists of asking at least one retailer in each of the studied area about his main supply source for each of the medicine surveyed, and the process is repeated at each stage of the chain until the top of the chain is reached (WHO and HAI, 2008).

In summary, a "bottom-up approach" offers the opportunity to identify formal and informal providers. This method however does not provide estimates of the total number of wholesalers operating at each level of the distribution chain.

An overview of the range of methods that have been reviewed for identifying providers at different levels of the distribution chain for antimalarial and pharmaceutical drugs in general is given in Table 3-1.

Table 3-1: Summary of approaches used for identifying different provider types

Methods	Distribution level		
	Manufacturers	Wholesalers	Retailers
Lists of outlets			
Official lists	✓	✓	✓
Other lists			✓
Interviews			
Central informants	✓	✓	✓
Local informants			✓
Providers	✓	✓	
Outlet census			✓
Household survey			✓

It is difficult to conclude on the relative completeness of each method in absence of a gold standard approach. The choice of method or combination of methods to be used will be driven by the types of outlets to identify and the resources available to do so. An outlet census seems to be the most reliable approach to identify providers although it can be a huge task especially if it is undertaken in large areas. The census approach has been used to identify retailers but never wholesalers so its relevance at higher levels of the chain is unknown. To date the “bottom-up” method which consists in interviewing providers about their supply sources has been the most common approach for identifying wholesalers. But key challenges emerge with respect to whether all providers have been identified (e.g. retailers might have a lot of different suppliers for different products) and how a representative sample can be drawn under this uncertainty.

Research studies are generally conducted on a sample rather than on the whole population. Three sampling procedures have been used in studies of markets for antimalarial and pharmaceutical drugs in general, namely convenience, random and stratified sampling methods. These methods are described below.

3.3.2 Sampling providers

3.3.2.1 Convenience sampling method

During the evaluation of the vendor-to-vendor training programme in Kenya, retailers, who had been identified from wholesalers’ sales receipts, were conveniently sampled based on logistical considerations with those located in remote areas purposively excluded from the

evaluation (Tavrow et al., 2003). This approach limits the extent to which findings can be generalised to the whole study district.

3.3.2.2 *Random sampling method*

The simple random sampling method has been used to draw samples of outlets identified from existing lists of providers. In the study that explored the practices of patent medicines sellers in Nigeria, a sample of outlets was randomly drawn from the list of retailers registered to handle prescription-only drugs in the study area (Adikwu, 1996). Similarly, registered pharmacies operating in 3 municipalities of Dar es Salaam were randomly sampled from the official list of pharmacies available from the TFDA (Kachur et al., 2006). One limitation shared by these 2 methods is that outlets might not be homogeneous, varying for example by outlet type and geographic location, and simple random sampling may fail to ensure that each group is adequately represented. To address this issue, some studies drew stratified samples.

3.3.2.3 *Stratified sampling method*

Stratification involves the creation of relatively homogenous sub groups or strata, from which samples are taken either randomly or purposively. A method developed by WHO/HAI was to stratify outlets by geographic area and draw a sample using a combination of randomisation and purposively driven techniques. They select the main urban centre and 5 other geographical areas that can be reached within one day's drive from the urban centre. In each area, the main public hospital is purposively selected and 4 public facilities are randomly chosen from the official list of government outlets ;then, in each area the closest private outlet to each public facility is selected (WHO and HAI, 2008).

This sampling approach has been adapted in a couple of studies. For example, in Maputo City, Mozambique, a sample of private pharmacies was stratified by outlets located in the suburbs and those in the town centre (Russo and McPake, 2010). An advantage of the WHO/HAI approach is feasibility but it is limited in its focus on registered outlets. The sample is at best informative for pharmacies in the surveyed area but not for all the retail sources that might also stock medicines in the selected geographic areas. Another adaptation of the WHO/HAI approach by the Medicines for Malaria Venture partially solved this issue, by identifying all private registered and unregistered sources of antimalarial drugs found within 3 hour's-drive from each public health facility using lists of outlets and key informants. Then, 5 outlets are

randomly sampled (MMV, 2007). However, the representativity of the sample remains questionable.

Other methods of stratification have included by village (Hetzel, 2007) or area of operation (wealthy versus poor) (Russo and McPake, 2010); by type of drugs handled (generics or brands) (Russo and McPake, 2010); and by level of the distribution chain (manufacturers, wholesalers and retailers) (Yadav, 2007). One study conducted in Uganda drew random samples of private wholesalers and retail pharmacies using official lists and stratified the total sample proportionally by the share that wholesalers and retailers each represented to the total number of registered private outlets (Nakyanzi J et al., 2009). In another study, a stratified sample of wholesalers serving retailers was drawn directly by selecting the 5 most frequently mentioned supply sources by retail shopkeepers for each category of general and drug outlet (Goodman, 2004).

Another challenge in studying the provision of pharmaceutical products and antimalarials in general in developing countries is to identify the range of drugs dispensed in a particular area. The next sub-section reviews the range of methods used in the literature.

3.3.3 Identifying the range of products

The review identified two sets of approaches for exploring the range of products available in a particular area. The first set includes approaches that explore availability from a supply-side perspective, including product lists, outlet surveys and the mystery shopper's technique. The second set covers household surveys and exit interviews, which investigate product availability from the demand-side.

3.3.3.1 Product lists

Official lists have been used to count the number of products with marketing authorisations in a given country. In a study that explored the supply and use of antimalarial drugs in Tanzania, the list of registered medicines available from the Pharmacy Board was used to identify the number, types and formulations of imported antimalarials (Battersby et al., 2003). In another study on malaria treatment conducted in the Kenyan retail sector, the official list of registered antimalarials was obtained from the Pharmacy and Poisons Board of the Ministry of Health and was supplemented by information on newly registered antimalarials available from the Board's minutes and Gazette notices (Amin and Snow, 2005).

The main limitation of this approach lies in the quality of the information contained in the list and whether registration status reflects availability on the ground. For instance, the Kenyan study found that out of the 218 oral antimalarial products that were found to be in circulation in Kenya in 2002, 83 products were not included in the official list (Amin and Snow, 2005). In addition, it reported that many of the drugs listed were due for re-registration, creating uncertainty around their status and availability in the market (Amin and Snow, 2005). A preferred approach has therefore been to assess the availability of medicines by visiting outlets.

3.3.3.2 Outlet surveys

A range of studies has surveyed outlets to assess medicines availability.

In a study that explored the supply of medicines by informal outlets in the Division of Ntem, Cameroon, a medical anthropologist collected information on the types, formulations and pack sizes of all medicines on display in each outlet. If none were displayed, the shopkeeper was asked whether medicines were sold in the premises (van der Geest, 1987, Van der Geest and Hardon, 1988). The main limitation of this approach relates to the time needed to record detailed information about each medicine. Implementation of this approach in all outlets or large samples of outlets selling drugs is likely to become unmanageable.

An alternative is to focus the data collection on selected products. The WHO/HAI methodology consists of selecting a maximum of 50 medicines, including 14 global and 16 regional essential medicines selected on the basis of the global burden of disease, and 20 supplementary essential medicines identified at country level. One pack size and one strength are surveyed for each medicine type, which can include innovator brand, generic, locally produced and imported drugs. Advantages of this approach include its feasibility and the potential for comparison across countries.

A third approach is to assess availability of medicines commonly used to treat a specific condition. For instance, several rounds of outlet surveys have been conducted during the IMPACT programme to provide evidence to help improve malaria control in 4 districts of rural Tanzania over a 5 year period. Data on the formulation and packaging of all antimalarials and painkillers stocked by drug and general outlets were collected at different points in time allowing stocking patterns to be investigated over time and compared across outlet types

(Goodman, 2004). By contrast, a later survey focused on the availability of the first-line antimalarial drug only from both drug and general shops in the study area (Hetzl, 2007). Availability of antimalarials and painkillers was also investigated at wholesale level by following up the sources of supply for drug and general retail outlets (Goodman, 2004).

The most important limitations of exploring the range of all or selected medicines on display in shops is that the information collected does not tell us about the use of medicines and their relative importance (Conteh and Hanson, 2003). In addition, there is a potential for shopkeepers to withhold information as prescription-only medicines may not be openly displayed. The mystery shopper technique can address this limitation.

3.3.3.3 Mystery shoppers

The mystery shopper technique consists in the unobtrusive observation of shop attendants by researchers who pose as clients seeking care from a provider who is unaware of their identity (Conteh and Hanson, 2003). This strategy has been used in Tanzania during a pilot study during which ACT was sold at subsidized prices. In the 210 Part II drug shops that were visited, shoppers posed either as clients with malaria symptoms or as care takers of a 9-month old child sick at home. When shoppers were not directly offered an ACT, they specifically asked for one referring to a radio ad they had recently heard (CHAI, 2007). They bought whatever product was available and after leaving the outlet recorded the details of their visit (CHAI, 2007).

In addition to these supply side approaches, two methods for exploring product availability from the demand-side were identified and are described below.

3.3.3.4 Household surveys

Many household surveys collect data on drugs used for fever/malaria treatment. For example, in a study of the management of paediatric fever in 4 districts of Kenya, a sample of households was surveyed and in each home a child under five years of age was randomly selected. The main caretaker was then asked whether the child had had a fever in the preceding 14 days, and if they had, the duration of illness, if care had been sought and the type of care sought. When modern medicines had been obtained, the caretaker was asked to identify the medicines from a photo-illustrated chart of common branded antimalarials and

painkillers available in the retail sector (Amin et al., 2003). Health cards and prescriptions were also examined (Amin et al., 2003).

The main limitation of the household survey approach as a means to explore product availability lies in respondents' ability to recall their past actions, which may also be influenced by social desirability biases. For instance, caretakers might not accurately report the treatment obtained and the name of the providers they visited.

3.3.3.5 Exit Interviews

Interviews can also be conducted outside each outlet surveyed where clients who exit the shop are asked about their purchases by a researcher. In the ACT subsidy pilot conducted in Tanzania, a data collector was stationed outside each Part II drug shop for one day and asked customers who had purchased an antimalarial the brand name of the purchased medicine, the price paid, the reasons for purchasing this product and a set of demographic characteristics (CHAI, 2007).

This approach has the potential to unveil information about medicines stocked behind the counter but it can be time consuming as the interviewer has to wait outside the outlet. For example, during a study of illicit drug sellers in two markets located in the suburbs of Dakar, 10 drug sellers were randomly selected and observed during 10 hours per day for 7 days, with a total of 144 seller-customer interactions recorded (Fassin, 1987).

3.3.4 Measuring sales volumes and values

This section reviews four methods identified for measuring sales volumes and values, namely the review of sales records, interviews with providers, exit interviews with customers and the retail audit technique.

3.3.4.1 Review of sales records

One approach to measuring sales volumes is to collect information from sales recorded by storekeepers. In a study conducted in Tanzania, researchers used sales records available in each store to estimate the volumes of antimalarial drugs sold over one month (CHAI, personal communication).

3.3.4.2 Interviews with providers

Sales volumes can also be estimated during interviews with retailers who are asked to recall their sales volumes during the week preceding the interview (PSI, 2008b).

3.3.4.3 Exit interviews

Exit interviews with customers can be conducted outside public and private pharmacies to estimate the utilisation of medicines as done in a study conducted in Addis Ababa, Ethiopia. (Kloos et al., 1986).

3.3.4.4 Retail audits

Another approach, developed by market research agencies, is to undertake a retail audit during which stock information is collected by field research teams who visit a panel of outlets at regular intervals. At each visit and in each outlet fieldworkers measure the stocks of an entire product category and ask about any volumes added and/or disposed during the visit interval. The volume of sales for each shop during the period is then estimated by subtracting the stock at the end of the period from the stock at the initial visit, corrected by any additions/disposals during the period. Periodic sales volumes can then be calculated by summing the sales volumes of each audit and scaling up accordingly to the period of interest. In the study of the retail market for malaria treatment in rural Tanzania, the retail audit technique was used to collect antimalarial sales data (Goodman, 2004). All public facilities and drug shops and a sample of general stores that stocked antimalarials were visited during two separate 2-week periods.

More recently during the evaluation study of the impact of subsidised ACT in Tanzania, retail audits were conducted to assess the volume of antimalarials sold by each Part II drug shop. Data collectors visited all the shops in each of the 3 districts two times with a 4 week interval between visits (CHAI, 2007). Data on the stocks at the first visit, stocks at the second visit, volumes purchased and volumes disposed were then used to determine the volume of all antimalarials sold at each outlet in the past month.

Research International, a market research company, used a panel of pharmacies, drug stores and clinics to survey each outlet on a monthly basis for a period of 3 months (MMV consensus methodology meeting, March 2007): fieldworkers visited outlets and asked retailers to see

their receipts for wholesale purchases, asked about products that were out of stock at the time of the visit and counted the stock available of each product surveyed. In Kenya, a panel of 300 registered and unregistered outlets were surveyed (MMV consensus methodology meeting, March 2007).

During our review, the literature did not indicate which approach may provide the most accurate estimates. However, common challenges were identified. The first is that shopkeepers may be reluctant to share their records. They may fear that their data could be disclosed to drug registration bodies, revenue authorities or competitive outlets. They may also simply object to being observed because it might interfere with their work (Conteh and Hanson, 2003).

When shopkeepers are willing to disclose sales data, the second challenge lies in the completeness of the data that can be collected. Approaches tend to be better suited for estimating the sales of formal rather than informal outlets (Conteh and Hanson, 2003) and sales of registered rather than unregistered products. Shopkeepers are unlikely to display products that they are not authorised to handle and exit interviews may be the best approach to address this problem, although the presence of interviewers may still bias sales patterns.

The third challenge is to obtain annual estimates by scaling up sales data that are available over shorter time periods. Information about the seasonality of sales patterns is therefore needed. Reviewing sales records can potentially address this challenge as if they exist they will cover a longer time period. Retail audits can also be an alternative if they can be carried out all year continuously. Otherwise, proxies are needed, such as, for example, outpatient records available from health information systems.

The fourth challenge relates to the valuation of sales volumes. It can be relatively straightforward to collect sales values directly from shopkeepers' records. However, if other approaches are used, price data are required and need to be collected. In addition, a question concerns which price should be used for valuing sales volumes. Ideally, one could collect the retail price of each product during a retail audit and then use these data for valuing sales volumes. The biggest challenge however is in the valuation of highly subsidised or free products. In a study conducted in rural Tanzania, volumes of antimalarials dispensed from government facilities were valued assuming a zero mark-up using international reference

prices (IRPs) to which 30% were added to account for delivery costs (Goodman et al., 2009, Goodman, 2004).

The fifth and last challenge is to scale up sales volumes or values for outlets that were not sampled and for which no data are available in order to obtain estimates for the total market size. Mean sales volumes and values might be used but this may under or over estimate actual volumes/values and as a result market concentration measures. Whilst these common challenges have been identified, relatively little is known about the strengths and weaknesses of different methods implemented in the same context. This will be explored in Chapter 8 of this thesis. The review now turns to methods for studying economic markets.

3.3.5 Defining economic markets

As previously mentioned, market power is traditionally estimated using market concentration measures. These are based on market share data and therefore require the market to be defined appropriately. In the IO literature, markets are defined along product and geographic lines.

The product definition relates to the set of buyers, sellers and products sold in the market whilst the geographic definition is the area within which buyers and sellers interact and determine the product price. The range of methods used for defining the product dimension in the literature on markets for pharmaceutical drugs in developing countries is reviewed first, followed by the range of methods used for defining the geographical dimension.

The study of medicines prices in urban Mozambique followed the WHO/HAI approach and set the product definition as public and private registered pharmacies dispensing a sample of essential medicines (Russo, 2007). In the study of the retail sector for malaria treatment in rural Tanzania, the provider market was defined as all outlet types found to be widely used to obtain fever or malaria treatment using household survey data collected on treatment seeking behaviour in the study areas. As a result, the product definition included all public and private facilities, drug shops and general stores stocking painkillers and/or antimalarial drugs, with these medicines representing the vast majority of drugs obtained for treating fever or malaria during the household survey (Goodman et al., 2009, Goodman, 2004). Other provider types that were rarely used were excluded as potential competitors, including itinerant vendors, community health workers and traditional healers (Goodman et al., 2009, Goodman, 2004). In

the ACT pilot study implemented in 3 rural districts of Tanzania, the product definition included Part II drug shops on the basis of evidence provided by Goodman and colleagues that these were the most commonly visited provider type for treating fever or malaria treatment in rural areas (CHAI, 2007).

Overall, few studies we reviewed specifically aimed to define the product dimension of pharmaceutical markets. This partly reflected the challenges in assessing which products to consider as close substitutes and therefore part of the same market in the absence of data on between-product cross-elasticity. Furthermore, products part of the same market may not face the same degree of competition (Goodman, 2004).

Three approaches have been used for defining the geographic dimension of pharmaceutical drug markets in developing countries: the fixed radius method, the use of administrative areas alone or combined with the shipment approach.

The fixed-radius method was used in the ACT pilot implemented in Tanzania. The geographic dimension was set as all outlet types that potentially competed with Part II drug shops in the study districts, including other shops situated within a 1km radius of each Part II drug shop and government and NGO facilities located within 10kms of each drug shop and providing free ACT (CHAI, 2007).

Administrative areas alone were used in the study of medicine prices in urban Mozambique. The geographic definition was set as the main urban centre based on household survey data that showed that consumers who lived in the Machava and Matola areas of the Maputo Province reported buying medicines in Maputo City (Russo 2007).

The shipment method consists of identifying self-contained areas using data on the proportion of the population that seek care in the market area but live outside it and data on the proportion of the population in the market area that use providers located outside it (Zwanziger et al., 1994). This approach was used by Goodman and colleagues in their study of fever/malaria treatment in Tanzania in order to assess the appropriateness of different levels of administration areas. The most appropriate administrative area for most sub-markets was identified by minimising the proportion of customers who travelled outside the area to purchase the product and maximise the proportion who remained within the area. Shipment data were also used to take account of local specificities in care seeking behaviours and

adjustments were made to some sub-markets for which a different geographical definition was more appropriate (Goodman, 2004). For example, in situations where a smaller administrative area was relatively self-contained, it was considered as a more appropriate geographic definition and used to set up boundaries for some of the sub-markets.

All these approaches that have been used for defining the geographical dimension of markets have their weaknesses. Administrative area and fixed radius methods ignore consumers' actual treatment seeking behaviours. For example, during the Mozambican study, evidence showed that consumers crossed the Mozambican border to seek care from providers outside the country, although these providers had been excluded from the market definition. As for the shipment method, it uses utilisation data by patient origin that may not be readily available, and where available, cut-off points of proportions of the population that seek care inside and outside the area are generally arbitrary. In summary, the extent to which the geographic definition can be fine tuned to customers' preferences and location of providers is generally limited and it is unrealistic to define completely distinct markets in the context where providers' catchment areas often overlap and vary in size (Goodman, 2004).

To conclude, defining the market is challenging and all approaches tend to have limitations. Combining approaches seems to be the best method for defining markets. Once an appropriate market has been defined the intensity of competition in the market can be explored, starting with the measurement of market concentration.

3.3.6 Measuring market concentration

In the empirical literature, horizontal concentration has typically been measured by the n-firm concentration ratio (CR) or the Herfindahl-Hirschman- index (HHI), although additional approaches have also been identified.

The CR measures the proportion of market output accounted for by the n largest firms, with n often set at 3, 5 or 10. Formally:

$$CR_r = \sum_{i=1}^n S_i$$

Where S_i is the share of the i^{th} firm in the market and n the number of firms considered to be the largest.

Concentration ratios are easy to calculate but they only consider the n largest firms in the industry and the choice of n is arbitrary.

Another approach is therefore to calculate the HHI, which is the sum of squared firm market shares of all firms in the industry.

Formally:

$$HHI = \sum_{i=1}^N S_i^2$$

Where N is the total number of firms in the industry.

The HHI can vary from 0 to 1, with fewer firms and larger variations of market shares increasing the index and indicating a greater degree of concentration and lower competitive intensity.

CRs and HHIs have been used to measure concentration at various levels of the distribution chain for pharmaceutical drugs in developing countries. At wholesale level, a study of the structure of the antimalarial market in Uganda assessed the level of concentration of the import wholesale market by calculating the n-firm concentration ratio and the HHI index using the value of all antimalarial drugs imported into the country by each importer (Yadav and Conesa, 2008). The level of concentration was assessed using a three tier cut-off, following US horizontal merger guidelines, which at the time of the Ugandan study considered markets with an HHI below 0.1 as unconcentrated, between 0.1 and 0.18 as moderately concentrated and above 0.18 as highly concentrated (Yadav and Conesa, 2008).

In a study of medicine prices in Mozambique, the degree of concentration of the wholesale market for essential medicines was estimated by calculating the market shares of registered drug importers using pre-tax turnover data available from the National Directorate of Tax and Auditing (Russo 2007). The HHI index was calculated and the cut-off value of 0.18 was used to assess the level of concentration in that market. One limitation of using pre-tax turnover data is that it provides the market share that each wholesaler holds in value terms in the overall drug markets rather than solely in the market under study. Therefore, through this approach, the HHI is calculated on the market defined as all wholesalers of any pharmaceutical drugs. It implies that all wholesalers were expected to compete with one another despite the fact that they were likely to operate in different markets as they sold drugs that were unlikely to have all been close substitutes.

At retail level, Goodman calculated the 3-firm CR and the HHI by sub-market and outlet owner using sales values data (Goodman, 2004). The measures were calculated by owner rather than by outlet because of evidence that the same owner managed more than one outlet.

Additional methods have also been used. In the Tanzanian study, the number of providers per capita was estimated to assess concentration in the retail market for antimalarials. A similar approach was used for the wholesale market by calculating the number of retailers per supply source (Goodman, 2004). In another Tanzanian study, retail market concentration was measured using a competition index referring to the number of shops located within a 1km radius of each Part II drug shop. The index was defined to range from 0 (no other shops within the 1km radius) to 5+ (more than 5 other shops within the 1km radius) providing a proxy of the degree of competition (CHAI, 2008b, CHAI, 2007).

In the absence of sufficient quantitative data, interviews have been conducted to explore the relative importance of suppliers within and across supply chain levels. In the Mozambican study, semi-structured interviews were conducted with policy makers, importers and pharmacists to collect information on the number of pharmacies located in central Maputo and in the suburbs, their product orientation (either generic or brand) and the relative volumes they were perceived to handle to assess the level of retail concentration (Russo and McPake, 2010, Russo, 2007). This approach is useful to get a feel of the structure of the market but is much less informative to assess market concentration and the extent to which market power is exercised.

Concentration in vertical markets is also of interest when studying competition in distribution chains. However, there is no measurement technique akin to those used to assess horizontal concentration. In the absence of consensus about which approaches are best suited for studying vertical integration, some attempts have however been made in two studies of pharmaceutical drug markets in developing country settings. In Mozambique, Russo interviewed key informants to collect information on importers and pharmacists' ownership status and the existence of long term agreements between manufacturers, importers and pharmacists (Russo, 2007, Russo and McPake, 2010), whilst Goodman investigated the degree of vertical integration during semi-structured interviews by collecting evidence on ownership links and long-term coordination such as long-term contractual arrangements (Goodman, 2004).

In summary, several techniques are available for measuring market concentration, with the HHI and CR being the most commonly used. Taking into account solely those providers that are currently operating in the market however ignores potential competitors who may enter the market and fails to provide a comprehensive assessment of the intensity of market competition. The notion of contestability needs therefore to be explored.

3.3.7 Assessing market contestability

A third step in the study of markets is to look at competition that firms already in the market face from potential new providers. This is done by exploring barriers to market entry and exit. During our review, 3 methods were identified: use of regulatory documents, interviews with providers and calculation of providers' turnover.

During his study of medicines prices in Mozambique, Russo investigated contestability by identifying the regulatory and economic barriers that providers face to enter the pharmaceutical drug market. Regulatory documents detailing the legal requirements to establish drug importing, wholesaling and retailing businesses were reviewed, covering for instance staff qualification requirements and drug pricing (Russo, 2007, Russo and McPake, 2010). Interviews with key informants were also used. Registered importers and urban-based pharmacists were interviewed about the legal and economic requirements new providers were likely to face to enter their respective markets (Russo, 2007, Russo and McPake, 2010). Economic barriers included the initial investment required, the perceived profitability of entering the market and risks encountered (Russo, 2007, Russo and McPake, 2010).

Finally, in her study of the retail market for malaria treatment in rural Tanzania, Goodman explored contestability by estimating the turnover of providers in her study areas using data collected during two rounds of retail censuses conducted 1 year apart (Goodman, 2004). This technique was thereafter repeated annually for several years in a follow-up study (Alba et al., 2010b).

In summary, there is a wide range of approaches available for exploring the structure of pharmaceutical drug markets. Combining methods may be the best strategy in order to triangulate the information collected and obtain more accurate estimates. However, the study of wholesale markets and distribution chains in general appears to be less common and the range of methods used in low income settings more limited.

3.3.8 Measuring price mark-ups

Price mark-up is a key variable in the study of economic markets as it provides an indication of the extent to which providers influence the price at which they are paid. The range of empirical methods that have been used for measuring price mark-ups are described first, followed by methods for analyzing their determinants.

3.3.8.1 Review of pharmaceutical regulations and key informant interviews

Reviewing official central policies and conducting central level interviews are the simplest methods for collecting medicines mark-ups. In a study of the market for essential drugs in 4 East African countries, researchers reviewed pharmaceutical drug policies to identify the maximum mark-up level authorized at each stage of the private commercial distribution chain (Myhr, 2000). In another study of the components of medicines prices in 10 countries, open-ended questions were sent via email to government officials (Levison, 2002).

These two methods are relatively convenient and inexpensive and they offer the opportunity to collect information on other components of medicine prices, including port and custom clearing tariffs and quality insurance check costs.

There are however 3 key shortcomings. The first is that it is only a valid approach in countries where mark-ups are regulated. The second shortcoming is that the collected data are likely to be inaccurate in countries where regulation enforcement mechanisms are weak as is often the case in developing settings. The third and last shortcoming is that mark-ups for individual medicines or different provider types cannot be collected.

3.3.8.2 Interviews with providers

Interviews with providers are an alternative method, which consist of asking providers directly about their mark ups. The advantage of this method is that mark-ups at different levels of the distribution chain can be collected, although again there may be concerns about the accuracy of self-reported mark-ups. In the Tanzanian study of the retail market for malaria treatment, 5 of the 6 surveyed drug wholesalers reported mark-ups ranging from 5% to 10% for both antimalarials and painkillers, reaching sometimes 15% for antimalarials. However, when mark-ups were calculated using selling and purchasing prices they were very different and varied

across drugs, with no mark-up on locally produced aspirin and 24.5% on quinine (Chukwujekwu, 2007).

3.3.8.3 Use of existing price data

Price data may also be used for calculating price mark-ups. Total mark-up, or the difference between the price at which a consumer buys a drug in retail shops and the price at which manufacturers sell it, provides a measure of the additional costs that are added as a medicine travels from the top of the distribution chain down to the bottom.

An alternative approach to calculating this difference is to calculate the Medicine Price Ratio (MPR) which is an expression of the price faced by customers in terms of its procurement costs. As the availability of procurement costs for particular drugs tends to be rare, IRPs have been used as a proxy for drug procurement prices to compare total mark-ups across medicines (Amin and Snow, 2005, Goodman, 2004, Russo and McPake, 2010), sectors (Levison, 2006, Ewen and Dey, 2005, WHO, 2007) and countries (Laing, 2006, Ewen and Dey, 2005, WHO, 2007). However, an important limitation of using IRPs for calculating price mark-ups is that IRPs are not *actual* procurement costs and therefore may not provide a reliable measure of providers' price setting decisions. The next section describes the range of methods used for analysing pricing determinants in low income countries and briefly reviews those used in developed countries.

3.3.9 Analysing price setting decisions

This review identified a single study that analysed providers' price setting decisions for antimalarial drugs and painkillers in a developing country setting, using quantitative methods, including bivariate and multivariable analyses, combined with semi-structured interviews with retailers and wholesalers.

Semi-structured interviews were conducted to explore how providers set their prices and mark-ups, providing insights on some of the factors to consider during the quantitative analysis (Goodman, 2004).

A bivariate analysis was then conducted to explore the association between the median price of a 2-year old child's treatment dose and a range of outlet and product characteristics. Outlet characteristics were used to account for differences in perceived quality of service, overhead

costs and wholesale prices between drug and general outlets. They included whether the outlet was a drug shop or a general shop, the area in which the outlet was situated (Rufiji, Ulanga and Kilombero areas) and whether the outlet was situated in a market centre, rural village or farming area. Product characteristics were used as proxies for variations in the cost and perceived quality of drugs that retailers reported customers to associate with effective medicines. They included the antimalarial and painkiller type, whether the tablets were packaged or loose, whether the drug was the innovator brand, a branded or unbranded generic and its country of manufacture (Tanzania, Other Africa, Asia or Europe) (Goodman et al., 2009, Goodman, 2004). This type of analysis provided information on which characteristics were associated with drug prices. However, drug and outlet characteristics were highly correlated, so it was therefore not possible to assess the relative importance or marginal effect of each of the different outlet and product characteristics on drug prices.

An ordinary least square (OLS) log-linear regression model was developed. The median price of a 2-year old child's treatment dose was logged to reflect the skewed distribution of drug prices and it was regressed on several predictor variables, including the generic drug type, type of packaging, country of manufacture, brand status, DSS area, outlet type and location and market concentration as measured by the HHI calculated for antimalarial sales volumes and values at private outlets (Goodman et al., 2009, Goodman, 2004). The analysis accounted for clustering of drug prices within outlets and the stratification of the outlet sample between Kilombero/Ulanga and Rufiji areas. As for other studies of price setting for pharmaceutical drugs in developing countries, they used semi-structured interviews with retailers and/or wholesalers (Chukwujekwu, 2007, Russo and McPake, 2010, RBM, 2007, MMV, 2007). Other studies conducted in low or middle income countries have also explored the influence of market structure on price and quality outcomes in markets for hospital services (Nakamba et al., 2002, Bennett, 1996).

In high or middle income countries, econometric models have been used to investigate changes over time in market structure (mergers, entry, regulation) on price or quality outcomes in markets for pharmaceutical drugs and hospital services (Wang, 2006, Sorensen, 2000, Danzon and Chao, 2000, Meiners et al., 2011). Within this literature, few studies have also investigated the conduct of both providers and buyers, notably in the US insurance and hospital markets (Moriya et al., 2010). These studies have faced challenges in measuring concentration on both sides of the market, and as a result nearly all, except one, measured concentration on one side of the market only whilst on the other side they used the share of a

particular buyer for a particular seller rather than the market share of the buyer in his market (Moriya et al., 2010, Gaynor and Vogt, 2000). The single study that measured market concentration on both sides used the sum of the squared market shares of each firm in their market (Moriya et al., 2010)

In summary, a range of methods have been used for studying healthcare markets across different settings (Conteh and Hanson, 2003, Van der Geest and Hardon, 1988). However, few studies conducted in developing countries have analysed drug markets from an economic lens. In addition, there is limited evidence available on how methods for studying a particular aspect of the market compare.

3.4 A review of the empirical literature on markets for malaria treatment

In this section, the literature on retail markets is summarised briefly (Section 3.4.1), as it has been the subject of a previous review (Goodman et al., 2007). Greater focus is placed on the literature on private commercial sector distribution chains for antimalarial and pharmaceutical drugs in general (Section 3.4.2). The private commercial sector distribution chain refers to all levels of the in-country distribution chain, in other words to the chain of wholesalers serving private commercial retailers. The focus is on suppliers who operate from the point where commodities leave the factory gate or port of entry down to those directly supplying retailers.

The review presents literature from outside Cambodia given that recent data on Cambodia have been presented in Chapter 2. As will become evident, most of the evidence available on retail markets and private commercial sector distribution chains concerns countries with high malaria transmission, notably those in Africa, where children under five years of age bear most of the disease burden. By contrast In Cambodia, as described in Chapter 2, malaria transmission is lower, concentrated in forest areas and affects mainly adult males. This implies that consumer demand and preferences may differ substantially between Cambodia and the countries for which most of the evidence is available. This may have important implications in terms of, for example, the range of products stocked, relative importance of different provider types in terms of sales volumes, and providers' pricing behaviour. Furthermore, Cambodia was the first country to introduce ACT and RDT in 2000 and availability and market shares for these products can be expected to be higher than in other malaria endemic countries. Finally, the structure of the private commercial distribution chain in Cambodia is likely to have been influenced by the nationwide social marketing programme, although as the review will demonstrate there is too little evidence on the structure of the chain in Cambodia and other

countries to conduct comparative analysis. The literature presented is however still of relevance to the thesis as there are several features that the Cambodian market shares with those covered in this review, as will become apparent from later chapters. These include the importance and heterogeneity of the retail sector, concerns about retail sector quality of care, and the range of wholesale supply sources. Moreover understanding the differences between the Cambodian context and other malaria-endemic settings is important in assessment of the generalisability of the thesis findings, considered in Chapter 9.

The methods used for the literature search are also detailed in Appendix 2. An earlier version of this review was published in 2010 and is available in Appendix 3.

This section starts by reporting the key structural aspects of retail markets for malaria treatment before presenting in more detail the evidence available on the private commercial distribution chain for antimalarial drugs. The section ends by describing and discussing the available data on price mark-ups on antimalarial drugs as they flow down distribution chains.

3.4.1 Retail markets for malaria treatment

This section reviews the available evidence on private commercial retailers' characteristics, range of antimalarial drugs stocked, sales volumes and interventions working with shopkeepers.

In many low and middle income countries, retail shops play an important role in the provision of malaria treatment (Agyepong and Manderson, 1994, Foster, 1991, Foster, 1995, Geissler et al., 2000, Hamel et al., 2001, Krause and Sauerborn, 2000, McCombie, 1996, Molyneux et al., 1999, Ndyomugenyi et al., 1998, Njau et al., 2006, Ruebush et al., 1995, Salako et al., 2001, Snow et al., 1992, Rutebemberwa et al., 2009). For example, the retail sector was the first source of care for around 45% of households seeking malaria treatment across four communities in Enugu State, Nigeria (Onwujekwe et al., 2008). In three rural districts of Tanzania nearly 40% of all anti-malarial volumes were dispensed within the retail sector, mainly through drug shops (Goodman et al., 2009).

Private shops' popularity is commonly based on convenience as they tend to operate closer to homes (Adikwu, 1996, Adome et al., 1996, van der Geest, 1987, Onwujekwe et al., 2008), and availability and reliability of drug stocks compared to public health providers (Snow et al.,

1992, Adome et al., 1996, Goodman, 2004, Molyneux et al., 1999, Rutebemberwa et al., 2009, van der Geest, 1987), sometimes at lower costs (Rutebemberwa et al., 2009, Williams and Jones, 2004, Amin et al., 2003, Brieger et al., 2001).

Private retailers' characteristics vary substantially across settings. They can be pharmacies, drug shops, grocery stores, market stalls or itinerant hawkers. In Nigeria, Uganda and the Democratic Republic of Congo (DRC), drug stores were the most common type of outlet stocking antimalarials whilst in Benin it was market stalls and in Nigeria grocery stores (O'Connell et al., in press). Mobile vendors are common in West Africa, but are rarely found in East and Southern Africa (Goodman et al., 2007).

Outlets staffed by trained pharmacists are rare in all countries (Adikwu, 1996, Tavrow et al., 2003), and concentrated in urban areas, whilst drug shops can be found in both urban and more densely populated rural areas. Finally, general shops that sell drugs alongside household goods are often the only medicine retailers in more remote rural villages. Pharmacies are generally authorized to stock both prescription-only drugs and over-the-counter (OTC) products, while other outlets can only sell OTC drugs, although in practice some illegally stock prescription-only medicines (Goodman et al., 2007).

The market for antimalarial drugs includes artemisinin combination therapy (ACT), the most effective medicine and the official first-line treatment of uncomplicated *P.f* in most developing countries; non-artemisinin therapies (nAMT), some of which were recommended before the ACT era (e.g. chloroquine, amodiaquine, sulphadoxine-pyrimethamine and quinine), and artemisinin monotherapies (AMT) (e.g. artesunate, dihydroartemisinin, artemether)¹⁵.

These three product types are available under different formulations including tablets, suppositories, suspensions, syrups and liquid injectables. Some are sold under their proprietary names, and referred to as innovator brands when they are products patented by their originators, or branded generics in the case of generic versions of innovator products marketed under a different name. Others are sold as unbranded generics without a proprietary name.

¹⁵ Some are still recommended for treating uncomplicated *P.f* in pregnant women for example and in severe *P.f* cases

Whilst antimalarial drug availability is relatively high in the private commercial retail sector, the range of antimalarials is generally lower in outlets which are more remote or have less qualified staff (CHAI, 2008b, CHAI, 2007, Amin and Snow, 2005, Goodman et al., 2004, Tavrow et al., 2003, van der Geest, 1987, MMV, 2007).

In terms of the volumes of antimalarial drugs sold annually across different provider types, limited data show that in Tanzania, 233 606 equivalent adult antimalarial doses were dispensed per annum from all facilities and shops in 3 rural districts of Tanzania, equivalent to 1.7 adult doses per capita. Drug shops sold a mean of 2,310 equivalent adult doses per annum whilst general stores sold a mean of 74 equivalent adult doses per annum (Goodman, 2004). Retail market concentration in volume terms was reported to be high, with the 3-firm CR ranging from 68 to 100%, and the HHI from 0.18 to 1 (mean of 0.45) (Goodman, 2004, Goodman et al., 2009).

ACT has been rarely available outside facilities and pharmacies whilst older therapies remain relatively popular. For example, In Tanzania, despite the change of treatment policy to the ACT artesunate-lumefantrine (AL) in 2004, the old therapy sulphadoxine-pyrimethamine still accounted for 51% of all antimalarial sales whilst AL represented 19% of total sales, of which 68% was from public health facilities and 14% from faith based health facilities and 17% from drug shops (Alba et al., 2010b). In 2009/2010, in Benin, Madagascar, Uganda and Zambia, nAMT was the most commonly sold antimalarial category whilst in the DRC and Nigeria it was oral AMT (O'Connell et al., in press). In these countries, recommended first-line ACTs accounted for less than 25% of total antimalarial volumes sold across public and private sectors and for less than 6% of sales volumes in the private sector(O'Connell et al., in press) .

Other concerns around the quality of care provided in private shops relate to retailers' lack of qualifications, poor knowledge of drugs and dosages (Marsh et al., 1999, Nshakira et al., 2002, Abuya et al., 2007, Okoro and Jones, 1995), and stocking of unregistered (Battersby et al., 2003, Goodman et al., 2004) and sometimes substandard or counterfeit drugs (Basco, 2004, Geissler et al., 2000, Kaur et al., 2008, van der Geest, 1987, Dondorp et al., 2004, Newton et al., 2001, Rozendaal, 2001).

Although care provided by pharmacies is far from perfect (Adu-Sarkodie et al., 2000, Mayhew et al., 2001), most of these concerns are directed to non-pharmacy outlets. Drug shop staff are rarely qualified pharmacists (Rajakaruna et al., 2006), having at best a basic nursing

background (Goodman et al., 2007, MMV, 2007) or sometimes just secondary education (Rajakaruna et al., 2006). General retailers have even fewer qualifications and some are illiterate (Goodman, 2004, Adome et al., 1996).

A strong interest in working with retailers to improve the quality of care they provide has emerged in recent years. Reviews of interventions working with shopkeepers indicated that various activities and mix of activities have been implemented (Goodman et al., 2007, Wafula and Goodman, 2010, Smith et al., 2009, Smith, 2009, Shah et al., 2011).

The most commonly used intervention for improving providers' knowledge and practice has been training, including individual sessions, training of trainers and workshops. Many interventions however had more than one component such as training combined with the provision of printed materials (e.g. job aids and posters) to display in outlets, pre-packed medicines, outlet accreditation or franchising, and supervision. Intervention components have also targeted factors influencing providers' practices, including the provision of information to consumers through social marketing programmes¹⁶, mass media or public information campaigns, or the creation of an "*enabling environment*" by changing drug policies and regulations or the provision of credit facilities to retailers (Goodman et al., 2007).

The reviews pointed out to the limited evidence on which interventions work best. They found however that training led to improvements in shop attendants' knowledge and practice, although the sustainability of the latter, including drug dispensing and referral of severe cases was questionable. In addition, participatory approaches within education and supervision interventions were reported to be relatively successful when they involved trainees and key stakeholders (e.g. national drug regulatory authorities) in the design and content of the intervention and in the planning of actions for performance improvements (Goodman et al., 2007, Wafula and Goodman, 2010, Smith et al., 2009, Smith, 2009, Shah et al., 2011). Finally, the reviews found higher improvements achieved during multi-faceted interventions addressing providers' knowledge and practices, and the broader context within which retailers operate, including the degree of competition faced by providers, regulatory mechanisms, consumer demand and influence of what happens at higher levels of the distribution chain (Goodman et al., 2007, Wafula and Goodman, 2010, Smith et al., 2009).

¹⁶ Social marketing involves the tools and concepts of commercial marketing, including promotional activities, branding, pre-packaging and/or financial subsidy of public health commodities

More recently, ACT subsidy schemes have been introduced in several malaria-endemic countries. Evaluations of these pilot interventions found that a subsidy, combined with supporting interventions (as those described above), increased ACT availability and uptake (Kone et al., 2007, Sabot et al., 2009, Sabot et al., 2008, Cohen et al., 2010, Talisuna et al., 2009, Kangwana et al., 2011). For example, a cluster randomised controlled trial of subsidized paediatric ACT packs provided to retail outlets, training of retail shopkeepers and community awareness activities was conducted in 3 districts of Kenya. The percentage of children receiving the subsidized ACT on the day of fever or the following day was 25.5% points greater in the intervention arm than in the control arm (95%ci 14.1%-35.9%, $p < 0.001$) (Kangwana et al., 2011). However, there was some evidence that this kind of intervention benefited the more accessible and wealthier populations (Cohen et al., 2010), perhaps in part because of the small implementation scale (e.g. municipal, district) or/and scope (e.g. pharmacies and/or drug shops only).

A global subsidy mechanism, known as the Affordable Medicines Facility-malaria (AMFm) and managed by the Global Fund to fight AIDS, Tuberculosis and Malaria (the Global Fund) has been introduced in Ghana, Kenya, Madagascar, Niger, Nigeria, Uganda and Tanzania, and is to be introduced in Cambodia. Co-payments are made by the Global Fund directly to preselected ACT manufacturers on behalf of both public and private sector buyers in each country, with the aim to reduce ACT retail prices to a level similar to less effective antimalarials, increase demand for ACT and displace less effective medicines from the market. Additional funding is available to countries for introducing “supporting interventions” such as community awareness, provider training and regulatory strengthening.

A rapid assessment of the preliminary effects of the AMFm, which was conducted in the capital city of Nigeria and Ghana found that, whilst ACT prices had decreased following the intervention, ACT was sold at a price higher than that of less effective therapies, and questioned the potential for ACT crowding out and ultimately the AMFm’s capacity for increasing access to good quality malaria treatment (Tren and Hess, 2011). A more formal independent evaluation of the AMFm is conducted in the participating countries.

3.4.2 Distribution chains and wholesale markets for antimalarial drugs

This section reviews the available evidence on distribution chains in developing countries, including the general structure of the chain for antimalarial and pharmaceutical drugs¹⁷ in general and, at each level, suppliers' numbers and characteristics, range of antimalarial drugs stocked, antimalarial sales volumes and interventions working with wholesalers. An overview of the reviewed studies is available from the published manuscript in Appendix 3.

For the purpose of the review, a taxonomy of suppliers was developed. Suppliers who sell directly to retailers are termed *terminal* suppliers. They buy from upstream suppliers, referred to as *primary* suppliers if they are the point of entry into the distribution chain, or *intermediate* suppliers if they themselves obtain drugs from primary suppliers.

Overall, the distribution chain has been relatively less researched than the retail sector. The available evidence focused mainly on supply sources for retailers, with more limited evidence on higher levels of the distribution chains, notably intermediate ones.

The private commercial sector distribution chain of pharmaceutical drugs had a pyramid shape, similar to that of other private distribution channels, with fewer suppliers at the top and more numerous suppliers at the bottom (Yadav and Conesa, 2008, IOM, 2004, Tavrow et al., 2003, Battersby et al., 2003, International Finance Corporation, 2008, RBM, 2007, Shretta and Guimier, 2003, CHAI, 2008b, Russo, 2007, Russo and McPake, 2010, Chukwujekwu, 2007, MMV, 2007, Tougher et al., 2009, Palafox et al., 2009).

The chain serving more remote outlets and those with less qualified staff tended to have more numerous levels. There were two intermediate levels of general wholesalers in the chain serving general shops operating in three rural districts in Tanzania but no intermediate level in the chain serving drug shops located in the same districts (Chukwujekwu, 2007). In a rural district of Uganda, two intermediate levels of wholesalers supplied the chain down to general stores and market stalls whilst the chain serving drug shops had a single intermediate level of wholesalers (MMV, 2007).

¹⁷ Antimalarials are expected to follow the same distribution route as other drugs and to represent an important share of all drugs distributed in malaria-endemic countries.

Data on the total number of suppliers operating at each level of the antimalarial distribution chain were generally lacking. When available, data mainly concerned registered suppliers of pharmaceutical products in general (Yadav, 2007, Battersby et al., 2003, IOM, 2004, IFC, 2008, Russo, 2007, Tavrow et al., 2003, MMV, 2007, Palafox et al., 2009) and rarely provided information on the total number of suppliers handling antimalarials (Chukwujekwu, 2007, Yadav and Ongola, 2007, Yadav and Conesa, 2008, CHAI, 2008b, Bojang et al., Tougher et al., 2009). For example, in Nigeria, 286 registered importers and 616 registered wholesalers supplied pharmaceutical drugs in general (Palafox et al., 2009). In Benin, 3 private wholesalers imported antimalarials (Tougher et al., 2009) whilst in Burkina Faso and Uganda 4 and 15 did so respectively (RBM, 2007).

The type of businesses acting as terminal, intermediate and primary suppliers is described below, although as will become clear, there is considerable overlap between these categories in practice.

At the terminal level, wholesalers were the most common suppliers, serving pharmacies, drug shops and general shops (Yadav, 2007, RBM, 2007, Amin and Snow, 2005, Buabeng et al., 2008, CHAI, 2008c, IOM, 2004, IFC, 2008, Russo, 2007, Tavrow et al., 2003, Yadav and Ongola, 2007, MMV, 2007). In some settings, different types of wholesalers tended to supply different types of retail outlets. In Tanzania and Kenya, wholesalers who supplied drugs alongside other commodities served general shops, whilst wholesalers specialized in handling drugs usually served pharmacies and drug shops (Chukwujekwu, 2007, Tagbo and Henrietta, 2007, Tavrow et al., 2003).

Retailers themselves frequently operated as terminal suppliers for outlets located in more remote areas (Foster, 1991), although with variation across countries and retailer types. Pharmacies frequently supplied rural drug shops and general stores (Yadav, 2007, MMV, 2007, Battersby et al., 2003, IOM, 2004), sometimes in a relatively organized manner, such as in Nigeria where they sent sales teams (Adikwu, 1996). Drug shops were somewhat less common terminal suppliers, at times serving other drug shops in Uganda and Tanzania (CHAI, 2008b, MMV, 2007) and general stores in Uganda only (MMV, 2007).

Importers were also terminal sources when they directly served pharmacies that they sometimes owned and also drug shops (Yadav, 2007, Buabeng et al., 2008, Russo, 2007, MMV,

2007, Chukwujekwu, 2007), using sales teams, such as in Tanzania (Chukwujekwu, 2007) and Nigeria (Palafox et al., 2009)

Public agencies were terminal suppliers, either officially such as in Sri Lanka where the State Pharmaceutical Corporation supplied retail outlets (Rajakaruna et al., 2006) or in Benin where the Centrale d'Achat des Médicaments Essentiels et des Consommables médicaux supplied generic antimalarials to private clinics and retail pharmacies (Tougher et al., 2009), or unofficially in several countries where government health workers sold public sector drugs to retail shops (Adome et al., 1996, van der Geest, 1987, IOM, 2004, Tougher et al., 2009, Palafox et al., 2009)

Terminal suppliers' characteristics were rarely explored. When available, the evidence shows that wholesalers infrequently had any health-related qualifications, although drug specific wholesalers were reported to employ more qualified staff (mainly pharmacy and biochemistry graduates) and to have been in operation for longer than general wholesalers (Chukwujekwu, 2007).

Information on terminal suppliers' locations shows that overall, remotely located drug shops and general stores obtained their supplies more locally than more accessible retailers. In Zambia, 24% of outlets located in 3 border districts with DRC or Tanzania obtained their drugs from district suppliers and the same proportion chose to cross borders to buy from Tanzanian or Congolese suppliers (CHAI, 2008c). In Tanzania, drug shops generally obtained antimalarials from terminal level drug specific wholesalers or pharmacies located in the capital city, hundreds of kilometres away (Goodman et al., 2004, Chukwujekwu, 2007, CHAI, 2008b), whilst those located more than 1,000 kilometres away from the capital city obtained their supplies from more nearby locations (CHAI, 2008b). In Uganda and Kenya, general shops usually obtained their supplies from local suppliers (Amin and Snow, 2005, MMV, 2007, Tavrow et al., 2003). In Kenya, the location of general shops' supply sources varied with outlet size, such that large shops where more than one person worked during opening hours obtained their supplies from terminal general wholesalers located inside or outside the district whilst smaller shops where one person worked during opening hours bought more frequently from general wholesalers located within the district (Amin and Snow, 2005).

Mobile suppliers such as sales representatives of drug companies or general distributors served retailers in many settings, although their popularity and the types of outlets they

served varied. In Kenya, mobile vendors commonly supplied both drug and general shops (Amin and Snow, 2005, Marsh et al., 2004, Tavrow et al., 2003) whilst in Tanzania mobile vendors only served general shops, representing in some districts only 1% of supply sources (Goodman et al., 2004), but in others being a more common source of supply (Battersby et al., 2003). In Nigeria, sales representatives of large national and international drug companies supplied all types of retail outlets (Adikwu, 1996). By contrast, in Uganda and Tanzania, local manufacturers' sales teams supplied the more accessible retailers with more qualified staff (Chukwujekwu, 2007, MMV, 2007).

Finally, overseas manufacturers were only found at terminal level in Sri Lanka where 5% of retailers obtained drugs directly from drug companies in India (Rajakaruna et al., 2006).

At intermediate level, studies provided much less information on supply sources. In settings where intermediate level suppliers were identified (MMV, 2007, IOM, 2004, IFC, 2008), they were wholesalers who, as in the case of those operating at terminal level, either handled drugs alongside other commodities or specialised in drugs, hence supplying distinct distribution chains. Information on the location of intermediate suppliers was available only for Tanzania and Uganda, where they operated in the capital city (Chukwujekwu, 2007, MMV, 2007) and at regional (Chukwujekwu, 2007) or district level (MMV, 2007). In Tanzania, intermediate wholesalers were sometimes agents of upstream suppliers at regional level (Chukwujekwu, 2007). Regional wholesalers also, at times, used mobile services providing door-to-door services to their customers (Chukwujekwu, 2007). In other settings, there was no information available at this level or no intermediate suppliers operating in the chain serving the studied areas (PSI, 2007, Amin and Snow, 2005, Adome et al., 1996, Tavrow et al., 2003). Finally, as at terminal level, information on suppliers' characteristics was provided by a single study reporting that in Tanzania general suppliers had started their business more recently than drug specific wholesalers and rarely employed staff with health related qualifications (Chukwujekwu, 2007).

At the top of the chain or primary level, suppliers were importers who were sometimes agents of overseas pharmaceutical companies, at times contracted to act as their sole supplier for distributing their products locally (MMV, 2007, Chukwujekwu, 2007, Yadav, 2007, Palafox et al., 2009) or integrated with manufacturers (Russo, 2007, Palafox et al., 2009). The literature provided little information on the nature of this agency relationship. In the case of exclusive distributorship agreements between overseas companies and local importers, the latter

frequently exchanged products with other importers for which one or the other was the sole supplier (Battersby et al., 2003, Chukwujekwu, 2007, Yadav, 2007, MMV, 2007), creating horizontal transactions at the top of the chain. This situation was reported in Zambia where importers tended to have regular customers who would generally purchase the bulk of their supplies from few importers. As importers were generally the sole entry point for a particular drug, they would often exchange products between one another (Chukwujekwu, 2007, Yadav, 2007) rather than send customers to buy from the relevant importer. As a result, no clear differentiation between wholesalers and importers existed in many settings, as these roles were product dependent (Yadav, 2007, MOH, 2004a). As at terminal and intermediate levels, suppliers' characteristics were provided only by the study conducted in Tanzania. None of the primary general suppliers employed staff with health related qualifications and had started their business more recently than drug specific suppliers (Chukwujekwu, 2007).

Finally, illegal distribution channels were reported in several countries, whereby drugs were smuggled from one country to another (Buabeng et al., 2008, Rozendaal, 2001, IOM, 2004, van der Geest, 1987, Tougher et al., 2009, Palafox et al., 2009). For example, in Nigeria, informal suppliers were reported to operate in large markets selling a wide range of consumer goods, with drugs originating from neighbouring countries (Palafox et al., 2009). Drugs from Nigeria were commonly found on sale in Benin (Tougher et al., 2009) or Cameroon or passing through Cameroon to reach Gabon or the Central African Republic (van der Geest, 1987). Medicines imported illegally from Togo were also sold in Benin by a wide range of informal providers, such as mobile drug sellers or sellers operating in or outside open-air markets (Tougher et al., 2009). Inter-sectoral leakages were also said to be common in Nigeria and Benin, with in the latter ACT designated for the public sector (Benin's or that of neighbouring countries) sold at informal outlets (Tougher et al., 2009, Palafox et al., 2009). Finally, in Senegal, smuggling took the form of sea or air shipments diverted from their initial destination or illegal imports of donations from European countries (IOM, 2004). Whilst illegal channels were commonly reported, the literature offered very limited information on their structure and actual size (van der Geest, 1987).

As previously mentioned, sales volume data are key for assessing the relative importance of sellers within a market. Data on sales volumes across different chain levels were however relatively rare. For example, antimalarial sales volumes reported by 21 wholesalers operating across 6 regions of Tanzania ranged from 2,001 and 27,000 doses per month (CHAI, 2008a). In Benin, the total volume of antimalarial adult equivalent treatment doses (AETD) supplied

annually by the country's three registered private importers was estimated at 999,606 AETDs, equivalent to a total value of US\$ 647,530 (Tougher et al., 2009). Wholesale markets were reported to be relatively concentrated compared to retail markets, especially at the top of the chain where a few suppliers were found to be responsible for most of the volume sold (CHAI, 2008c, Yadav and Ongola, 2007, Yadav and Conesa, 2008). However, only one study on the antimalarial import market in Uganda calculated market concentration measures. The study found that 5 importers accounted for nearly 72% of antimalarial sales with a HHI of just under 0.14, indicating relatively "moderate" market concentration (Yadav and Conesa, 2008).

Interest in working with wholesalers has been relatively limited, with two interventions implemented within the distribution chain, including one that involved training wholesalers and mobile vendors in Kenya and one sales representatives in Madagascar (Goodman et al., 2007).

3.4.3 Price setting in private commercial sector distribution chains

More attention has been paid to measuring antimalarial price mark-ups, especially on first-line treatments for uncomplicated malaria or the most common alternatives at the time of the studies. Evidence of mark-ups on antimalarial drugs at different levels of the chain is summarized in the published manuscript in Appendix 3. It should be noted that these figures are gross mark-ups, including both provider overhead costs and profit margins.

Primary mark-ups refer to the percentage margins that primary suppliers (entry point to the distribution chain) add on top of their purchase prices when they serve intermediate or terminal wholesalers. *Terminal* mark-ups relate to margins added by terminal wholesalers (retailers' direct supply sources) on top of the price at which they obtained the drug, either from primary or intermediate suppliers.

Studies reported price mark-ups within the distribution chain serving pharmacies or/and drug shops, except one that also provided mark-ups within the chain supplying general stores. Overall, mark-ups varied across levels, ranging from 27% to 99% at primary level, 8% at intermediate and 2% to 67% at terminal level. In some settings, mark ups varied depending on the structure of the chain, with somewhat higher mark-ups at a given level observed in a distribution chain made of fewer levels. For example, in Tanzania, when supplying regional

wholesalers, importers added between 27% and 43%, whilst when directly supplying retailers they added between 50% and 67% (Goodman et al., 2007).

In the retail market, price mark-ups on antimalarial drugs have been relatively more researched. They were sometimes very high and varied greatly across outlet type and location, and antimalarial type and packaging. There were four main findings:

- Mark-ups ranged between 3% and 566% in pharmacies, 29% and 669% in drug shops and 100% and 233% in general shops.
- Mark-ups were somewhat higher in rural outlets compared to urban ones. In Zambia, for example, the median ACT mark-up in Lundazi, a rural district was 54% whilst in Kabwe urban district the median was 29%; in Choma, a peri urban district, the median ACT mark-up was, however, much higher than in rural Lundazi reaching 300% (CHAI, 2008c).
- Generics tended to have higher percentage mark-ups, a situation that may not have translated into higher absolute margins given that generics are generally purchased at lower prices than branded products.
- Mark-ups varied across packaging types, with a mark-up of 669% on one loose tablet of amodiaquine compared to 270% on a blistered tablet in Tanzania (Goodman, 2004). Again, assuming that loose tablet prices are lower than packed tablet prices, this may not have automatically translated into higher absolute margins.

In some settings where ACT subsidy schemes have already been implemented, prices were within the range expected by the managers of the schemes. In Senegal, private pharmacies purchased the subsidized first-line ACT from public sector medical stores and added on average 35% to the price of an adult dose, which translated into a retail price only 4% higher than the RRP (Kone et al., 2007, Sabot et al., 2008). In three districts of Kenya, 95.3% of caregivers in the intervention arm who had bought the subsidized ACT reported they paid the recommended retail price of US\$ 0.25, whilst other caregivers said they paid less or more (Kangwana et al., 2011). In two districts of Tanzania, the subsidy scheme was piloted in drug shops and in one of these two districts it was combined with a RRP printed on ACT packs. The subsidy effectively decreased the price of ACT below the price paid by consumers in the control area and below the price of older antimalarials, leading to a large increase in the proportion of antimalarial consumers purchasing ACT in the two intervention areas (from 1% to 44.2% one year later) (Sabot et al., 2009). Surprisingly, ACT prices were higher in the district

with the RRP than in the district without, suggesting caution in future use of this approach for controlling ACT retail prices (Sabot et al., 2008). Overall, relatively little is known about the factors that influence pricing decisions. Only one study used statistical methods to analyse price determinants, examining prices in drug and general retail shops selling antimalarials and painkillers in rural Tanzania (see Section 3.3.9). The study found that higher retail prices were associated with branded and packed products, being sold in general shops (which might have reflected higher prices charged by their terminal supply sources) and higher market concentration (Goodman, 2004, Goodman et al., 2009).

The rest of the literature provided findings from semi-structured interviews. Retail and wholesale mark-ups were reported to be influenced by fixed price or mark-up regulation or, in the absence of regulation, market competition and consumer demand. Wholesale pricing decisions were also said to be influenced by product characteristics, business practices and costs (Chukwujekwu, 2007, RBM, 2007, MMV, 2007). In Uganda, mark-ups were reported to be lower for antimalarials with shorter shelf life (MMV, 2007). In Tanzania, drug wholesalers reported giving discounts to customers who bought drugs in relatively large quantities (Chukwujekwu, 2007), and general wholesalers to customers who purchased drugs alongside other commodities (Chukwujekwu, 2007). One wholesaler also reported adding 6-7% to cover his expenses and 3-4% for profit (Chukwujekwu, 2007).

The available evidence on the private commercial sector distribution chain for antimalarial drugs provides some useful descriptive information. However, there is a lack of nationally representative data, and of analysis of retailers and wholesalers' behaviour notably in terms of price setting. This is an important gap as retailers are likely to remain an important source of malaria treatment and price is likely to be a major obstacle to improve access to quality malaria treatment.

3.5 Summary

This chapter has reviewed three literatures relevant to this thesis: the standard models of markets and competition and the IO field; the methods used for collecting and analysing data on retail and wholesale markets in developing countries; and the empirical evidence on markets for malaria treatment in low and middle income countries. The thesis now turns to the study design and methods used in the thesis.

CHAPTER 4 STUDY DESIGN & METHODS

4.1 Introduction

This Chapter first presents the study design, including the thesis' aims and objectives, analytical framework and scope of research (Section 4.2). Then, an overview of data sources is given (Section 4.3), followed by a description of the institutional setting and intellectual ownership of the thesis (Section 4.4). Finally, aspects of ethical clearance and informed consent are described (Section 4.5) before the methods for data collection and analysis are presented (Section 4.6).

4.2 Study design

4.2.1 Aims and objectives

The main aim of this thesis is to analyse the market for malaria treatment in Cambodia, including the retail market and its distribution chain, with a focus on the private commercial sector, and to draw recommendations for public health policy and future research for improved availability of appropriate and affordable malaria treatment. A further aim is to conduct a comparative analysis of different measurement methods for studying retail and wholesale markets for pharmaceutical drugs in developing countries.

The specific objectives are:

- 1) To describe the structure of retail markets for malaria treatment and analyse product differentiation and non-price competition
- 2) To describe the structure of the private commercial sector distribution chain for antimalarial drugs and analyse product differentiation and non-price competition
- 3) To analyse the intensity of price competition in retail and wholesale markets
- 4) To analyse different empirical methods for identifying and sampling wholesalers and measuring retail and wholesale sales volumes
- 5) To discuss the implications of the interplay between market structure, provider conduct, consumer demand and regulation on the availability, price and quality of malaria treatment and draw recommendations for public health policy and future research.

4.2.2 Analytical framework

The analytical framework used throughout the thesis is built on concepts from the Industrial Organization (IO) literature and standard models of markets and competition (Chapter 2). The primary reason for choosing this field of the economic literature is that it has already proven to be particularly helpful for studying hospital markets in industrialised countries (Gaynor, 2006) and its relevance in low and middle income settings has also been demonstrated in studies of hospital and pharmaceutical markets (Goodman, 2004, Bennett, 1996, Nakamba et al., 2002).

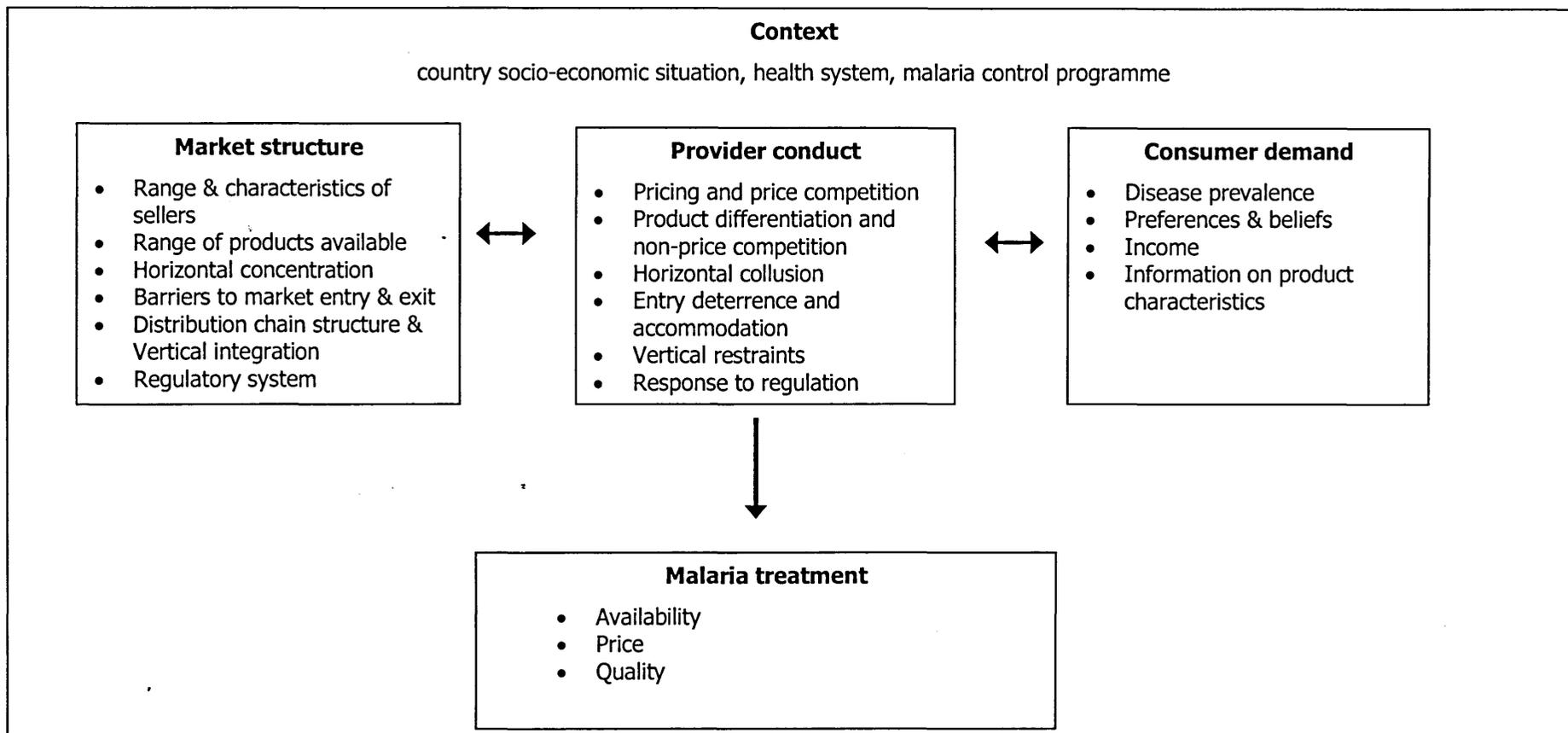
As described in Chapter 2, the IO literature provides useful analytical concepts, notably through the structure-conduct-performance paradigm (SCP), which holds that the structure of the market determines the way firms behave which in turn affect market performance (Scherer and Ross, 1990). In this early perspective more concentrated markets - few large firms with relatively large market shares - were associated with less price competition, higher price mark-ups and higher consumer prices (Demsetz, 1973). Later refinements of the paradigm recognised that the SCP sequence was far from being linear and that the direction of causation between structure and conduct was two-way (Tirole, 1988).

For instance, providers might attempt to shape the structural aspects of markets by colluding with one another on price or quantity produced or through marketing strategies to attract consumers. Collusion is facilitated by high concentration but it may also be found in less concentrated markets, if providers are well organised through physicians' organisations for example. Strategies that aim to change the nature of the product – e.g. deliberate product differentiation - will have key influences on competition in markets where consumers are sensitive to quality attributes. Where consumers can never observe quality or poorly understand the scientific or technical aspects of the product, the decision to purchase might be influenced by the providers themselves and distort competition. Other strategies that may affect competition can originate in the distribution chain where suppliers may impose restrictions on their customers that may ultimately affect retail availability and price. Competition is also not only shaped by current levels of concentration but also by potential new entrants. Where a market has high levels of contestability, firms may have very little market power and influence on the price at which they are paid, even if there are currently few firms in the market. Government might choose to intervene by directing policies towards market structure and conduct, or consumer demand in an attempt to improve the functioning of the market. Government intervention can take various forms including the provision of

products and services, its regulation including provider certifications, business licensing, product registration, quality controls, price and/or mark-ups regulation, taxes or the provision of information to consumers through communications and education campaigns.

The analytical framework used throughout the thesis is presented in Figure 4-1. It draws on previous work from Conteh and Hanson further developed by Goodman (Goodman, 2004, Conteh and Hanson, 2003). Given the focus of the thesis, market outcomes are expressed in public health terms, namely the availability, price and quality of malaria treatment.

Figure 4-1: Analytical framework



4.2.3 Scope of research and data sources

The aims of this thesis are to analyse the market for malaria treatment, including the retail market and its distribution chain, with a focus on the private commercial sector, and to compare different methods for studying private commercial sector distribution chains.

The term *retail market* includes all outlets that provide antimalarial drugs to patients, either at a cost or free of charge, including both health facilities such as hospitals and clinics and shops. The *private commercial retail sector* includes all private for-profit outlet types at which antimalarial drugs are sold to patients, and the public retail sector includes all outlets owned by or working for the Government or for non-governmental not-for-profit organisations (NGO). The term *private commercial sector distribution chain* includes wholesale suppliers who operate from the point where commodities leave the factory gate or port of entry down to those directly supplying retailers. In this thesis, it refers to the chain of private or public suppliers who serve private commercial outlets, and to private commercial suppliers who serve public retail outlets, such that any transactions between public and private commercial sectors are noted. Public suppliers who only supply public retail outlets are not included in the study.

The focus is on the market for different antimalarial drugs and rapid diagnostic tests for malaria (RDT). Antimalarial drug categories include Artemisinin Combination Therapy (ACT), Artemisinin Monotherapy (AMT) and non-Artemisinin Monotherapy (nAMT), in different formulations (tablets, syrups, injectables etc), whether they are used for inpatient or outpatient care. It excludes complementary products, such as drips, water for injections and syringes because of the problems in distinguishing those used for malaria treatment from those with other purposes.

Table 4-1 gives an overview of the data sources that were used for achieving the objectives of the thesis.

Table 4-1: Data sources

	Sampling frame and sample size
Thesis' Objectives 1,2,3 - Economic analysis of retail and wholesale markets for malaria treatment	
Outlet Survey (OS), June-July 2009	
Cross-sectional survey of retail outlets stocking antimalarial drugs at the time of visit or in the preceding 3 months. Data on retailer's characteristics and operations; top 2 supply sources for antimalarials in last 3 months; range of antimalarial drugs stocked and blood testing services offered, including microscopy and rapid diagnostic tests (RDT); for each antimalarial and RDT purchase and selling prices; for each antimalarial stocked recall of volumes sold over previous week.; for microscopy services selling price only.	<i>Sampling frame:</i> all private, public and NGO outlets operating in a representative sample of 38 malaria-endemic sub-districts (health facilities' catchment areas) with the potential of selling antimalarial drugs. <i>Sample size:</i> all outlets stocking antimalarial drugs at the time of visit or in past 3 months: 792 retailers interviewed.
Supply Chain Survey (SCS), August-November 2009	
Cross-sectional survey of suppliers operating in the chain that served retailers interviewed during OS. Data on wholesalers' characteristics and operations; top 2 supply sources for antimalarials and RDT in last 3 months; and for each antimalarial and rapid diagnostic test stocked purchase & selling prices, recall of volumes sold over previous week and recall of last purchase value.	<i>Sampling frame:</i> all supply sources mentioned as top 2 suppliers for antimalarial drugs by retailers operating in a random sample of 20 sub-districts surveyed by the OS. <i>Sample size:</i> 95 wholesalers interviewed.
Semi-Structured Interviews (SSIs), August-November 2009	
Semi-structured interviews with retailers and wholesalers surveyed during OS and SCS. Data collected for defining retail and wholesale markets and investigating retailers' and wholesalers' operations, in terms of product differentiation strategies and pricing decisions. As part of thesis' Objective 4 below, data on all supply sources for antimalarial drugs used by retailers and wholesalers in last 3 months, including for each supplier name and share of antimalarials purchased from each supplier.	<i>Sampling frame:</i> all private commercial retailers and wholesalers interviewed during OS and SCS. <i>Sample size:</i> 33 interviews, including 11 with retailers and 22 with wholesalers, stratified by outlet type, location and characteristics.
Thesis' Objective 4 – Comparative Analysis of empirical methods for studying retail and wholesale markets	
Sales Level Survey (SLS), August-November 2009	
Cross-sectional survey of retailers and wholesalers using the retail audit technique, which consisted of visiting each sampled outlet 2 times with a 2-week time interval between each visit. At the first visit, data on antimalarial and RDT quantities stocked of each product were collected. At the second visit, data on quantities stocked and quantities delivered between 1 st and 2 nd visits, quantities thrown away/transferred to other shops or sent back to wholesalers or confiscated were collected for each product in stock, including products in stock at either or both visits. Volumes sold of each product in-between 2 visits were calculated. Semi-structured interviews with SCS and SLS fieldworkers in the form of semi-formal group discussions to collect fieldworkers' experiences in collecting sales volumes data during SLS and SCS, combined with fieldworkers' written diaries of their visit to each outlet using large blank comment boxes on each SCS and SLS questionnaire.	<i>Sampling frame for the SLS survey:</i> All private commercial retailers and wholesalers who participated in OS and SCS. <i>Sample size:</i> 105 providers interviewed, including 66 retailers and 39 wholesalers. <i>Sample frame for the SLS group discussions:</i> All fieldworkers who participated in both SCS and SLS and all completed diaries. <i>Sample size:</i> 5 group discussions conducted each with 8 data collectors; 105 diaries.
Snowball Census (SC), August-November 2009	
Census of all wholesalers operating in districts visited during the SCS. Wholesalers identified using the "snowball technique" by asking wholesalers interviewed during the SCS about the name, location, contact details, outlet type and stocking practice (antimalarial and/or RDT) of all other wholesale businesses operating within the district. "Snowballed" wholesalers were then visited and interviewed to verify information on name, location, outlet type and stocking practices, and asked if they could identify any more additional wholesalers in the district.	<i>Sampling frame:</i> 95 private commercial wholesalers interviewed during the SCS. <i>Sample size:</i> 63 snowball censuses completed.
Key Informant Interviews (KIIs), August-November 2009	
Semi-structured interviews with government officials and organisations involved in the supply of antimalarials in Cambodia. Data collected on antimalarial chain structure and number of private providers operating at each level. Official lists of registered drug outlets were also collected.	<i>Sampling frame:</i> all organisations and authorities involved in activities related to the supply of antimalarials in Cambodia. <i>Sample size:</i> 10 interviews completed.

4.3 Institutional setting and intellectual ownership

The genesis of this thesis goes back to the development of the PhD research proposal submitted to the UK Medical Research Council in January 2007. Later developments of the thesis scope, study design, data collection tools and data analysis plans were undertaken within the framework of the ACTwatch project that was launched in March 2008 and which provided additional financial support and data sources for the PhD research.

The ACTwatch project is a collaborative research study undertaken by the London School of Hygiene and Tropical Medicine (LSHTM) and Population Services International (PSI). Above mentioned OS, SCS, SSIs, KIIs are 4 core components of the ACTwatch project. A fourth component is a household survey that collected data on treatment seeking behaviours. Each of these 5 study components were implemented in Cambodia and six African countries (Benin, Democratic Republic of Congo, Madagascar¹⁸, Nigeria, Uganda and Zambia). PSI was responsible for the design and implementation of the household survey and OS and LSHTM for that of the SCS, SC, SSIs and KIIs. In Cambodia, these were supplemented by a comparative analysis of methods for studying retail and wholesale markets for antimalarial drugs, including the SLS and additional SSIs and KIIs designed and implemented by the author. Table 4-2 gives an overview of the author's (EP's) participation and responsibilities in the design, implementation and analysis of data sources.

Table 4-2: Overview of the author's participation and responsibilities

Data Source	Participation and responsibilities		
	Research design	Data collection	Data analysis
OS (Objectives 1 & 3)	PSI	PSI	EP ¹
SCS (Objective 2)	EP,BP,ST,KH,CG	EP	EP ³ ,BP,ST,KH,CG
SSIs (Objectives 1 & 2)	EP ² ,BP,ST,KH,CG	EP	EP
SC (Objective 4)	EP,BP,ST,KH,CG	EP	EP
SLS (Objective 4)	EP	EP	EP
KIIs (Objective 4)	EP,BP,ST,KH,CG	EP	EP

EP is Edith Patouillard; BP is Benjamin Palafox; ST is Sarah Tougher; KH is Kara Hanson; CG is Catherine Goodman; PSI is Population Services International; ¹Data from the outlet survey presented in Chapter 3 was analysed by PSI. ²Additional questions were added for the purpose of the PhD. ³Analysis of concentration in wholesale markets conducted solely by the author.

¹⁸ SCS not implemented in Madagascar.

The author was involved in the research design of all components, except the OS, and solely responsible for the SLS design. In Cambodia the author conducted all data collection except the OS, and was sole analyst for all results presented in the thesis except the SCS where she was the lead analyst in collaboration with other ACTwatch team members.

4.4 Ethical clearance and informed consent

The research received ethical approval from the ethics review committee of the LSHTM and the Cambodian National Ethics Committee for Health Research (Appendix 4).

Before the start of all interviews, informed consent was obtained from each research participant in a language that she/he understood. Trained interviewers visited wholesalers and retailers and sought to speak with the person most knowledgeable about the antimalarial and RDT businesses. Before the start of all interviews, they informed respondents about the study by providing an information sheet stating their name, institutions involved, aims of the study, nature of questions to be asked and length of the interview. Interviewers emphasized that a respondent's participation was voluntary and could be stopped at anytime without any negative implications if a respondent wished to change his/her mind over the course of the interview. Interviewers also emphasized that a respondent could refuse to answer any specific question or pause the interview at anytime (e.g. for serving customers). They informed each respondent that there was no individual benefit in taking part in the study. All respondents were given the opportunity to ask questions at any time before, during and after the interview and received the contact details of the local research coordinator. Interviewers emphasized that individual information was confidential and that no information would be passed on to the regulatory authorities or any individual outside the research team. Interviewers then invited respondents to participate in the study and they asked for informed consent, witnessed by a member of the research team. During SSIs, only written notes were taken, rather than tape recordings as many of the issues to be discussed in the interviews could be judged sensitive for commercial or regulatory reasons. Tape recording respondents' answers could have made respondents uncomfortable and introduced a bias in their answers or lead respondents to refuse discussing some of these issues.

4.5 Methods for data collection and data analysis

In this section, we describe in detail the methods used for achieving Objectives 1, 2 and 3, for which results are presented in Chapters 5, 6 and 7. A detailed description of methods used for achieving Objective 4 (i.e. the comparative analysis of measurement methods for studying retail and wholesale markets of pharmaceutical drugs in low income settings) is given at the beginning of Chapter 8 before presenting the results that pertain to this objective. Data collection tools are available in Appendix 4.

4.5.1 Outlet survey

4.5.1.1 Overview

For the purpose of the OS, PSI divided Cambodia into 2 strata: one stratum covered areas with Suspected or Confirmed Multi-Drug Resistance (MRDSC stratum, roughly North/North-West provinces), and the other areas Free of MDR (MDRF stratum, roughly South/North East provinces) (PSI, 2008c). In each stratum, PSI randomly sampled 19 sub-districts using a probability proportional to size (PPS) approach through which more populated sub-districts had a higher chance of being selected (Figure 4-2). Sub-districts were defined as the catchment areas of public health centres with reported malaria cases in 2008, each covering a population of around 10,000 to 15,000 inhabitants. In each of the 38 sub-districts, PSI conducted a census of all government, NGO and private commercial outlets that had the potential to dispense antimalarials and invited outlets that stocked antimalarials at the time of the survey or in the past 3 months to participate in the OS¹⁹. A total of 792 retailers were identified to stocked antimalarial drugs and all were successfully interviewed²⁰, of which 644 (81.3%) were private commercial outlets and 148 (18.7%) government outlets. There was no

¹⁹In order to estimate antimalarial availability and price across different outlet types, PSI supplemented the sample by a booster sample that included all government outlets operating in the operational district of the sampled sub-districts. The use of a booster sample is a procedure used by PSI across all ACTwatch outlet surveys to ensure adequate representation of relatively rare but important antimalarial provider types. Booster government and NGO outlets that stocked antimalarials were identified through a census in the relevant districts. Data pertaining to the booster sample were not used in this thesis because the focus is on private commercial outlets which were not surveyed in the booster areas. In this context, results pertaining to the retail market for malaria treatment that are presented in Chapter 5 draw on a different sample than those presented in Chapter 3.

²⁰ There was no refusal to participate in the OS from retailers operating in the 38 sub-districts identified to stock antimalarial drugs.

particular drug combination in the treatment guidelines for uncomplicated malaria in areas of low drug resistance issued by the World Health Organization (WHO). Where WHO treatment guidelines did not exist, AETDs were based on the product manufacturer's treatment guidelines. In the case of ACT, as the treatment consists of 2 or more active antimalarial ingredients packaged together (either co-formulated or co-blistered), the strength of the artemisinin-based component was used as the principal ingredient for the AETD calculations. Information collected on both the medicine strength and unit size, as listed on the product packaging, was then used to calculate the proportion of AETDs contained in each unit.

4.5.1.2 Data analysis

To account for the differences in sampling probabilities across sub-districts selected using PPS and in strata of varying size, observations were weighted using stratum-specific weights calculated for each sub-district sampled.

The weight for sub-district i within stratum j was given by:

$$w_{ij} = \frac{N_j}{n_j \times N_{ij}}$$

with N_j the population in stratum j , N_{ij} the population of sub-district i in stratum j and n_j the number of sub-districts sampled²¹ in stratum j .

Stratum-specific weights calculated for each sub-district sampled are available in Appendix 6. Weights were applied during data analysis using STATA 11 commands *aweight* or *svyset* depending on the calculations performed. Proportions were calculated using STATA 11 survey estimation command *svy:tab* and differences in proportions were tested for significance using the Pearson chi-squared statistic with the Rao and Scott correction to account for the survey design (Stata Inc., 2003). Median and inter-quartile range (IQR) were calculated using the STATA 11 commands *tabstat* and *aweight*²². Differences in medians were investigated using the Hodges-Lehmann method, which consists of calculating the median value of the difference between 2 variables that are randomly selected within 2 independent populations (Newson,

²¹ The number of sub-districts sampled in the stratum was included in the formula because the probability that a sub-district was selected from a given stratum depended on the number of sub-districts selected from the stratum, with a greater probability that a given sub-district was selected the more sub-districts were sampled from the stratum.

²² providing the same results as the STATA 11 commands *_pctile* combined with *pweight*

2002) (e.g. observations are randomly selected within the drug shop population and within the population of all other retailer types.). Median differences and 95% confidence intervals were calculated using STATA 11 *cen dif* command (Newson, 2002)

4.5.1.3 Measuring the size of the antimalarial drug market

The size of the market for antimalarial drugs refers to the total volumes and values of antimalarial drugs dispensed annually in Cambodia. It was calculated as follows. There were 1259 antimalarial drug observations and for 185 observations sales volume data were missing²³ (e.g. respondents did not remember or refused to provide the information). To avoid underestimating the volumes of antimalarial drugs sold, missing data were imputed using an imputation model developed in STATA 11. We used the command *mi impute* to generate a set of plausible values that were used for “filling in” missing sales volume observations. The mean matching imputation method (STATA 11 command *mi impute pmm*), a partially parametric method for imputing observations of a continuous variable that does not follow a normal distribution was used (Schafer, 1999). This method combines a standard linear regression of sales volumes on a set of explanatory variables to obtain predictions, which are then used as a distance measure for selecting the observation with the smallest difference between the linear prediction for the missing value and that for the complete values (StataCorp., 2009).

Sales volumes were estimated using the following explanatory variables: sub-district, stratum, area type²⁴, antimalarial category²⁵, brand name, generic type, dosage form and manufacturer. These explanatory variables were selected under the assumption that they would explain most of the variation in sales volumes across outlet and antimalarial types. A similar approach was used in an earlier study that estimated antimalarial sales volumes at private shops in rural Tanzania (Alba et al., 2010b). Given the relatively small number of missing sales volume observations (185 missing observations out of a total of 1259 observations (around 14.5%)), the imputation model was run 5 times in order to obtain 5 imputations per missing value, and each missing value was imputed with the average value of the 5 imputations. Increasing the number of imputations from 5 to 10 and to 50 had little effect on the average values as has been reported elsewhere (Schafer, 1999).

²³ Out of the 185 missing values, 89 (48%) were nAMT, 48 (26%) ACT and 48 (26%) AMT. Missing values were most frequent at village shops (28% of all missing values), followed by public health facilities (25%), and least frequent at pharmacies/clinical pharmacies (8%).

²⁴ Rural or urban area

²⁵ ACT, AMT, nAMT

For each outlet, we calculated the total volume sold for the week preceding the survey by summing all antimalarial sales volume observations. Then, for each sub-district, we calculated the total volume sold for the week preceding the survey by summing the total volume sold by all outlets operating in that sub-district. The total sales volume in sub-district *i* within stratum *j* was multiplied by its corresponding analytical weight and sales totals were summed under each stratum in order to obtain 2 stratum-specific total sales volume estimates. Given that the 2 strata covered the whole population at risk of malaria in Cambodia, the total antimalarial sales volume for the week preceding the survey across all malaria endemic areas was calculated as the sum of the 2 stratum-specific antimalarial sales volume estimates.

An annual sales volume estimate was calculated by scaling up the weekly total estimate to a whole year, accounting for monthly variations in malaria transmission risk by using data on the number of cases treated each month in the public sector (CNM, 2009a): the weekly sales volume estimate was scaled up pro-rata to a monthly estimate assuming constant weekly sales within each month, by using the ratio of the number of days during the month of data collection divided by the number of days in a week; scale-up factors were then calculated for each month of the year as the ratio of the number of cases treated each month in the public sector to that treated during the month of data collection (Appendix 7); the annual antimalarial volume dispensed was then obtained by calculating the sum of the 12 monthly sales volume estimates. It was not possible to calculate stratum-specific annual sales volume estimates in the absence of data on patterns of malaria transmission risk in MDR free and MDR suspected/confirmed areas respectively.

Annual sales values were calculated following a similar approach. Sales values were estimated in each outlet by multiplying each antimalarial sales volume by its selling price in that outlet. For around 6% of all sales volume observations, price data were missing and estimated using the median selling price of that antimalarial generic type and dosage form for the corresponding outlet's category (e.g. sales of artemether injection sold at a drug shop were valued using the median selling price of artemether in injection form for the drug shop outlet category). For around 0.5% of all sales volume observations, there was no corresponding median retail selling price because the antimalarials were rarely stocked in a given outlet category. In such cases, sales volumes were valued using the median price for the given antimalarial generic type in the most similar outlet category (e.g. sales values of mefloquine at pharmacies/clinical pharmacies were estimated using mefloquine price at drug shops). For antimalarial drugs sold at highly subsidized prices or provided free of charge, their value was

estimated using procurement costs inclusive of carriage and insurance costs for delivering the drugs to in-country warehouses, collected from the Ministry of Health and PSI (Appendix 8). Procurement costs were inflated by 15% to account for in-country storage and other distribution costs (Goodman, 2004). The ACT ASMQ provided free of charge at government outlets and at a subsidized price to private commercial outlets was valued using the same procurement cost across both sectors as they used the same procurement process. One could argue that a lower factor should be used to account for PSI's storage and distribution costs because one may expect an NGO institution to be more efficient than the MOH. However, in the absence of such evidence and in the context where the MOH may have benefited from economies of scale in distributing antimalarials with other products, procurement costs were inflated by the same factor for both sectors.

4.5.1.4 Defining economic retail markets

Economic markets can be defined on product and geographic dimensions (Section 3.3.5). In the thesis, a combination of different approaches was used and is described in detail in Chapter 5 in which results on the structure of retail markets are presented.

4.5.1.5 Measuring retail market concentration

Market concentration was measured using the Herfindahl-Hirschman index (HHI) defined as the sum of the squared market shares of all the firms operating in the market (Section 3.3.6). The HHI was compared with US anti-trust guidelines, which indicated that a market with an HHI below 0.15 could be considered as unconcentrated, between 0.15 and 0.25 moderately concentrated and above 0.25 highly concentrated²⁶ (U.S. Department of Justice and Federal Trade Commission, 2010). Whilst these thresholds are essentially based on the experience of US anti-trust agencies, they provide a useful guide for starting an analysis of market competition. In cases where it was not possible to calculate the HHI, concentration ratios were used (Section 3.3.6).

Market concentration measures were calculated on antimalarial sales volumes and values including both public and private outlets. Public sector sales were included in the measure of concentration based on evidence from SSIs that some private shopkeepers perceived government providers to compete in the provision of malaria treatment (see Section 5.2.4).

²⁶ These thresholds for interpreting the degree of concentration using the HHI were released in August 2010. Previous guidelines used lower thresholds (Section 3.3.6)

There was no indication of ownership of several private shops by the same provider within a given market so market share calculations were performed at the level of the outlet. Conversely, government providers operating in the same market were not assumed to compete with one another so the quantities/values of antimalarial drugs that they dispensed were treated as those of a single outlet and summed.

4.5.1.6 Measuring retail market accessibility

The geographical accessibility of retail markets is likely to be associated with competition but it is not a result of competition. For example, fewer providers, and therefore less competition are expected in more remote areas. In addition, it is likely to be more costly to obtain drug supplies in more remote areas than in more accessible ones (e.g. transport costs). Therefore, the analysis of competition on retail availability, price and quality of malaria treatment needs to control for the geographical accessibility of retail markets.

Accessibility was measured as the time required to travel in a 4-wheel drive vehicle from each market to the closest main commercial area. Main commercial areas were identified using 2008 census data on the total number of commercial establishments in each province available from the Cambodia National Establishment Listing. The Cambodia National Establishment Listing defines an establishment in conformity with the International Standard Industrial Classifications of the United Nations as:

'an enterprise or part of enterprise which is situated in a single location and in which only a single (non-ancillary) productive activity is carried out or in which principal productive activity accounts for most of the value added.' (NIS, 2009).

Provinces where 5% or more of all establishments nationwide operated were considered to be main commercial areas. The 5% cut-off was based on discussions with informants working at the Ministry of Planning and PSI Cambodia, supplemented by the author's own observations during fieldwork. A total of eight provinces each accounted for more than 5% of all establishments operating nationwide: Phnom Penh, Kampong Cham, Kandal, Takeo, Prey Veng, Siem Reap, Battambang and Kampong Thom. These provinces were therefore defined as main commercial areas.

The travel time from each market to the closest commercial area was estimated by calculating the average time required to travel from all the villages located in each market to the closest main road (i.e. the sum of minutes required to travel from each village to the main road divided by the number of villages), plus the estimated time to travel from the main road to the closest main commercial area, using the province's capital city as point of arrival (thereafter referred as closest commercial centre). This approach was based on the assumption that most commercial establishments within a province were located in each province's capital city. Data on villages covered in each market were collected from the Health Coverage Plan 2004/5, supplemented by KIIs with PSI Cambodia's staff members (in order to check whether coverage had changed since the publication of the Health Coverage Plan). Data on travel time between each village to the main road were collected from the 2004 SEILA household survey, again supplemented by KIIs with PSI Cambodia's staff members. Data on travel time from each main road to the closest commercial centre were estimated through KIIs with PSI staff members and during fieldwork travels for conducting the SLS and SSIs with retail shopkeepers.

4.5.1.7 Assessing malaria transmission risk level in retail markets

Malaria transmission risk is also an important characteristic that needs to be considered in the analysis of competition in retail markets for malaria treatment in Cambodia. Transmission risk is likely to be associated with retail competition but is not due to competition. For example, markets at higher malaria transmission risk may be more contestable than those at lower risk. In addition, as mentioned in Chapter 3, malaria control activities in Cambodia tend to be more intense in areas at higher transmission risk, for instance through the introduction of Village Malaria Workers (VMWs).

Following the MOH's malaria transmission risk categorisation (Section 3.5.2), markets were classified at "high risk" of malaria transmission if they were located less than 250 meters from the forest, at "moderate risk" if located within 250 meters and less than 1 kilometre from the forest and at "low risk" if located 1 kilometre or more from the forest. For markets that covered several villages with different risk levels, the number of people living in the different risk level categories was calculated using 2008 census data (NIS, 2008). Markets were finally assigned the level of risk that was most common in that area in terms of number of inhabitants exposed.

4.5.1.8 Calculating retail price mark-ups

Summary estimates of retail selling prices per AETD for different antimalarial categories and different retail outlet types were analysed by PSI and have been reported elsewhere (ACTwatch Group, 2009b) (see Section 2.6 also). For this thesis, median purchase prices and price mark-ups and IQR for one antimalarial AETD were calculated. Retail percentage mark-ups were calculated for each AETD as the difference between selling price and purchase price, divided by purchase price, and retail absolute mark-ups as selling price minus purchase price. For the calculation of absolute price mark-ups, prices were converted using the average exchange rate during the OS period (9 June to 8 July 2009) [4,248.24 Cambodian Riel to US\$ 1] (www.oanda.com). Retail price mark-ups were analysed using a regression model based on the ordinary least squares (OLS) method. The methods used for developing the model are described in detail in Chapter 7.

4.5.2 Supply chain survey

For the SCS, we randomly sampled 20 sub-districts (10 in each stratum) out of the 38 sub-districts surveyed by PSI during the OS (Appendix 9). This approach was used because of logistic and time constraints. The sampling procedure for wholesalers used the list of all antimalarial supply sources reported by retailers as their two top antimalarial suppliers (termed the *terminal* wholesalers) during the OS administered by PSI. From these data, a list of all terminal wholesalers mentioned was created and all these terminal wholesalers were visited and invited to participate in the SCS. Wholesalers were eligible to participate if they had either an antimalarial or RDT in stock at the time of interview, or if they reported having stocked either antimalarials or RDTs in the three months prior to interview. During the interview, eligible wholesalers were also asked about their top two supply sources for antimalarials (termed the *intermediate-1* wholesalers). From these data, a list of all intermediate-1 wholesalers mentioned was created. All these intermediate-1 wholesalers were visited and invited to participate in the SCS, during which, as at previous levels, they were asked about their two top supply sources for antimalarials (termed the *intermediate-2* wholesalers). This process was repeated until the factory gate or port of entry was reached.

Where horizontal trading was identified within the distribution chain, with for example terminal wholesalers purchasing antimalarial drugs from other wholesalers who had already been identified from the OS as terminal wholesalers, the SCS was not administered again to this wholesaler, though the relationship was noted and accounted for in the analysis. However,

in the case where horizontal trading was identified at the retail outlet level (for example, a retailer identifies another retailer as the source of their antimalarials) the SCS was administered to the source of supply, even if they had already been surveyed during the OS, because the questions asked in OS and SCS were different.

The SCS questionnaire was used for collecting data on each wholesale business' characteristics and operations and on the wholesalers' top two supply sources for antimalarials and RDTs. Inventory sheets were used for collecting data for each antimalarial/RDT stocked on brand name, generic name and strengths (for antimalarials), package type and size, recall of volumes sold over the week before the survey, recall of last purchase value and selling and purchase prices.

The questionnaire, information sheet and consent form were piloted in Uganda in January 2009. Tools were further developed by the author for the purpose of the thesis and revisions were made to account for the specificities of the Cambodian context (Appendix 4). All data collection survey tools were translated into Khmer by a trained native speaker and back translated into English to identify any translation errors. Tools were piloted by fieldworkers recruited and trained by the author. The SCS was implemented shortly after the OS, from August to November 2009.

4.5.2.1 Data analysis

A challenge in the analysis of wholesalers is their classification into sub-groups, as in practice many are likely to operate at several levels of the distribution chain. Two approaches were therefore used for describing and analysing the distribution chain:

- To describe the structure of the chain, wholesalers were classified into mutually-exclusive categories (MECs) defined by the levels they supplied. For example, wholesalers supplying retailers only, wholesalers supplying retailers and terminal wholesalers only, and wholesalers supplying intermediate and terminal wholesalers only.
- For analytical purposes, wholesalers were grouped into 2 broader and overlapping categories: one including wholesalers supplying retailers and one for wholesalers supplying wholesalers. Some wholesalers may therefore be included in both analytical categories. This second approach for classifying wholesalers addresses the issues of individual MECs including very few wholesalers. Furthermore, this approach reflects

the actual operations of wholesalers in the distribution chain. In this context, it was not possible to conduct statistical tests of difference in key indicators (e.g. price mark-ups) between the wholesaler analytical categories.

4.5.2.2 Calculating wholesale sales volumes

As for retail sales volumes, wholesale volumes were calculated on the basis of AETDs. RDT wholesale sales volumes were calculated in terms of the number of RDT units sold. A total of 230 antimalarials were surveyed, of which 9 (4%) had missing sales volumes²⁷ that were imputed by conducting 5 imputations using STATA 11 *mi impute pmm* command on a set of provider and product characteristics, including generic name, antimalarial category²⁸, brand, dosage form, outlet location (district), number of staff employed, whether wholesaler imports, provides credit, supplies retailers and finally MEC. For RDT, no imputation procedure was required as there was no missing data.

In the context of overlapping distribution chain levels, it was not possible to calculate the total volume of antimalarials flowing down the chain without the risk of overestimation (i.e. wholesalers often sell to each other, sales volume of a given pack could be counted several times). Three alternative summary measures of wholesale sales volumes were developed:

- The median volume sold for the different antimalarial categories available in the distribution chain across all wholesalers
- The median volume sold of the different antimalarial categories across those wholesalers who stocked at least one antimalarial within the particular category at the time of interview.
- The proportion of wholesalers selling at least one antimalarial drug the week before the survey who reported a particular antimalarial drug as his top selling antimalarial based on sales volumes data collected for each antimalarial in stock at the time of the survey, as a proxy to the relative importance of different antimalarial drugs sold in the distribution chain.

²⁷ At outlets not stocking antimalarials on the day of interview, sales volumes were set to zero for all antimalarial categories. At wholesale outlets with no antimalarials of a specific category in stock at the time of the survey, sales volumes for the past week were assumed to be zero for that category. At wholesale outlets without information about the type of antimalarials stocked (because of refusals to participate in the study or to provide information on the type of antimalarials stocked or because of interrupted interviews), sales volumes were treated as missing and therefore imputed.

²⁸ ACT, AMT, nAMT

4.5.2.3 Calculating wholesale price mark-ups

Because it is common for wholesalers to vary their prices with the volumes they sell, minimum, mid-point and maximum mark-ups were calculated using data on wholesale purchase price and maximum and minimum selling price charged for one unit. The wholesale *maximum* percentage mark-up was calculated as the difference between the highest wholesale selling price (that is the price of the minimum volume sold wholesale) and the wholesale purchase price, divided by the wholesale purchase price. The wholesale *minimum* mark-up was calculated as the difference between lowest wholesale selling price (that is the minimum price charged for wholesale sales) and wholesale purchase price, divided by wholesale purchase price. The wholesale percent *mid* mark-up was calculated as the difference between the *average* wholesale selling price (i.e. mean between the maximum and minimum wholesale selling price) and wholesale purchase price. Wholesale absolute mark-ups were calculated for each product following the same approach as for percent mark-ups (i.e. high-, low-, mid-selling price minus purchase price). Prices were converted using the average exchange rate during the data collection period for wholesale purchase prices (21 August to 1 November 2009) [4,239.76 Cambodian Riel to US\$ 1] (www.oanda.com).

4.5.3 Semi-structured interviews

The review of methods for studying private commercial markets for antimalarial and pharmaceutical drugs in developing countries (Section 2.3) indicated that several studies have used SSIs for identifying providers, defining economic markets, assessing market contestability, collecting price mark-ups and investigating price determinants. These studies demonstrated that qualitative data have the potential to enhance our understanding of the operation of markets that have been little researched. More generally, it has been argued that qualitative methods can improve the application and interpretation of economic theory in health systems research (Coast et al., 2004).

SSIs were conducted with retailers and wholesalers to better understand private commercial providers' behaviour, notably in terms of their stocking and pricing practices and to collect data on providers' perceptions and opinions on sensitive commercial and regulatory issues not amenable to quantitative research (Conteh and Hanson, 2003). Data on providers' accounts of their own behaviours were used to triangulate quantitative summary measures obtained from the analysis of OS and SCS data and were used in their interpretation, notably for antimalarial and RDT availability and pricing, supplier choice and providers' responses to government

regulatory and non-regulatory interventions. In addition, qualitative data informed the generation of hypotheses to be tested for the analysis of retail price mark-up determinants (Chapter 7).

Fluency in Khmer would have been ideal for conducting our SSIs (Green and Thorogood, 2004). However, it was not possible for the author to reach such a level over the course of the research study. To address this issue, all SSIs were conducted by the author with the assistance of a local interpreter with an excellent command of the English language. Simultaneous translation was used, with each question translated from English to Khmer and respondents' answers translated from Khmer to English. The same interpreter was used for all the SSIs conducted over the course of the research. Prior to data collection, the translator was trained on the research aims, objectives and data collection tools. The interview guide was developed to cover topics on key aspects of market structure (type and provenance of customers, type and location of competitors, barriers to market entry and exit), provider conduct (delivery services, credit facilities, competitive strategies, vertical restraints, collusion, supplier choice, cost structures) and providers' perceptions and opinions of regulations. However, a flexible approach was kept during the interviews to provide the opportunity to collect data on issues that may not have been specified in the analytical framework described Section 4.2.2. In addition, providers were asked to reflect on the challenges and risks they faced in the provision of malaria treatment and were given the opportunity to share suggestions on how to improve their operations and also malaria control in Cambodia. As many of the issues that were discussed were sensitive for commercial or regulatory reasons, interviews were not tape recorded and only written notes were taken by both the candidate and the interpreter. After each interview, the author and her interpreter reflected on their own experience and impressions of the interview and issues were clarified where required.

In order to capture the full range of providers, a sub-sample of 33 private commercial providers was interviewed, including 11 retailers and 22 wholesalers. The sample of retailers was purposively selected using OS data: we selected primarily retailers that had been interviewed during the OS and who had mentioned a supplier interviewed during the SCS (i.e. the sampling frame included all retailers operating in the 20 sub-districts sampled for the SCS). We sampled at least one private commercial retailer within each retail outlet type identified during the OS, including pharmacies/clinical pharmacies, drug shops, mobile providers, grocery stores and village shops. The sample was stratified across outlet type, resistance strata (i.e. MDRF stratum or MDRSC stratum), accessibility levels (defined as the travel time from each

market to the closest commercial centre) and whether antimalarials, ACT and RDT were stocked (Table 4-3). As there were few retail outlets located in urban areas, we interviewed 2 additional providers, including one in Phnom Penh City and one in Kampong Cham city.

Table 4-3: Overview of the characteristics of retailers who participated in semi-structured interviews

	All	Pharmacy/ Clinical Pharmacy	Drug Stores	Mobile Providers	Grocery Stores	Village Shops
Total sample	11	2	3	4	1	1
Characteristics:						
Stratum:						
MDR-Free	7	1	2	2	1	1
MDR-Suspected/Confirmed	3	0	1	2	0	0
Non-endemic area	1	1	0	0	0	0
Area type:						
Urban	2	1	1	0	0	0
Rural	9	1	2	4	1	1
Located in:						
Accessible market	4	1	1	1	0	1
Moderately accessible market	2	1	1	0	0	0
Remote market	5	0	1	3	1	0
Stock antimalarial at time of OS	9	1	3	4	0	1
Stock ACT	8	1	3	4	0	0
Stock RDT	5	1	2	2	0	0

Source: ACTwatch Outlet Survey data, 38 sub-districts, June 2009

As for sampling wholesalers, a question on whether wholesale respondents would be interested in participating in SSIs was added at the end of the SCS questionnaire and a list of wholesalers who agreed to do so was created. The wholesale sample was stratified across chain levels, whether antimalarials, ACT and RDT were stocked, whether antimalarials were imported and whether the outlet reported selling antimalarials directly to patients (Table 4-4).

Table 4-4: Overview of the characteristics of wholesalers who participated in semi-structured interviews

	ALL	Mutually Exclusive Categories of Wholesalers (WS)					Structured Survey Analytical Categories	
		Supply Retailers	Supply Retailers & Terminal WS	Supply Terminal WS	Supply Intermediate & Terminal WS	Supply Intermediate & Terminal WS & Retail	Supply Retailers	Supply WS
Total sample	22	15	2	3	1	1	18	7
Characteristics:								
Stock antimalarials at time of SCS	18	13	2	2	0	1	18	5
Stock ACT	17	12	2	2	0	1	15	5
Stock RDT	16	11	2	2	0	1	14	5
Sell to end consumers	17	13	2	2	0	0	15	4
Import	3	0	0	1	1	1	1	3

ACT is for artemisinin combination therapy; RDT is rapid diagnostic test for malaria.

Source: ACTwatch Supply Chain Survey data, August-November 2009.

During data analysis, a deductive approach was used to test predefined hypotheses generated by the analytical framework. Key themes related to market structure, provider conduct, consumer demand, regulation and the broader policy context were used to develop an initial coding scheme. Interview notes were read and data coded under the relevant themes using NVIVO 8. A flexible approach to framework analysis was however adopted in order to identify additional themes and sub-themes. Data on the impact of the candidate on the research process or “Hawthorn effect” (Pope and Mays, 1995) were also coded to ensure reflexivity during the analysis of findings. The coding scheme developed during the analysis of the qualitative data is presented in Appendix 10.

4.6 Summary

The main aim of this thesis is to analyse the market for malaria treatment in Cambodia, including retail and wholesale markets, with a focus on the private commercial sector, and to draw recommendations for public health recommendations and future research. A further aim is to conduct a comparative analysis of different measurement methods for studying key aspects of markets of pharmaceutical drugs in general in developing countries. To address these aims, a mix-method approach was used to collect data through cross-sectional surveys and SSIs of retailers and wholesalers, supplemented by a sales level survey, snowball census, and interviews with key informants including policy makers, people working in organisations involved in the provision of antimalarial drugs, and finally fieldworkers. Results are presented in the 4 following chapters, starting with an economic analysis of retail markets in Chapter 5.

CHAPTER 5 RETAIL MARKETS FOR MALARIA TREATMENT

5.1 Introduction

This chapter starts the analysis of competition in retail markets for malaria treatment. It presents the key structural aspects of the market, including the number and range of antimalarial drug providers, antimalarial drug sales volumes and values, market characteristics (accessibility, malaria transmission risk, and concentration), and entry and exit barriers. The chapter then assesses the extent of product differentiation and explores retailers' non-price strategies for differentiating their products and services from that of their competitors in order to attract custom. Price competition, which is the other key dimension of provider conduct will be analysed in Chapter 7. It may be seen more conventional from the perspective of economic theories to study price competition first. However, the analysis of product differentiation and non-price competition can provide insights on the structural factors that provide retailers with market power and retailers' strategies to maintain or gain market power and temper price competition. Furthermore, the study of retail price competition will draw not only on factors peculiar to retail markets but also on key aspects of the distribution chain, in terms of structure and suppliers' conduct, which will be presented in Chapter 6. In this Chapter, for the analysis of retail market structure and retailers' conduct, we use quantitative data from the ACTwatch Outlet Survey (OS) and qualitative data collected during Semi-Structured Interviews (SSIs) with retailers. We also draw on data collected during SSIs with wholesalers when the latter served consumers directly (many wholesalers also sold on a retail basis, see next chapter).

5.2 Structure of retail markets

5.2.1 Providers stocking antimalarial drugs

As indicated in Chapter 4, in the 38 sub-districts surveyed during the OS, there were 792 retail outlets with antimalarials in stock on the day of the survey or in the previous 3 months, of which 644 (81.3%) were private commercial outlets and 148 (18.7%) government owned outlets. At the time of the study, there was no retail outlet owned by not-for-profit non-governmental organisations (NGO) that stocked antimalarial drugs in the surveyed areas.

There was 1 private provider for every 821 people at risk of malaria transmission and 1 public provider for every 3571 people. Important variations across the 2 strata were observed: in the surveyed areas free of multi-drug resistance (MDRF areas), there was 1 private provider for every 900 people at risk and as few as 1 public provider for every 5551 people; in the surveyed areas with MDR suspected or confirmed (MDRSC areas), there was 1 private provider for every 753 people and 1 public provider for every 2621 people.

Private commercial providers included mobile providers (25.5%), village shops (19.3%), drug shops (13.0%), pharmacies/clinical pharmacies (12.1%) and grocery stores (11.4%); government providers included village malaria workers (VMWs) (13.0%) and health facilities (5.7%). In both strata, mobile providers were the largest category of providers, accounting for 34.0% of all antimalarial outlets in MDRF areas and 19.0% in the MDRSC areas (Table 5-1).

Table 5-1: Retail providers stocking antimalarials in the 38 surveyed sub-districts

Antimalarial provider types	All Surveyed Sub-Districts		Surveyed Sub-Districts of MDR Free Stratum		Surveyed Sub-Districts of MDR Suspected/Confirmed Stratum	
	Number	%	Number	%	Number	%
All Providers	792	100%	344	100%	448	100%
Private Commercial Providers	644	81.3%	296	86.0%	348	77.7%
Pharmacies/clinical pharmacies ¹	96	12.1%	26	7.6%	70	15.6%
Drug shops	103	13.0%	35	10.2%	68	15.2%
Mobile providers	202	25.5%	117	34.0%	85	19.0%
Grocery stores	90	11.4%	37	10.7%	53	11.8%
Village shops	153	19.3%	81	23.5%	72	16.1%
Government providers	148	18.7%	48	14.0%	100	22.3%
Referral hospitals	3	0.4%	0	0.0%	3	0.7%
Public health centres and posts	42	5.3%	24	7.0%	18	4.0%
Village Malaria Workers	103	13.0%	24	7.0%	79	17.6%

¹ comprised of around three-quarters small clinical pharmacies ("cabinets") and one quarter of drug-only pharmacies. MDR is for multi-drug resistance. Source: ACTwatch Outlet Survey in 38 sub-districts, June 2009.

5.2.2 Antimalarial drug sales volumes and values

Annual antimalarial sales volumes in malaria-endemic areas of Cambodia were estimated following the approach described in Chapter 4 (see Section 4.5.1.3). After calculating the total antimalarial volume sold at each outlet and the total volume sold by all outlets in each sub-district during the week preceding the survey, the total sales volume in each sub-district was multiplied by its corresponding analytical weight and sales totals were summed under each

stratum in order to obtain 2 stratum-specific total sales volume estimates. During the week preceding the survey, 8292 adult equivalent treatment doses (AETDs) were estimated to have been dispensed in the MDRSC stratum and 4253 AETDs in the MDRF stratum. As the 2 strata covered the whole population at risk of malaria in Cambodia, the total antimalarial sales volume for the week preceding the survey across all malaria endemic areas was calculated as the sum of the 2 stratum-specific antimalarial sales volume estimates. During the week preceding the OS, a total of 12,545 AETDs were estimated to have been dispensed across all malaria endemic areas (Table 5-2).

The weekly total estimate was then scaled up to the whole month of data collection assuming constant weekly sales within that month. A total of 53,766 AETDs were estimated to have been dispensed in June 2009 (data not shown). A monthly total estimate for each of the other months of the year was calculated using scale-up factors calculated for each month as the ratio of the number of cases treated during that month in the public sector to that treated during the month of data collection (Appendix 7), in order to account for monthly variations in malaria transmission risk. The annual antimalarial volume dispensed in all malaria endemic areas was obtained by calculating the sum of the 12 monthly sales volume estimates. It was not possible to calculate stratum-specific annual sales volume estimates in the absence of data on patterns of malaria transmission risk in MDRF and MDRSC areas respectively. A total of 500,225 AETDs were estimated to have been dispensed across all malaria endemic areas in 2009 (Table 5-2).

Sales values were calculated following a similar approach (Section 4.5.1.3). Sales values were estimated in each outlet by multiplying each antimalarial sales volume by its selling price in that outlet. Sales volume observations for which price data were missing (6%) were valued using the median selling price of the corresponding antimalarial generic type and dosage form for the corresponding outlet's category (e.g. sales of artemether injection sold at a drug shop were valued using the median selling price of artemether in injection form for the drug shop outlet category). For sales volume observations with no corresponding median retail selling price (0.5%), sales volumes were valued using the median price for the given antimalarial generic type in the most similar outlet category. For instance, sales values of mefloquine sold in pharmacies were estimated using the median price at drug shops; for primaquine sold at pharmacies/clinical pharmacies only, no price data were available so the median price of mefloquine sold at drug shops was used. For antimalarial drugs sold at highly subsidized prices or provided free of charge, their value was estimated using actual procurement costs inclusive

of carriage and insurance costs for delivering the drugs to in-country warehouses (Appendix 8), inflated by 15% to account for in-country storage and other distribution costs (Goodman, 2004). During the week preceding the survey, the value of AETDs dispensed was estimated at US\$ 24,892 in the MDR Suspected/Confirmed stratum and US\$ 16,649 in the MDR Free stratum, amounting to a total of US\$ 41,541 across all malaria endemic areas (Table 5-2). Finally, the value of AETDs dispensed annually was estimated at US\$ 1,074,612 (Table 5-2).

Table 5-2: Estimated total antimalarial sales volumes and values in malaria-endemic areas

	Total sales volumes, during the week preceding the survey (AETD)	Annual total sales volumes (AETD)	Total sales values¹, during the week preceding the survey (US\$)	Annual total sales values (US\$)
All malaria endemic areas	12,545	500,225	US\$ 41,541	US\$ 1,074,612
MDR Free areas	4,253	-	US\$ 16,649	-
MDR-Suspected/Confirmed areas	8,292	-	US\$ 24,892	-

AETD is adult equivalent treatment dose; “-” when estimate could not be calculated

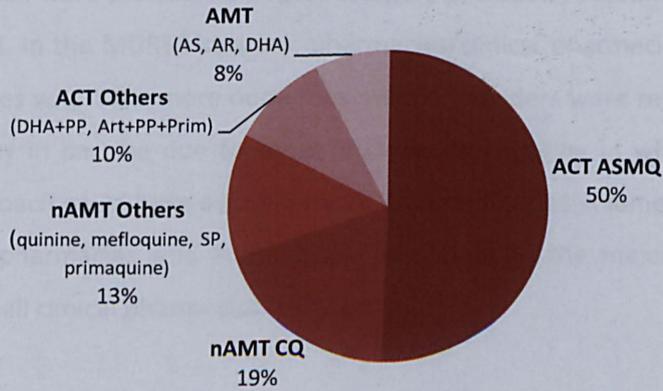
5.2.3 Market shares of different antimalarial categories and provider types

Figure 5-1 presents market shares in volume terms of different antimalarial categories across all malaria-endemic areas and in each of the two strata. Artemisinin Combination Therapy (ACT) made up 60% of all AETDs dispensed, and this was constant across strata. There were key differences between strata. First, the relatively higher market share of ACT other than co-blistered artesunate and mefloquine (ASMQ) in the MDRSC stratum compared to the MDRF stratum reflected the switch to the ACT dihydroartemisinin and piperaquine in areas with confirmed MDR. Second, the relatively higher market share of chloroquine in the MDRSC stratum than in the MDRF stratum may have reflected the higher prevalence of *P.v* in the former than in the latter. Third, artemisinin monotherapy (AMT), which were banned at the time of the study, accounted for a larger share of the antimalarial market in the MDRF stratum than in the MDRSC stratum (14% of all antimalarial sales volumes compared to 4%), although in absolute terms the volume dispensed in the latter was larger than in the former (595 AETDs vs. 331 AETDs)

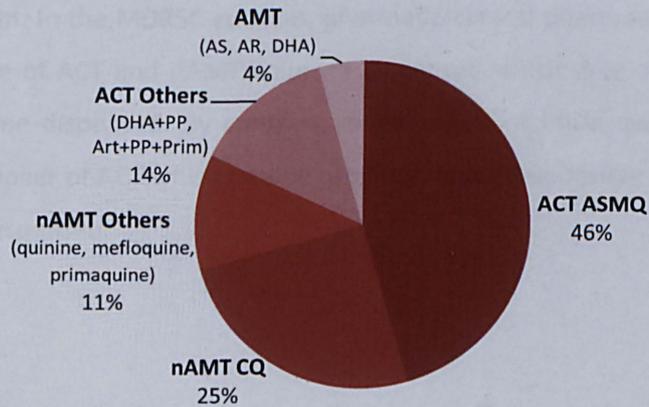
Figure 5-1: Antimalarial market shares in volume terms

As % of the total volume of AETDs dispensed during the week preceding the OS in all malaria endemic areas (N=12,545), MDR Suspected/Confirmed areas only (n=8,292) and MDR Free areas only (n=4,253) (Source: ACTwatch Outlet Survey, 38 sub-districts, June 2009)

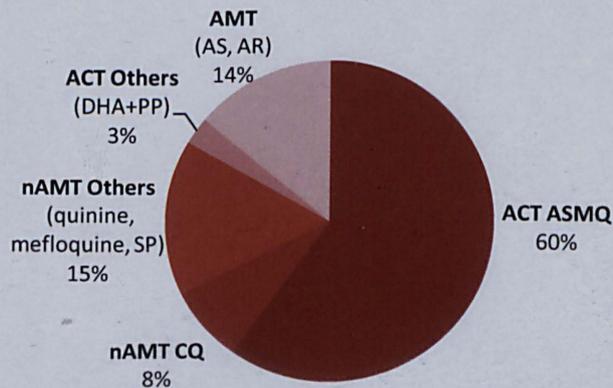
ALL MALARIA ENDEMIC AREAS (N=12,545 AETDs)



MDR SUSPECTED OR CONFIRMED AREAS (n=8,292 AETDs)



MDR FREE AREAS (n=4,253 AETDs)



AMT=artemisinin monotherapies; nAMT=non-artemisinin monotherapies; ASMQ=artesunate+mefloquine; CQ=chloroquine; AS=artesunate; AR=artemether; DHA=dihydroartemisinin; PP=piperazine; Art=artemisinin; Prim=primaquine; SP=sulphadoxine+pyrimethamine.

Figure 5-2 presents market shares in volume terms of each provider type across all malaria-endemic areas and in each of the two strata. Three-quarters of antimalarial volumes were sold by private commercial providers whilst the rest were dispensed by government providers, and this was constant across the 2 strata. In the MDRF stratum, mobile providers, the largest category of antimalarial outlets, accounted for 25% of all antimalarial sales volumes whilst village shops, which were the second largest category of outlets, accounted for only 12% of all antimalarials sold. In the MDRSC stratum, pharmacies/clinical pharmacies accounted for 38% of all sales volumes whilst the more numerous mobile providers were responsible for only 8%. This situation may in part be due to some pharmacies engaging in wholesale trade. In this context, our approach could have overestimated total retail sales volumes. However, it is likely that only a few pharmacies sold antimalarials wholesale as the majority of outlets in this category were small clinical pharmacies (cabinets).

Figure 5-3 presents market shares in volume terms of each provider type by antimalarial category and stratum. In the MDRSC stratum, pharmacy/clinical pharmacies were responsible for the largest share of ACT and nAMT volumes dispensed whilst drug shops for the largest share of AMT volume dispensed. By contrast, in the MDRF stratum, government providers were the largest supplier of ACT whilst mobile providers were responsible for the largest share of AMT and nAMT dispensed.

Figure 5-2: Provider market shares in volume terms

As % of the total volume of AETDs dispensed during the week preceding the OS in all malaria endemic areas (N=12,545 AETDs), MDR Suspected/Confirmed areas only (n=8,292 AETDs) and MDR Free areas only (n=4,253 AETDs) (Source: ACTwatch Outlet Survey, 38 sub-districts, June 2009)

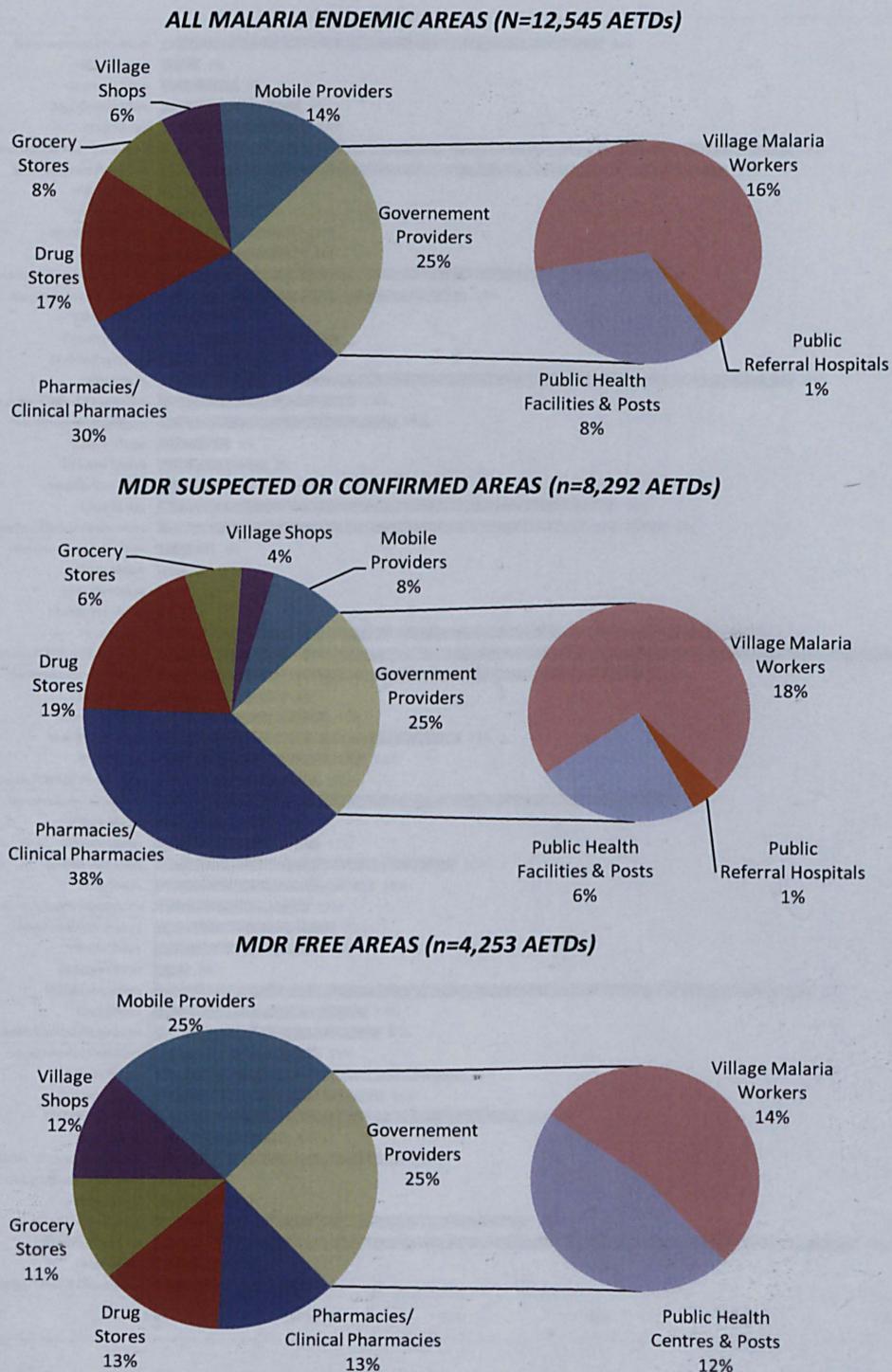
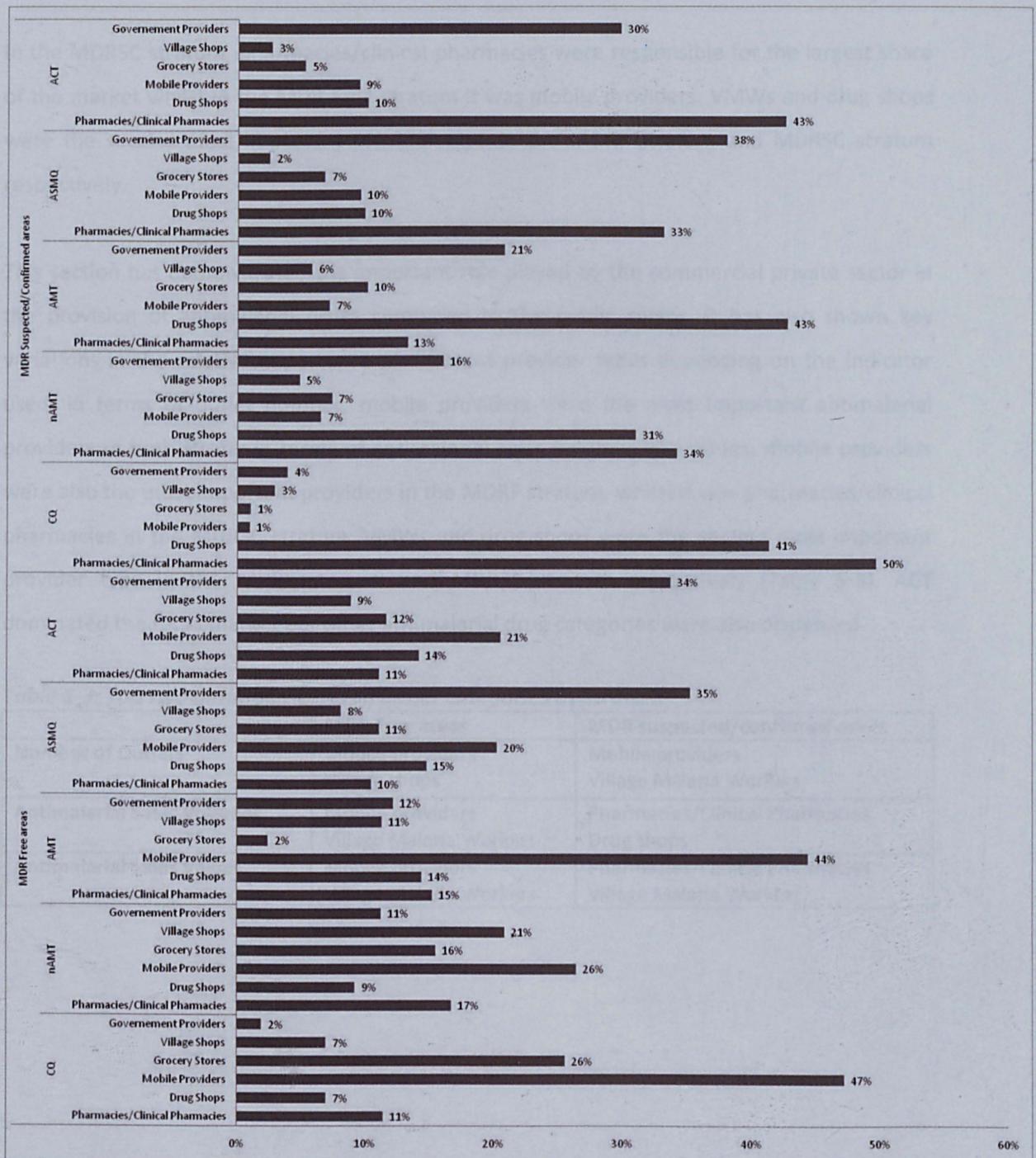


Figure 5-3: Market shares in volume terms of each provider type by antimalarial drug category

As % of total volume of AETDs dispensed by each provider type for different antimalarial categories during the week preceding the OS in MDR Suspected/Confirmed areas only (n=8292) and MDR Free areas only (n=4253) (Source: ACTwatch Outlet Survey, 38 sub-districts, June 2009)



ACT is artemisinin combination therapy; ASMQ is the ACT artesunate and mefloquine; AMT is artemisinin monotherapy; nAMT is non-artemisinin monotherapy; MDR is multi-drug resistance.

Finally, Figure 5-4 presents market shares in value terms of each provider type.

Private commercial providers were responsible for 70% of the market and government providers for 30%, and this was constant across strata.

In the MDRSC stratum, pharmacies/clinical pharmacies were responsible for the largest share of the market whilst in the MDR Free stratum it was mobile providers. VMWs and drug shops were the second most important provider type in the MDRF stratum and MDRSC stratum respectively.

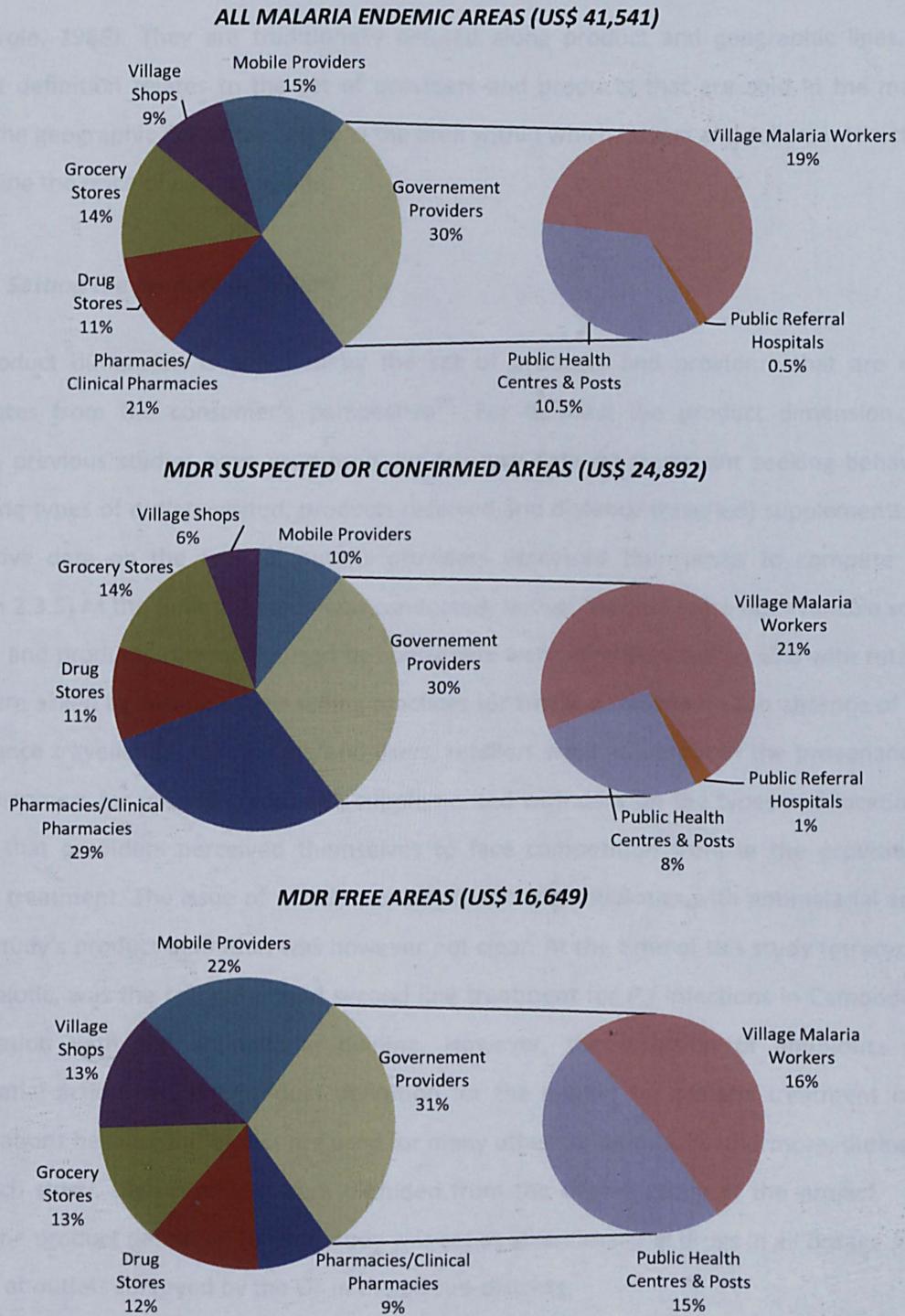
This section has demonstrated the important role played by the commercial private sector in the provision of antimalarial drugs compared to the public sector. It has also shown key variations in the relative importance of different provider types depending on the indicator used: in terms of outlet number, mobile providers were the most important antimalarial providers in both strata; in terms of antimalarial sales volumes and values, mobile providers were also the most important providers in the MDRF stratum, whilst it was pharmacies/clinical pharmacies in the MDRSC stratum. VMWs and drug shops were the second most important provider type in the MDRF stratum and MDRSC stratum respectively (Table 5-3). ACT dominated the retail market but other antimalarial drug categories were also dispensed.

Table 5-3: Top two antimalarial retail outlet categories by stratum

	MDR Free areas	MDR suspected/confirmed areas
Number of Outlets	Mobile providers Village shops	Mobile providers Village Malaria Workers
Antimalarial Sales Volumes	Mobile providers Village Malaria Workers	Pharmacies/Clinical Pharmacies Drug shops
Antimalarial Sales Values	Mobile providers Village Malaria Workers	Pharmacies/Clinical Pharmacies Village Malaria Workers

Figure 5-4: Provider market shares in value terms

As % of total sales value of AETDs dispensed during the week preceding the OS in all malaria endemic areas (US\$ 41,541), MDR Suspected/Confirmed areas only (US\$ 24,892) and MDR Free areas only (US\$ 16,650) (Source: ACTwatch Outlet Survey, 38 sub-districts, June 2009)



Source: ACTwatch Outlet Survey data. 38 sub-districts, June 2009

5.2.4 Defining the market

An important and challenging step in the analysis of market structure is to define the market. As discussed in Chapter 2, markets can be defined as the set of sellers and buyers who are in sufficiently close contact for their transactions to affect the terms on which the others buy or sell (Tirole, 1988). They are traditionally defined along product and geographic lines. The product definition relates to the set of providers and products that are sold in the market whilst the geographic definition refers to the area within which buyers and sellers interact and determine the price of each product.

5.2.4.1 Setting the product definition

The product dimension is specified by the set of products and providers that are close substitutes from the consumer's perspective²⁹. For defining the product dimension of a market, previous studies have used household survey data on treatment seeking behaviour (including types of outlets visited, products received and distance travelled) supplemented by qualitative data on the type of outlets providers perceived themselves to compete with (Section 2.3.5) At the time this study was conducted, household data were not available so the sources and products commonly used by consumers were identified during SSIs with retailers who were asked to describe their selling practices for treating malaria. In the absence of data on distance travelled by care-takers/end users, retailers were asked about the provenance of their customers for malaria treatment, supplemented with data on the types and location of outlets that providers perceived themselves to face competition from in the provision of malaria treatment. The issue of whether or not to include antibiotics with antimalarial action in this study's product definition was however not clear. At the time of this study tetracycline, an antibiotic, was the recommended second line treatment for *P.f* infections in Cambodia, in combination with the antimalarial quinine. However, the inclusion of antibiotics with antimalarial action into the product definition for the market for malaria treatment raises complications because antibiotics are used for many other conditions. Furthermore, during the ACTwatch study, such products were excluded from the overall scope of the project. As a result, the product definition for this study was set as all antimalarial drugs in all dosage forms stocked at outlets surveyed by the OS in the 38 sub-districts.

²⁹ By contrast, the analysis of substitutability in supply focuses on a provider being able to switch his supply for treating one condition to another at a limited or no cost.

As discussed in Chapter 4, retail outlets were identified for inclusion in the OS if they stocked antimalarials or had done so in the preceding 3 months through a census of all outlets that may potentially sell antimalarials in each of the 38 sub-districts. All these outlets were included in the product definition for providers. Whilst the focus of this study is on private commercial retailers, government outlets were also included on the basis that they were perceived by private shopkeepers to compete in the provision of malaria treatment and therefore influence private shopkeepers in their strategies for attracting customers.

“When people get malaria, they go first to the health centre” (Pharmacy/clinical pharmacy #1, accessible market, MDRF stratum)

“Before the malaria business was good but now public health centres provide treatment. There are also village malaria workers around” (Wholesaler supplying retailers #3, MDRSC stratum)

Other providers of health care services and products included *Kru Khmer* (traditional healers). However, *Kru Khmer* have been reported to play a relatively small role in the provision of healthcare in Cambodia, as they accounted for only 1.5% of all health care visits (DHS 2005). At the time of this study, there was no reason to believe that they played a significant role in the provision of malaria treatment. This was backed up by data collected during SSIs with retailers who did not report perceiving other types of outlets than those identified during the OS to be their main competitors in the market for antimalarial drugs.

5.2.4.2 Setting up the geographic definition

In previous studies on pharmaceutical drug markets (Section 3.3.5), 3 approaches have been used for defining geographic markets: the fixed-radius method, the simple administrative boundary approach and the shipment approach.

The fixed-radius approach defines a market as the area within a given radius around an outlet. This approach creates challenges at the boundaries of the whole study area as outlets that are outside the area have not been sampled whilst, by definition when using this approach, they are part of the market under study and are expected to influence the operation of outlets in the study area. In this thesis, the whole study area was made up of 38 sub-districts implying that setting the geographic definition through the fixed-radius method would have created repeated challenges for defining markets at the boundaries of each sub-district (or group of clustered sub-districts).

The shipment approach uses household data on the distance travelled by care takers when seeking malaria treatment. However, as previously mentioned, such data were not available for use in this thesis.

The administrative boundary approach was therefore used. To avoid oversimplifying the geographical definition and as a result over or under estimating competition, the appropriateness of 4 different administrative areas (district, sub-district, commune and village) was assessed using data collected during SSIs with retailers on the provenance of their customers for malaria treatment and the location of outlets that they perceived as competitors.

The sub-district, which formed the primary sampling unit for the OS, was the catchment area of public health facilities with reported malaria cases in 2008. The sub-district therefore appeared as an attractive candidate for setting the geographic definition of the market. The suitability of this definition was hard to assess during SSIs because sub-districts formed operational areas defined by the MOH for planning activities rather than widely recognised administrative units. However, evidence from SSIs with retailers indicated that the sub-district, which covered around 10,000 to 15,000 people, was a too broad definition for retail markets for malaria treatment.

“My main competitions are approximately 10 minutes walk away, near the main road’s roundabout and a bit farther away in the market”. (Mobile provider #5, remote market, MDRF stratum)

Using the sub-district would overestimate the market and therefore the intensity of competition. In this context, the sub-district, and consequently the district were considered inadequate.

During SSIs, most providers mentioned surrounding villages or/and their village as the areas within which competitors operated and/or customers came from.

“Other drug shops in the village and in the surrounding villages compete with me” (Pharmacy/clinical pharmacy #1, accessible market, MDRF stratum)

The village was therefore considered to provide too narrow boundaries and the geographic definition was therefore set as the commune. The commune was considered to be the most relevant area, especially in the presence of mobile providers who were likely to travel outside their own village. The suitability of this approach was validated with researchers on fever treatment seeking behaviour in Cambodia and using evidence on utilisation data from a household survey conducted some years ago that found that the median time travelled when seeking treatment for malaria symptoms was 60 minutes (Shunmay Yeung, personal communication), indicating that consumers were likely to travel outside their own village when seeking malaria treatment. To illustrate, villages had a median population of 623 (368-998) people and communes a median of 3507 inhabitants (IQR 1764-6054). With an average density of 75 people per km² (NIS, 2008), the average village surface would be around 8km² and that of communes 46km², which appears to be consistent with a 60 minute walk.

On the basis of the product and geographic definitions developed above, 87 markets were defined, of which 40 were in the MDRF stratum and 47 in the MDRSC stratum. These markets each served a median population of 3507 inhabitants (data not shown), and this was relatively constant across strata (Table 5-4).

In summary, in this section, the market for malaria treatment was defined. The product definition was set as all types of drugs developed for the treatment of malaria in all dosage forms whilst the product definition for providers was set as pharmacies/clinical pharmacies, drugs stores, mobile providers, grocery and village shops, and public sector referral hospitals, health centres/posts and VMWs because in several instances private shopkeepers perceived they faced competition from government providers. Finally, the geographical definition of the market was set as the commune after assessing the appropriateness of 4 different administrative boundaries (district, sub-district, commune, and village). The next 2 sections assess market accessibility and malaria transmission risk (Section 5.2.5), and market concentration (Section 5.2.6).

5.2.5 Market accessibility and malaria transmission risk

Market accessibility was measured by calculating the total travel time from each market to the main commercial centre (Section 4.5.1.6). The median travel time was 3.35 hours (IQR 1.6-5.4, min 0.5, max 10.5). Markets were grouped into 3 categories, with markets located less than 2.5 hour-drive from the closest main commercial area categorised as “accessible”, within 2.5 and 4.5 hour-drive as “moderately accessible” and more than 4.5 hour-drive as “remote”.

The suitability of this approach was backed-up during discussions with key informants working at Population Services International in Cambodia (PSI Cambodia) who were asked about what “remote” or “accessible” meant to them in terms of travel time using a 4-wheel vehicle. Following the MOH’s malaria transmission risk categorisation, markets located less than 250 meters from the forest were classified as “high risk” of malaria transmission risk, within 250 meters and 1 kilometre from the forest as “medium risk” and more than 1 kilometre from the forest as “low risk” (Section 4.5.1.7).

A significantly higher percentage of markets located in the MDRF stratum was remote than in the MDRSC stratum (66.0% vs. 18.4%, $p=0.01$), with the latter significantly more likely to be moderately accessible (57.5% vs. 0.06%, $p<0.001$) (Table 5-4). Whilst the proportion of markets at high or moderate risk of malaria transmission was not statistically different across strata, markets in the MDRF stratum were more likely to be at low malaria transmission risk compared to the MDRSC stratum (44.5% vs. 20.7% $p=0.03$) (Table 5-4). Finally, in both strata, the levels of malaria transmission risk were not significantly different across markets with different levels of accessibility (e.g. more remote markets were not found to have higher risk of malaria transmission) (Chi2, $p=0.67$) (data not shown).

Table 5-4: Market characteristics by stratum

Market characteristics	MDR-Free Stratum n=40	MDR-Suspected/ Confirmed Stratum n=47
Median number of inhabitants (IQR)	3624 (1877-6023)	3403 (1757-6547)
Level of Accessibility¹		
• Accessible	33.4%	24.8%
• Moderately accessible	0.07%*	57.5%*
• Remote	66.0%*	18.4%*
Level of Malaria Transmission Risk²		
• High risk	14.3%	29.5%
• Moderate risk	41.1%	49.7%
• Low risk	44.5%*	20.7%*

¹Markets located less than 2.5 hours drive from the closest main commercial centre were defined as accessible, within 2.5 and 4.5 hours as moderately accessible and more than 4.5 hours drive as remote. ²Markets were classified as “high risk” of malaria transmission if they were located less than 250 meters from the forest, as “medium risk” if located within 250 meters and 1 kilometre from the forest and as “low risk” if located more than 1 kilometre from the forest. *significant differences between MDR-Free and MDR-Suspected/Confirmed Stratum (chi-squared test with Rao and Scott correction, $p<0.05$)

5.2.6 Retail market concentration

Retail market concentration was analysed by retail provider first and then by manufacturer.

5.2.6.1 Concentration by provider

The number of providers was very variable across markets, ranging from 1 to 32, with a mean of 5 outlets per market. In 61% of the markets, both public and private providers stocked antimalarial drugs whilst in 30% of the markets only private shops did so (and this was similar across strata) and in the remaining 9% it was VMWs only (with three-quarter of these communes situated in the MDR Free stratum). Appendix 11 presents the HHI on antimalarial sales volumes and values for each market including both public and private sector volumes. Table 5-5 presents median and IQR for the HHI calculated using sales volumes and values for all markets and across strata.

Table 5-5: Median HHI across all markets and by stratum

	Median HHI on antimalarial sales volumes (IQR)	Median HHI on antimalarial sales values (IQR)
All Markets¹	0.50 (0.34-0.74)	0.58 (0.32-0.72)
Markets in MDR Free Stratum (n=31)	0.63 (0.37-1.00)	0.64 (0.36-1.00)
Markets in MDR Suspected/Confirmed Stratum (n=42)	0.49 (0.30-0.61)	0.50 (0.29-0.64)

¹ HHI were calculated for 73 communes because in 14 communes total sales volumes were null so market shares could not be calculated. MDR is multi-drug resistance; IQR is inter-quartile range

The median HHI, both in volume and value terms, was not statistically different between strata (median difference 0, 95% ci -0.02 to 0.03). In the MDRF stratum, there was no significant difference in the median HHI in volume and value terms (paired t-test p=0.69) whilst in the MDRSC stratum the HHI in volume term was significantly higher than the HHI in value terms, although by only 0.03 (p<0.0001). These results are in line with previous studies that found little differences in HHIs calculated on different variables (Gaynor and Vogt, 2000).

According to US anti-trust agencies, markets with an HHI below 0.15 can be considered as unconcentrated, between 0.15 and 0.25 moderately concentrated and above 0.25 highly concentrated (U.S. Department of Justice and Federal Trade Commission, 2010). On the basis of these thresholds, markets for antimalarial drugs would be considered as highly concentrated in both strata, with some markets in monopoly situations. However, out of the

markets with an HHI equal to 1, two thirds in the MDR Free stratum and one third in the MDR-Suspected/Confirmed stratum were public sector monopolies.

5.2.6.2 Concentration by manufacturer

Competition between drug manufacturers was explored using information on antimalarial drug manufacturer collected during the OS.

ACT products audited originated from 7 manufacturers, with 3 manufacturers of co-blistered ASMQ accounting for 84% of the ACT market in volume terms and 91% in value terms. On the basis of US anti-trust agency guidelines, the ACT market would be considered as highly concentrated, with a HHI of 0.75 in volume terms and 0.79 in value terms.

For the market for non-ACT, it was not possible to assess the degree of concentration using the HHI. In the market for AMT, there was no information about manufacturers for 38.5% of sales volumes (20.7% of sales values). Similarly, in the market for nAMT, no manufacturer information was available for 31.5% of sales volumes (86.5% of sales values). Absence of information about manufacturers may be due to products being imported from Thailand or other neighbouring countries for which data collectors were unable to read packaging, or products being stored loose as blisters or single ampoules so that no information on manufacturer was available. Overall, 15 different manufacturers were identified to supply AMT and 13 nAMT. The top 3 “identified” manufacturers of AMT were responsible for 43% of all sales and 70% of sales from identified manufacturers in volume terms (50% and 63% in value terms respectively); for nAMT, the top 3 “identified” manufacturers made up 62% of all sales and 91% of sales from identified manufacturers in volume terms (11% and 84% in value terms respectively).

In summary, the analysis of concentration by providers indicated that markets could be highly concentrated, and sometimes in monopoly situations, notably in the MDR-Free stratum. However, two-thirds of these monopoly situations were public-sector monopolies. The analysis of concentration by manufacturer indicated that the market for ACT could be considered as highly concentrated, reflecting the crowding out by social marketing of sales of other ACTs. As for the market of AMT and nAMT, information about manufacturers was lacking for a relatively large share of sales therefore impeding the calculation of concentration indices. The analysis of market structure is not limited to market concentration but also includes the extent to which

market entry and exit is possible. The next section explores the presence and nature of entry and exit barriers to the market for malaria treatment.

5.2.7 Perceived barriers to entry and exit

This section explores the factors that inhibit market entry and exit as perceived by retailers. Data on providers' perceptions were collected during SSIs during which respondents were asked if they expected businesses like theirs to open in their area in the near future and the factors explaining this situation. As indicated previously, the analysis mainly relies on data from interviews with retailers, but data are also included from wholesaler interviews where it refers to their retail practices. Regulatory requirements, the lack of financial capital and the lack of experience of newcomers were perceived to be key obstacles to market entry.

Regulation was the most commonly reported source of obstacles to retail market entry. A key aspect was the cap on the number of new drug outlet licenses that could be issued in each commune. At the time of this study, the number of pharmacy licenses was capped at 1 outlet for 2,000 inhabitants, so once this ratio was reached no new pharmacy licenses were to be issued, but if there was less than 1 pharmacy per 2,000 inhabitants in a given commune, depot A licenses could be issued to pharmacy assistants wishing to set up a new drug business within the commune (Section 2.5).

"The provincial [Ministry of] health office does not authorise new pharmacies to open in the area. Four pharmacies are enough according to the authorities. I don't know more about it." (Wholesaler supplying wholesalers #5, MDRSC stratum).

Whilst it would have been of interest to know whether the 1:2000 ratio was respected in practice, it was not possible to assess this from the OS data as it collected license status data for drug outlets in general, without making a distinction between pharmacy and depot licenses. Official lists could have provided this information but they were incomplete or outdated, as will be seen in Chapter 8. It was therefore not possible to investigate whether the legislation was effectively implemented. However, as described below, in practice many providers had overcome this barrier by operating without the required license.

The process of applying for a drug outlet license was reported as a second regulatory hurdle with retailers perceiving it to be complicated and expensive. The Department for Drug and Food (DDF) encouraged applicants to submit the relevant documentation as soon as possible

with new licenses to be issued on a “first-come first served-basis”, assuming the relevant documentation had been submitted (DDF, personal communication). At the time of this study, there was no official fixed license fee though the DDF suggested provincial offices charge a small fee. During SSIs with providers, the fee reported to be paid to the MOH’s Provincial Health Departments (PHDs) for obtaining a drug outlet license was around US\$ 20, although one provider reported that the fee could be as much as US\$ 120, such that the cost of obtaining a license led providers to operate without a license.

Other requirements for opening a drug outlet were said to be hard to fulfil, notably in terms of the premises in which a drug business could be set up. This reflected Article 20 of *Praka*³⁰ no.14, which stated that a pharmacy outlet should be at least 20m² and depots 16m² with clear separation from the living space.

“I don’t know any problem for opening a business, except to have a house. I know someone who wants to set up a drug business in this area. But there is no house free so he can not open a new shop” (Village shop #10, remote market, MDRF stratum)

Buying a drug business from a licensee already operating in the market was said to be one way to enter the market, which was reportedly possible when licensees decided to retire. Retailers also reported renting licensees’ names for setting up their own shop. At the time of this study, the legislation authorised such practice provided that “new” entrants had the relevant qualifications. However, renting a license was reported to be near impossible because of the limited number of pharmacists in Cambodia and of those renting their names. In the situation where licensees’ names or premises were rarely for sell or for rent, their cost, when they became available, was reported as an additional barrier to entry.

“I have not found an affordable pharmacist name to rent. Pharmacist names are expensive, around US\$ 200 per month. I can only afford to pay \$50 per month” (Mobile provider #4, remote market, MDRF stratum)

However, there was also evidence that circumventing the above-mentioned regulatory entry barriers was common.

³⁰ Ministerial decision

“They are a lot of drug outlets that have opened here. This is a problem because they do not have enough knowledge about medicines and malaria. Some sell drugs only, some sell other products, and sometimes they cannot read nor write” (Pharmacy/clinical pharmacy #1, accessible market, MDRF stratum)

During the OS, the majority of respondents indicated that they operated without a drug outlet license (Table 5-6). To be more specific, MOH licenses were significantly more frequently observed at pharmacies/clinical pharmacies and drug shops than at other retail outlet types (26.7% vs. 3.0%, $p < 0.0001$ and 11.9% vs. 4.8%, $p = 0.005$ respectively). By contrast, they were less frequently observed at mobile provider outlets (1.5% vs. 8.0%, $p = 0.01$) and never observed at village shops ($p = 0.04$).

Table 5-6: Retailers who reported operating without a MOH drug outlet license
As % of providers for whom the information was available (N=637)

Retail outlet category n=sample size	Percentage of private shops reported to operate <i>without</i> a MOH drug outlet license (95%ci)
Pharmacies/clinical pharmacies n=95	55.3% (44.5, 66.0)
Drug shops n=101	88.5% (82.0,95.1)
Mobile providers n=201	99.3% (98.0,100)
Grocery stores n=89	96.7% (93.5,100)
Village shops n=151	100% (100,100)

Source: ACTwatch Outlet Survey data, 38 sub-districts, June 2009.

Setting up a pharmacy business was reported to require significant financial resources.

“To open a big pharmacy, it costs between US\$ 10,000 to US\$ 20,000. I cannot open such a big shop” (Pharmacy/Clinical pharmacy #1, accessible market, MDRF stratum)

In general pharmacy shopkeepers estimated that around US\$ 25,000 was required for setting up a pharmacy business, whilst for other outlet types US\$ 540 was reportedly sufficient although it could be 10 times more at US\$ 5,000. Resources included renting a house and purchasing shop furniture such as shelves and a drug cabinet, fittings and an initial stock of drugs, with the latter accounting for the largest share of capital required (40-97% of all capital reportedly required).

All interviewees, except one, said that they did not borrow money either because the bank in their area did not lend money or because they foresaw not earning enough to repay back later. However, when prompted on the cost of borrowing money, none of the retailers reported knowing about the interest rates charged by financial establishments. The sole provider who reported borrowing money from a bank said that to finance his inventory he borrowed at a monthly interest rate of 3% for sums less than US\$ 1,000 and 2.5% for sums above US\$ 1000. The only other source of financial resources mentioned, although rarely, was family members who had provided the initial capital for setting up the business.

Finally, the lack of experience in selling drugs or treating patients was perceived as a barrier to entry by retailers who reported that this was going way beyond having the relevant health qualifications to do so and related to practical experience of running such businesses.

“No other businesses will open in the area [...] because it takes time to build experience and people are not confident for opening this type of business” (Mobile provider #5, remote market, MDRSC stratum)

This was somewhat backed up by the outlet survey data which showed that median length in operation of antimalarial providers was 7 years (IQR 3-16).

During SSIs, private shopkeepers did not report any barriers to exiting the market for antimalarial drugs. One would expect that bankruptcy would be a cause for shop closure but it was never mentioned by shopkeepers who argued that shops never closed down because of the variety of products sold alongside antimalarial drugs. Two factors were mentioned as causes for shop closures: old age and recent developments in the regulatory environment. Whilst regulatory developments were perceived by some private shopkeepers as new requirements from the MOH, they frequently actually reflected strengthened enforcement of existing policies.

“There is a new policy that says that shops selling drugs without being registered will be closed down” (Drug Shop # 3, moderately accessible market, MDRSC stratum)

Several private shopkeepers mentioned that requirements had become stringent for outlets operating within *Phsars* (marketplaces) such that *phsar*-based outlets had recently been asked to obtain a license if they wished to continue operating. Some other respondents referred to a

controversial ongoing campaign from the regulatory authorities during which outlets providing clinical services were being closed down.

“Kru Pets³¹ practices will be closed down. But there will also be reaction. Providers are discussing and are unhappy” (Drug Shop # 3, moderately accessible market, MDRSC stratum)”

One mobile provider who also worked at the local health facility argued, however, that the authorities had limited capacity for closing unlicensed shops because the implementation of the intervention was delegated to the operational district and, it appeared, to government health workers themselves. As one clinical pharmacy interviewee, who was also the head of the local health centre said:

“The provincial office wants to stop the operation of informal providers who operate without a license but the implementation is not up to speed. I was told to close shops by the local authorities but I cannot do anything myself to stop the operation of informal businesses. I could be murdered for doing this because the lines are blurred, you see, I also run a drug business” (Pharmacy/Clinical Pharmacy #1, accessible market, MDRF stratum)

However, shortly after the end of our study, the MOH engaged in a crack-down on unlicensed providers and a few months later, in March 2010, the Ministry of Health announced that 65% of unlicensed outlets had been closed (BMJ, 2010). During SSIs, a few providers had also reported that the sales of drugs at private shops would soon be forbidden by their local authorities.

This section has analysed the structure of the market for malaria treatment in Cambodia. The product dimension of the market was set to include private commercial retailers and government providers stocking antimalarial drugs in the 38 sub-districts: pharmacies/clinical pharmacies, drugs stores, mobile providers, grocery and village shops, and public sector referral hospitals, health centres/posts and VMWs. The geographical definition of the market was set as the commune on the basis of evidence on the provenance of antimalarial customers and location of retailers’ competitors, and after assessing the appropriateness of 4 different administrative boundaries (district, sub-district, commune, and village). Markets could be

³¹ Kru Pets refer to semi-qualified or qualified health care providers. Semi-qualified health care providers may be those who received training in the camps after the Khmer Rouge regime. Qualified health care providers may include government health workers who have their own private practice or retired nurses or midwives.

considered as highly concentrated, with some in a monopoly situation, although some of these were public sector monopolies, notably in the MDRF stratum. Market concentration by manufacturer was high for ACT, reflecting the social marketing crowding-out of private sector sales whilst it was lower for nAMT and notably AMT. Entry barriers were reported to be high, although many outlets appeared to have overcome these obstacles. Market exit was generally perceived to be rare, except in areas where regulation was reported to have recently become more stringent.

5.3 Provider conduct: product differentiation and non-price competition

This section explores the key axes of product differentiation in the market for malaria treatment, describing the inherent product characteristics perceived to be the most valued by customers when choosing one product over another at a given price and the strategies used by providers to distinguish their products and services from that of other providers on the basis of other attributes than price.

5.3.1 Location choice

Antimalarial retailers said that they chose to locate where they perceived the demand to be. They reported that consumers preferred outlets located in or around *phsars*, which were said to be conveniently located so that if they did not find the products or services of their choice in a given shop they could easily visit another shop nearby.

“Phsar Tapang is an area with a lot of retail pharmacies [...] People go there because there are a lot of drug sellers and therefore a wider range of drugs available”. (Pharmacy/clinical pharmacy # 9, accessible market, Phnom Penh)

Being located in or around a *phsar* was also reported to create positive externalities between providers because it increased the overall demand for these providers. One retailer on the outskirts of a *phsar* indicated that she would close her shop shortly after midday because the *phsar* was only open in the morning and therefore she was not expecting customers to visit her shop in the afternoon.

Transport costs were reported to be a key factor influencing consumers' choice of outlet, and outlets located along main roads and roundabouts were reported to attract custom because they were said to be easily accessible for the majority of consumers. One retailer said that customers choose providers on the grounds of both treatment price and transport costs.

“People have to pay 10,000 riel (US\$ 2.50) to get to the health centre by taxi and come back. This is why people come to my shop because I am not more expensive” (Drug shop #6, remote market, MDRF stratum)

Section 5.2 indicated that many people were likely to have to travel longer distances to reach public health facilities than private shops: in as many as one third of communes, private shops were the only providers of antimalarial drugs and overall private commercial outlets tended to be more accessible than government ones, notably in MDR free areas where there was 1 private provider for every 900 people at risk and as few as 1 public provider for every 5551 people. Furthermore, seeking care from government facilities implied other indirect costs including the opportunity cost of being away from work or that of providing food to family members or friends who would have accompanied patients for the duration of their stay. Only when free treatment was available locally, such as through VMWs, was it reported to attract custom.

5.3.2 Outlet’s opening hours

Longer opening hours were reported to be an attribute highly valued by customers and shops were sometimes said to never close!

“I am open 24hours, 7 days a week because if I was not opened all the time, customers would go somewhere else”. (Wholesaler supplying retailer #5, MDRSC stratum)

This may have reflected situations where the drug outlet was located at the provider’s home, or where providers travelled to patients’ homes, such as mobile providers. Opening hours were also mentioned as one reason why people preferred seeking care at private shops rather than at public facilities. One mobile provider said that for people sick at night there was no alternative source of care available locally other than him because the nearby health post did not provide care at night.

5.3.3 Stock reliability and range of drugs available

Stock-outs were reported to be another factor that led consumers to avoid public health facilities. Stock-outs were said to be frequent, especially at lower level facilities, such as health posts. During two interviews with health workers, the latter explained that their outlet received only 4 to 5 adult doses of ASMQ per month. Requesting additional treatment packs

from higher level facilities, either to the health centre or directly to the operational district, was reported to be possible, but supplies were said to arrive one or two days later or health post staff were required to travel relatively long distances, sometimes 60 to 70 kilometres, to pick-up antimalarials from the operational district office.

Within the private sector, a wider range of drugs was also perceived to be an attribute that attracted custom, notably at outlets providing treatment services such as clinical pharmacies and mobile providers.

“Kru pets compete with me because they have a wider range of drug types, such as suppositories” (Grocery shop #7, remote market, MDRF stratum)

This was however not backed up by the outlet survey data which showed that only public health facilities stocked suppositories, with the exception of one drug shop. However, of private sector outlet types, mobile providers and clinical pharmacies stocked the largest share of injectable products (Table 5-7), reflecting the clinical services (e.g. injections, IV) offered by these providers.

Table 5-7: Antimalarial dosage forms by outlet type
As % of all antimalarial drugs stocked (N=1259), by dosage form and provider type

Provider type n=number of products	Antimalarial drug dosage form			
	Tablet n=1,096	Injectable n=90	Suppository n=72	Granule n=1
Pharmacy/clinical pharmacies	15.5%	23.3%	0.0%	0.0%
Drug stores	13.8%	13.3%	1.4%	0.0%
Grocery stores	9.6%	8.9%	0.0%	0.0%
Village shops	14.1%	8.9%	0.0%	0.0%
Mobile providers	14.4%	35.6%	0.0%	0.0%
Government providers	32.6%	10.0%	98.6%	100.0%
All	100%	100%	100%	100.0%

Source: ACTwatch Outlet Survey data, 38 sub-districts, June 2009.

5.3.4 Perceived drug quality

Customers' perceptions of drug quality were reported to influence providers' stocking decisions. Furthermore, nearly 35% of private providers reported brand reputation to be a factor influencing their stocking decisions for antimalarials. During SSIs with private shopkeepers, the quality of a drug was reported to be signalled by its popularity amongst customers such that customers preferred drugs that they knew or had heard of notably on TV,

and which they knew were popular amongst other customers. Malarine was the most commonly mentioned “high quality” antimalarial drug, a situation that may have reflected the social marketing programme which focused on promoting the Malarine brand. By contrast, A+M, the public sector version of ASMQ, which was not the object of any promotion campaign was reported to be less popular amongst consumers, although there was some evidence of drug leakages from public providers to private shops.

“Doctors write prescriptions for A+M4 so I stock it. But it is less famous than Malarine because there is no promotion” (Wholesaler supplying retailers #4 MDRF stratum)

This was in tune with OS data which showed that Malarine accounted for 38.1% of all antimalarial volumes and 90% of all ASMQ volumes sold by private providers whilst these percentages were 4.2% and 10% for the public sector A+M respectively.

Customers were also said to prefer antimalarial drugs, and notably Malarine, for which there were no counterfeited versions known to be available on the market. This may have reflected the effect of a government-led campaign on counterfeit medicines launched on Cambodian television at the start of 2009 (Section 2.6).

During the outlet survey, nearly two-thirds of private providers reported their decisions on stocking antimalarials to be influenced by government recommendations, although important variations across provider types could be noted: whilst around 48%, 43% and 33% of pharmacies/clinical pharmacies, drug stores and mobile providers reported government recommendations to influence their stocking decisions respectively, only around 18% of grocery stores and village shops did so. However, other antimalarial drugs than Malarine were regularly stocked by all types of retailers. Amongst nAMT, chloroquine sales represented the largest share of volumes sold, a situation that may have reflected cases treated for *P.v* infections. This was confirmed by a couple of providers who, during SSIs, explained that Malarine could only be used when *P.f* was confirmed by testing patient blood, which led them to stock chloroquine. Other factors may have however influenced providers’ to stock other drugs than Malarine, with the most commonly mentioned reason relating to its undesirable side-effects, which were associated with mefloquine.

“Malarine can only be used when the test clearly shows it is plasmodium, and it has side effects, so I also stock artesunate tablets” (Wholesaler supplying retailers #11, MDRF stratum)

This was supported by the OS data, which showed that artesunate sales volumes accounted for 6.3% of all antimalarial drug volumes sold and artemisinin monotherapies in general for 8.5%, although sales had been banned since November 2008. However, providers who knew about the ban reported trying to finish their stocks of artesunate. Others reported being out of stock, although unintentionally because artesunate was not available anymore from their supply sources. During one interview, a shopkeeper showed us the product list of a manufacturer of artesunate dated July 2009, indicating that artesunate was still available for sale.

A few providers said that the country of manufacture influenced their stocking decision for antimalarials, with antimalarial drugs manufactured in European countries, China and Vietnam argued to be of higher quality than products produced in Cambodia.

“Drug quality is poor in the country. Khmer manufacturer do not put the right amount of active ingredient in the drug.” (Wholesaler supplying retailers #2, MDRF stratum)

This was in tune with the OS data, which showed that less than 2% of antimalarial drugs had been manufactured in Cambodia and around 24% in Asia and 10% in Europe (Table 5-8). However, as indicated in Section 5.2, for many antimalarial drugs stocked in private shops there was no information on country of manufacture, indicating that the provenance of medicines might have had a relatively limited influence on providers’ stocking decisions.

Table 5-8: Country of manufacture of antimalarial drugs surveyed
As % of all antimalarial drugs stocked surveyed (N=1259)

Country of manufacture	Percentage of antimalarials surveyed (%)
Belgium	1.0%
Cambodia	1.7%
Canada	0.1%
China	11.1%
Denmark	0.3%
Germany	0.2%
India	2.0%
Switzerland	6.3%
Thailand	4.2%
Vietnam	6.3%
Unknown ¹	66.8%

¹mostly includes ASMQ products distributed by PSI Cambodia before May 2009 and for which manufacturer information was not printed on packs. Other products were nAMT and AMT (see Section 5.2.6.2).

Source: ACTwatch Outlet Survey data, 38 sub-districts, June 2009.

5.3.5 Personal relationship, providers' expertise and reputation

Customers were said to visit providers they had known of for a long time so that retailers who had been in operation for longer were perceived to have more expertise providing them with a competitive advantage.

Interviewee: "Why do you think that some customers choose other businesses instead of yours?"

Respondent: "Because they started their business before I did, more than 7 years ago" (Drug shop # 3, moderately accessible, MDRSC stratum)

"I started working just before the Khmer Rouge regime. I was treating the Khmer Rouge [soldiers] during the regime. I participated in surgeries, between 10 to 20 surgeries per day" (Wholesaler supplying wholesalers, MDRF stratum)

As indicated previously, this was backed up by the OS that showed that retailers had been in operation for a median of 7 years (IQR 3-16).

Outlets were run by a median of 2 (IQR 1-2) people, that often included a husband and wife, although generally a median of one person (IQR 1-2) was in charge of selling medicines and this situation may have contributed to building close relationships with customers. One clinical pharmacy owner said that he had recently moved from one village to another and that his customers had followed him as they would still seek care at his new cabinet, whilst he had not yet attracted new customers.

Customers were also reported to choose a private shop instead of a government facility due to personal relationships. Private shopkeepers argued that they were more pleasant, polite and receptive to customer needs than government health workers, and one even associated health workers' conduct with that of the Khmer Rouge guerrilla organisation.

"They [government health workers working at health facilities] are Khmer Rouge, not Kru Pets" (Wholesaler supplying retailers #3 MDRSC stratum)

Furthermore, customers were not only reported to choose a particular provider based on their own experience but also on that of other customers. Reputation within a community was reported to be key for increasing demand.

“Customers come here because of my reputation [...] customers make my reputation, it is mouth to mouth” (Drug shop # 6, remote market, MDRF stratum)

Reputation was said to be built on providers’ expertise in providing complementary services to drug sales, including medical consultation and clinical care services, and *Kru Pets* working at clinical pharmacies or as mobile providers were reportedly perceived to have more expertise than other providers, notably grocery and village shopkeepers who voluntarily admitted their lack of expertise.

“I don’t have health qualifications so I only sell drugs here so I have the smallest business of the village” (Village shop #1, accessible market, MDRF stratum)

This was also backed – up by the analysis of retail market shares by provider types presented in earlier in this chapter.

The agency role of grocery and village shopkeepers appeared to be more limited than that of other providers: 49.8% (95%ci 35.7-64.0) of grocery shops and 53.9% (95%ci 45.2-62.5) of village shops reported deciding which antimalarial customers received whilst 92.6% (95%ci 89.1-96.1) of mobile providers and 75.9% (95%ci 67.0-84.8) of pharmacies and clinical pharmacies did so (Table 5-9).

Table 5-9: Private providers reporting deciding which antimalarial customers receive
As % of private providers for whom the information was available, by provider type (N=635)

	Percentage of providers reporting deciding which antimalarial drugs customers receive (95%ci)
Pharmacies/Clinical Pharmacies n=96	75.9% (67.0-84.8)
Drug Shops n=101	73.3% (63.6-83.0)
Mobile Providers n=201	92.6% (89.1-96.1)
Grocery Stores n=88	49.8% (35.7-64.0)
Village Shops n=149	53.9% (45.2-62.5)

Source: ACTwatch Outlet Survey data, 38 sub-districts, June 2009

During SSIs, private providers described 2 different scenarios in which customers had a written prescription for antimalarials at the time of their visit. In the first scenario, one village shopkeeper reported that customers would come with prescriptions to buy drugs that the *Kru Pets* from whom they had first sought care had recommended but for which they were out of

stock, and that customers would then return to the treatment provider who would administer the treatment, in the case of an injection for instance. In the second scenario, a drug shopkeeper explained that it was common for health facility staff to have their own private shops, write prescriptions to their patients and send them to their shop, generally managed by their wives, or to the shop of someone they knew.

"[Kru]pets at the hospitals write prescriptions and send patients to shops that are managed by their wives." (Grocery shop #7, remote market MDRF stratum)

Health qualifications were also reported to signal expertise. During the OS, more than three-quarters of pharmacies/clinical pharmacies, drug shops and mobile providers reported having health qualifications compared to just above one quarter of grocery and village shops (Table 5-10). Compared to all other retailer types, village shops were less likely to report a staff member who had completed secondary or even primary education as indicated by the 95% confidence interval (Table 5-10). Very few retailers reported employing a pharmacist or pharmacist assistant and the most frequently reported qualifications were midwives followed by medical assistants. OS data showed that a median of 2 people generally worked at private outlets, of whom one was sometimes reported, during SSIs, to be qualified, generally working at the local health facility, or semi-qualified, having received some training just after the fall of the Khmer Rouge regime. Some mobile providers also reported having acquired experience in the United Nations camps that were set up in Cambodia after the fall of the Khmer Rouge regime.

Table 5-10: Retailers reporting having a staff member with completed primary and secondary education and with health qualifications

As % of providers for whom the information was available, by provider type (N=644)

Shopkeepers reporting they had a staff member ...	Pharmacies/ clinical pharmacies n=96	Drug shops n=103	Mobile providers n=202	Grocery stores n=90	Village shops n=153
...who has completed primary school	98.7% (96.3-100)	93.0% (87.8-98.2)	80.5% (73.0-88.2)	84.4% (76.2-92.6)	59.3% (51.0- 67.7)
...who has completed secondary school	92.0% (86.1-97.8)	80.6% (72.6-88.4)	54.6% (46.0-63.2)	56.1% (42.1-70.0)	31.5% (23.4-39.6)
...with health qualifications	89.6% (83.2-96.0)	82.4% (74.5-90.4)	75.4% (67.5-83.4)	27.8% (17.0-38.7)	26.2% (18.3-34.2)
...who is a pharmacist	1.1% (0.0-2.7)	0.0% (0.0-0.0)	0.5% (0.0-1.5)	0.0% (0.0-0.0)	0.0% (0.0-0.0)
...who is a pharmacist assistant	0.0% (0.0-0.0)	0.5% (0.0-1.5%)	0.4% (0.0-1.4%)	0.0% (0.0-0.0)	0.3% (0.0-1.0%)
...who is a nurse	21.6% (4.8-46.7)	17.5% (9.3-25.7)	21.2% (15.3-27.1)	3.0% (0.0-6.5)	7.7% (2.7-12.6)
...who is a midwife	25.0% (15.0-35.1)	22.2% (13.0-31.4)	15.5% (10.1-21.0)	1.9% (0.0-4.6)	3.8% (0.0-7.3)
...who is a medical doctor	15.8% (7.8-23.9)	2.0% (0.0-4.3)	0.9% (0.0-2.1)	0.0% (0.0-0.0)	0.0% (0.0-0.0)
...who is a medical assistant	27.5% (17.8-37.1)	22.0% (10.1-35.7)	6.5% (3.0-10.0)	5.8% (0.9-10.6)	1.9% (0.0-4.0)

Source: ACTwatch Outlet Survey data, 38 sub-districts, June 2009.

5.3.6 Provision of cocktail therapy

During SSIs, the provision of cocktail therapy was said to affect customers' choice of provider for antimalarial drugs. However, during the OS, few providers actually reported selling antimalarial drugs as part of cocktails (Table 5-11). The reasons for this are unclear but it is possible that providers underreported this practice during the OS. During the survey, those who said they reported selling antimalarials as part of cocktails reported that cocktails involved a mixture of up to 7 different types of drugs, although more generally 3. The most common antimalarial drugs included in cocktails were reportedly quinine, followed by chloroquine or artesunate, supplemented most frequently by paracetamol or sometimes tetracycline (but never in combination with quinine) and finally vitamin C. During SSIs, almost all private providers reported that providing cocktails was more profitable than selling other drugs only, with OS data revealing that the median price charged for cocktails for treating malaria was US\$ 1.88 (IQR 0.71-2.82).

Table 5-11: Retailers reporting selling antimalarial drugs as part of cocktail therapies for treating malaria symptoms

As % of providers for whom the information was available, by provider type (n=644)

	Percentage of providers who reported selling antimalarial in cocktail therapy (95%ci)
Pharmacies/Clinical Pharmacies n=96	4.4% (0.0-8.2)
Drug Shops n=103	4.9% (0.0-9.0)
Mobile Providers n=202	2.5% (0.0-9.4)
Grocery Stores n=90	3.4% (0.0-5.0)
Village Shops n=153	4.3% (0.0-8.0)

Source: ACTwatch Outlet Survey data, 38 sub-districts, June 2009.

5.3.7 Provision of blood testing services

The OS data showed that some private shopkeepers stocked RDT or offered microscopy services and that it was variable across provider types. The availability of blood testing was reportedly higher at outlets providing treatment such as mobile providers, pharmacies/clinical pharmacies and government health facilities (Table 5-12).

Table 5-12: Retail availability of blood testing services

As % of providers for whom the information was available (N=789)

	Percentage of providers offering microscopy services (95%ci)	Percentage of providers where RDT were available (95%ci)
Pharmacy/clinical pharmacies n=96	37.8% (27.3-48.4)	57.9% (47.1-68.9)
Drug stores n=103	32.3% (19.8-44.8)	38.5% (27.6-49.4)
Mobile providers n=202	44.8% (36.7-53.0)	41.7% (32.9-50.5)
Grocery stores n=90	3.6% (0.0-7.2)	33.8% (18.0-44.6)
Village shops n=151	3.7% (0.0-7.1)	8.7% (4.4-12.9)
Government facilities n=45	48.9% (26.4-71.5)	86.4% (75.8-97.0)
Village Malaria Workers n=102	3.1% (0.0-7.5)	72.1% (58.7-85.6)

Source: ACTwatch Outlet Survey data, 38 sub-districts, June 2009.

However, during SSIs with antimalarial retailers, the provision of blood testing services was rarely reported as a strategy for attracting custom. Customers were reportedly rarely interested in receiving a blood test because they were said to claim that they could recognize malaria themselves.

“Customers don't want to have their blood tested because they know it is malaria, they say they got it last year”. (Wholesaler supplying retailers #7, MDRSC stratum)

Providers who reported offering blood testing services were probed about their actions when customers refused to take a test. Most providers said that they would sell the drugs though a couple indicated they would warn customers that if the treatment failed or “something went wrong” they would decline any responsibility and would refuse any complaints from customers. One provider also reported that in such a case he would sell the antimalarial drug but at a lower dose than usual.

“When customers do not want to take a blood test, I give the drugs but in smaller quantities and I warn them [customers] that if something goes wrong or if they are not cured, they cannot come back and complain” (Grocery shop #11, remote market, MDRF stratum)

Another reason for not providing blood tests by some shopkeepers was that customers were reported to have visited private laboratories before visiting shops so that they already had a written prescription confirming malaria infection and would therefore only buy antimalarials.

One shopkeeper reported not selling RDTs because he said that the regulation forbade taking blood at private shops. A couple of shopkeepers also mentioned that the availability of a single buffer vial in a box of 10 tests prevented them from selling single RDT units to individual patients as the latter could not perform the test alone when back home.

General shopkeepers admitted being uncomfortable testing blood, a practice perceived to be within the remit of providers of treatment services (e.g. injections) only.

“I don't do blood tests. It is because I do not do treatment, I am not a Kru Pet. I only do cocktails” (Village shop #1, accessible market, MDRF stratum).

Whilst RDT were perceived to be easy to use and to produce fast results, their accuracy was questioned and preference was given to microscopy services, perceived to provide more precise results.

"I stocked Malacheck before; I had received training from PSI. But I stopped stocking it because now there is a clinical pharmacy with a microscope in the area" (Grocery shop #7, remote market, MDRSC stratum).

One clinical pharmacy owner argued that RDT were only effective for detecting severe malaria cases whilst another one indicated that RDT, such as Malacheck, could only detect *P.f* parasites, which was reported to be a challenge as patients could be infected by other parasite types. However, microscopy services were likely to require more expertise than RDT, creating barriers for untrained shopkeepers to test blood. This was corroborated by the OS report which showed that microscopy services tended to be less common at grocery and village shops than at other outlets (Section 2.6)(ACTwatch Group, 2009b).

"Only my husband uses the microscope, he was trained when he was working for the Government" (Pharmacy/clinical pharmacy # 9, accessible market, Phnom Penh).

During SSIs, some retailers also reported frequent RDT stock-outs.

"I have problems with the availability of tests. I don't know why but sometimes I cannot buy tests. I just heard from my supplier that it was because of a problem with manufacturing capacity" (Mobile Provider # 2, accessible market, MDRF stratum).

5.3.8 Offering credit

During the outlet survey, 40.5% of all providers reported they had offered credit to antimalarial drug customers during the month preceding the survey, with a significantly larger percentage of mobile providers doing so compared to other provider types (Table 5-13). The most frequently mentioned customer types to which credit was reportedly given included people who could not afford (22.0% of providers), people known to the provider (12.0%) and regular customers (3.5%).

*Table 5-13: Retailers who reported offering credit to antimalarial customers
As % of all providers for whom the information was available (N=627)*

	Percentage of outlets who reported offering credit to antimalarial customers in the past month (95%ci)
Pharmacy/Clinical Pharmacy n=94	25.7% (16.4-35.1)
Drug Store n=99	27.4% (17.5-37.3)
Mobile Provider n=199	58.4% (50.4-66.4)
Grocery Store n=86	35.7% (21.6-49.8)
Village Shop n=149	37.8% (29.5-46.2)

Source: ACTwatch Outlet Survey data, 38 sub-districts, June 2009.

Yet during SSIs, almost all providers who reported providing credit said that it was limited to customers that they had known for a long time. Some respondents said they did not offer credit to customers in general because of the challenge of being reimbursed. Several providers who offered credit indicated that customers sometimes paid them back after many months or even years and, at times, never so that default payments reportedly led to large sums of money lost.

“Bad debts are an important cost, around 4 million riel [around US\$ 900] per year lost” (Mobile provider # 8, remote market, MDRF stratum)

In summary, SSIs with providers suggested that malaria treatment was highly differentiated across providers, notably between private shops and government providers. Consumers were said to prefer private commercial retailers over public health facilities because the former were more conveniently located, with some providing door-to-door services; available at any time of day and night; and offered a more courteous and reliable source of malaria treatment. Customers were perceived to rely on their personal experience and when they had gained positive experiences, they remained loyal to these providers. Reputation within the community was also reported to be key for increasing demand. Reputation appeared to be built on providers' length of operation in a market and perceived experience in treating malaria. Customers were said to prefer Malarine because of its perceived high quality and popularity, creating stocking incentives for providers. However, Malarine's reported side effects were said to lead customers to choose other drugs, notably monotherapies. Some providers therefore reported that they continued stocking artemisinin monotherapies even though they knew that sales of such products were forbidden. There was some evidence that cheaper products and services available locally attracted customers, including when these

were provided free of charge by village malaria workers. The provision of cocktail drugs was also reported as a profitable activity that attracted custom, although during the OS few providers reported offering malaria treatment in cocktail form. The provision of blood testing services was rarely reported as a strategy for attracting custom for antimalarial drugs although it was clear that microscopy services and RDT were available from many outlets. Overall, microscopy services were reported to require training and expertise and, whilst RDT were perceived to be easy to use, they were said to be less precise for confirming malaria infection. Finally, credit facilities were restricted to customers known to providers but were also sometimes made available to those who could not afford treatment, despite the risks of payment defaults.

5.4 Summary

In this chapter, the range of retail providers and antimalarial drugs available in the retail sector was described and their relative importance assessed. The retail market was defined from an economic lens and market concentration by provider and product types, market accessibility and malaria transmission risk were assessed. Market contestability as perceived by private shopkeepers was explored and the degree of product differentiation and nature of non-price competition within the retail market were analysed. The structure and operations of private retailers are likely to be shaped by the structure of the distribution chain and conduct of their suppliers, which are analysed in the next chapter.

CHAPTER 6 THE PRIVATE COMMERCIAL SECTOR

DISTRIBUTION CHAIN FOR ANTIMALARIAL DRUGS

6.1 Introduction

In this Chapter, the structure of the private commercial sector distribution chain for antimalarial drugs is described and the importance and nature of product differentiation and non-price competition is assessed for different levels of the chain. In Section 6.2, the distribution chain for antimalarial drugs is mapped, wholesalers' characteristics and the range of products stocked are presented and concentration and contestability at different levels of the chain are assessed. In Section 6.3, the importance and nature of product differentiation and non-price competition in the distribution chain for antimalarial drugs are considered. In this Chapter, we use quantitative data from the ACTwatch Outlet Survey (OS) and Supply Chain Survey (SCS) and qualitative data collected during semi-structured interviews (SSIs) with retailers and wholesalers.

6.2 Structure of the distribution chain

This section describes the structure of the distribution chain serving the retail markets presented in Chapter 5.

6.2.1 Identifying wholesale suppliers

Wholesalers who supplied antimalarials directly to retailers were identified using OS data on retailers' top 2 supply sources for antimalarial drugs, focusing on a random sample of 20 sub-districts. Retailers reported a total of 322 supply sources, of which 91 (28%) were obvious duplicates (a source named by more than one shopkeeper). Uncertainties around the 231 other suppliers' business name or location were clarified by calling wholesale outlets, and in the absence of contact numbers, advice on location was sought from local informants, including PSI staff members and data collectors who had participated in the OS data collection. Through this process, an additional 65 (20%) duplicates were identified. For 39 (12%) supply sources, there was too little information on either business name or location for identification, so these sources were removed. A total of 127 (39%) suppliers remained and formed the sample of terminal wholesalers. Out of the 127 terminal level wholesalers sampled, 92 were invited to participate in the supply chain survey (SCS), of which 89 were successfully

interviewed and 3 refused, 18 were duplicates, 5 were not eligible (stocking neither antimalarials nor rapid diagnostic tests for malaria (RDT) at the time of the interview or in the preceding 3 months), 2 could not be interviewed for other reasons and 10 were not found (Table 6-1). All 89 terminal wholesalers who were successfully interviewed were asked about their top two supply sources for antimalarials.

A sample of 26 unique wholesalers, referred to as intermediate-1 wholesalers as they supplied terminal wholesalers, were identified, comprising 12 wholesalers who had already been identified at the terminal level (as they also supplied retailers directly), and 14 new wholesalers. Of these 14 wholesalers, 6 were successfully interviewed, 2 refused, 4 were not eligible and 2 could not be interviewed for other reasons (Table 6-1). All 6 successfully interviewed intermediate wholesalers were asked about their two top supply sources for antimalarials.

Two intermediate-2 wholesalers were identified, both of whom had already been identified at previous levels and who had reported antimalarial manufacturers to be their top two supply sources. To this effect, the top of the chain was deemed to have been reached.

Table 6-1: Supply chain survey data collection process

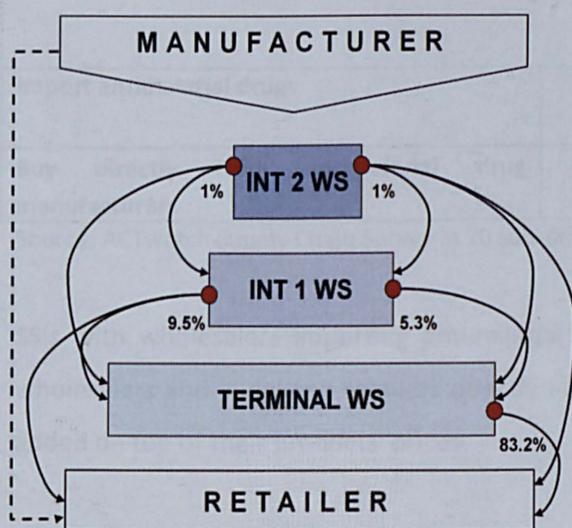
Levels of operation	Initial Sample Size	Number identified at previous level(s)	Number of refusals	Number of duplicates ¹	Number not eligible ²	Number not interviewed for other reasons ³	Number not found	Number of interviews completed
Total	-	-	5	18	9	4	10	95
Terminal	127	-	3	18	5	2	10	89
Intermediate-1	26	12	2	0	4	2	0	6
Intermediate-2 ⁴	2	2	0	0	0	0	0	0

¹ Wholesalers included in the initial sample size and found to be duplicates during data collection. ² Outlets not stocking antimalarials or RDT at the time of the interview or in the preceding 3 months. ³ At terminal level, 1 wholesaler was closed at the time of visit and 1 wholesaler had moved. At intermediate-1 level, one wholesaler had closed down and one did not speak English or Khmer. ⁴ This is the top of the chain, defined as the level at which wholesalers who were reported to supply intermediate-1 wholesalers mentioned manufacturers to be their two top supply sources for antimalarials. Source: ACTwatch Supply Chain Survey in 20 sub-districts, August-November 2009

6.2.2 Mapping the distribution chain for antimalarial drugs

The overall structure of the private commercial sector distribution chain for antimalarials in Cambodia is depicted in Figures 6-1 and 6-2. As described in Chapter 4, the structure of the distribution chain was explored by classifying wholesalers into mutually-exclusive categories (MECs) defined by the levels they supplied, whilst for analytical purposes, wholesalers were grouped into 2 broader and overlapping categories, with one including wholesalers supplying retailers and one wholesalers supplying wholesalers. Table 6-2 shows the relationship between MECs and analytical categories.

Figure 6-1: Representation of the antimalarial distribution chain showing interactions between levels by mutually exclusive wholesaler category



WS is for wholesaler; INT is for intermediate

Source: ACTwatch Supply Chain Survey in 20 sub-districts, August-November 2009

Figure 6-2: Representation of the antimalarial distribution chain showing the overlap between wholesaler categories used for analysis

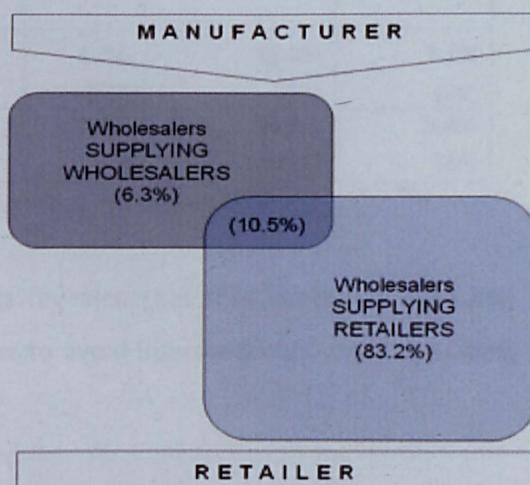


Table 6-2: Relationship between mutually exclusive and analytical categories of wholesalers

	Total	MUTUALLY EXCLUSIVE CATEGORIES OF WHOLESALERS					ANALYTICAL CATEGORIES OF WHOLESALERS	
		Supply Retailers	Supply Retailers & Terminal WS	Supply Terminal WS	Supply Intermediate & Terminal WS	Supply Intermediate, Terminal WS & Retail	Supply Retailers	Supply WS
Percentage of WS	100%	83.2%	9.5%	5.3%	1.0%	1.0%	93.7%	16.8%
(Number of WS)	(95)	(79)	(9)	(5)	(1)	(1)	(89)	(16)

WS is for wholesaler

Source: ACTwatch Supply Chain Survey in 20 sub-districts, August-November 2009

The private commercial sector distribution chain had a pyramid shape with a particularly broad base and narrow top: wholesalers were concentrated at the lowest level of the chain, with 83.2% supplying retailers only, 10.5% supplying wholesalers and retailers and 6.3% wholesalers only. Overall, a small proportion of wholesalers reported they imported antimalarial drugs and/or bought directly from drug manufacturers (Table 6-3). Suppliers operated at 3 overlapping levels of operation (intermediate-2 wholesalers, intermediate-1 and terminal wholesalers), with nearly all wholesalers (93.7%) supplying retailers and very few supplying wholesalers only (6.3%).

Table 6-3: Wholesalers' buying practices
As % of all wholesalers interviewed

		WHOLESALER CATEGORIES		
		ALL	SUPPLY WHOLESALERS	SUPPLY RETAILERS
Import antimalarial drugs	% (N)	3.2% (95)	18.8% (16)	2.3% (89)
Buy directly from antimalarial drug manufacturers	% (N)	5.3% (95)	18.8% (16)	3.4% (89)

Source: ACTwatch Supply Chain Survey in 20 sub-districts, August-November 2009

SSIs with wholesalers importing antimalarial drugs revealed that they preferred bypassing wholesalers and supplying retailers directly in order to avoid intermediaries' mark-ups being added on top of their products' prices.

"We try to avoid selling to other wholesalers because they add their margin and then the retail price of our product goes up [...]"(Wholesaler supplying retailers #1, Phnom Penh)

Wholesalers who imported antimalarials never reported exchanging products with one another. Vertical integration did not seem to exist as none of the retailers or wholesalers reported owning other retail or wholesale businesses.

Intersectoral transactions sometimes occurred between retailers with private shops reporting public (military forces and public health facilities) or nongovernmental (NGO and research institutes) suppliers as one of their top two supply sources for antimalarial drugs. However, no public facilities reported a private wholesaler as one of their top suppliers.

6.2.3 Wholesalers' characteristics

Wholesalers had been in operation for a median of 10 years (IQR 6-16) and were relatively small businesses as they had a median of 2 workers (IQR 2-3), although wholesalers supplying wholesalers tended to be slightly bigger with 3 workers (IQR 2-4) (Table 6-4). Wholesalers stocked a median of 2 (IQR 2-4) different antimalarial products and frequently other consumer goods (Table 6-4) with 22% of wholesalers reporting selling toiletries, 18% mobile airtime, 8.5% cigarettes, 6% groceries and 6% household goods.

Table 6-4: Years in operation, wholesale outlet size and range of products sold

CHARACTERISTICS		WHOLESALER CATEGORIES		
		ALL	SUPPLY WHOLESALERS	SUPPLY RETAILERS
Years in operation	median	10	10	10
	IQR	6-16	8-16	6-16
	(N)	(89)	(14)	(83)
Number of people working at outlet	median	2	3	2
	IQR	2-3	2-4	2-3
	(N)	(94)	(16)	(88)
Sells other products in addition to pharmaceuticals ¹	%	39.0%	31.3%	39.3%
	(N)	(95)	(16)	(89)

IQR is for inter-quartile range; ¹other products included toiletries, mobile air time, cigarettes, prepared food/ groceries and/or household goods. Source: ACTwatch Supply Chain Survey in 20 sub-districts, August-November 2009

Most (93.7%) wholesalers reported selling antimalarials directly to patients/care takers, with a higher proportion doing so amongst wholesalers supplying retailers compared to wholesalers supplying wholesalers (95.5% vs. 81.3%) (Table 6-5).

There was some evidence of private sector sales to public retail outlets, with for example village malaria workers (VMWs) and public hospitals mentioned by private wholesalers to be customers for antimalarial drugs (Table 6-5). However, as indicated in the previous section, private wholesalers were never reported by government providers to be one of their top 2 suppliers for antimalarial drugs, indicating that private sector sales to public outlets were unlikely to have been the norm.

Table 6-5: Wholesalers' customers for antimalarial drugs
As % of wholesalers interviewed for whom the information was available

ANTIMALARIAL CUSTOMER TYPES		WHOLESALER CATEGORIES		
		ALL	SUPPLY WHOLESALERS	SUPPLY RETAILERS
Patients/care-takers	%	93.7%	81.3%	95.5%
	(N)	(95)	(16)	(89)
Retail outlets				
Retail pharmacies	%	30.5%	50.0%	28.1%
	(N)	(95)	(16)	(89)
Depots A and/or B	%	17.0%	43.8%	13.5%
	(N)	(94)	(16)	(89)
Drug shops	%	40.7%	37.5%	40.5%
	(N)	(91)	(16)	(89)
Cabinets	%	43.2%	62.5%	40.5%
	(N)	(95)	(16)	(89)
Private health facilities ¹	%	10.5%	37.5%	9.0%
	(N)	(95)	(16)	(89)
Franchised Sun Quality Health Clinics	%	3.3%	6.7%	3.7%
	(N)	(92)	(15)	(89)
Grocery stores	%	26.9%	25.0%	27.0%
	(N)	(93)	(16)	(89)
Mobile vendors	%	16.1%	25.0%	16.9%
	(N)	(93)	(16)	(89)
Public hospitals	%	12.6%	31.3%	11.2%
	(N)	(95)	(16)	(89)
Public health centres	%	10.5%	25.0%	9.9%
	(N)	(95)	(16)	(89)
Village malaria workers	%	14.9%	18.8%	15.7%
	(N)	(94)	(16)	(89)
NGO/mission clinics	%	7.4%	18.8%	5.6%
	(N)	(95)	(16)	(89)
Wholesale outlets				
Wholesale pharmacies	%	17.9%	43.8%	14.6%
	(N)	(95)	(16)	(89)
General wholesale businesses	%	9.6%	18.8%	9.0%
	(N)	(94)	(16)	(89)
Customers in other countries	%	1.1%	0.0%	1.5%
	(N)	(93)	(15)	(78)

NGO is for non-governmental organisation. ¹ These include clinical pharmacies and any other outlets providing inpatient care (but larger than cabinets). Source: ACTwatch Supply Chain Survey in 20 sub-districts, August-November 2009

Data on wholesalers' health qualifications, training and knowledge are presented in Table 6-6. Around 63% of all wholesalers reported employing a member of staff with health qualifications, with the most common qualifications reported to be midwives (34%), followed by medical doctors, whilst 15% reported employing a member of staff with pharmacist qualifications. In addition, 60% of wholesalers reporting employing staff who participated in in-service training related to malaria treatment (Table 6-6).

Wholesalers' knowledge of the recommended first line treatment for uncomplicated *P.f* was high: 76.3% of all wholesalers reported ASMQ to be recommended by government with this knowledge being more common amongst wholesalers supplying higher levels of the chain (81.2% of wholesalers supplying higher levels compared to 74.7% of wholesalers supplying retailers) (Table 6-6). ACT was identified as the most effective treatment for *P.f* malaria in adults by 70% of wholesalers supplying higher levels and 87% of wholesalers supplying retailers. However, ACT was less frequently mentioned as the most effective treatment for the treatment of *P.f* malaria in children, with nearly 74% of all wholesalers doing so (Table 6-6).

Table 6-6: Wholesalers' knowledge, qualifications and training
As % of wholesalers interviewed for whom the information was available

HEALTH QUALIFICATIONS, TRAINING AND KNOWLEDGE		WHOLESALE CATEGORIES		
		ALL	SUPPLY WHOLESALERS	SUPPLY RETAIL LEVEL
Employ a member of staff with health qualifications	% (N)	63.4% (93)	50.0% (16)	65.5% (87)
Employ staff who participated in in-service training related to malaria treatment	% (N)	59.8% (92)	62.5% (16)	61.6% (86)
Identify an ACT as the most effective medication for treating uncomplicated <i>Pf</i> malaria in adults	% (N)	86.1% (72)	70.0% (10)	87.0% (69)
Identify an ACT as the most effective medication for treating uncomplicated <i>Pf</i> malaria in children	% (N)	73.6% (53)	77.8% (9)	72.0% (50)
Correctly identify the government recommended first line treatment for uncomplicated <i>Pf</i> malaria	% (N)	76.3% (93)	81.3% (16)	74.7% (87)

Source: ACTwatch Supply Chain Survey in 20 sub-districts, August-November 2009

6.2.4 Range of antimalarials and RDT stocked

Of the 95 wholesalers interviewed, around 5% did not stock any antimalarial drugs at the time of the survey but reported stocking antimalarials during the 3 months preceding the survey.

Artemisinin combination therapy (ACT) availability was relatively high with 88.4% of all wholesalers stocking it at the time of the survey and somewhat higher amongst wholesalers supplying retailers (89.9%) than those supplying wholesalers (81.3%) (Table 6-7). The ACT artesunate and mefloquine (ASMQ) was stocked by 85.3% of all wholesalers and Malarine, the socially marketed first line therapy in the private commercial sector, by 81% of all wholesalers. Overall, 75.8% reported having at least one ACT in stock throughout the 3 months preceding the interview (Table 6-7).

Non-artemisinin monotherapy (nAMT) was stocked by around 34% of all wholesalers and artemisinin monotherapy (AMT) by around 27% of all wholesalers, although the importation, distribution and sale of the latter had been banned in November 2008. As for RDT, 86% of all wholesalers stocked RDTs and 76% Malacheck, the socially marketed product (Table 6-7).

Table 6-7: Antimalarial and RDT wholesale availability
As % of wholesalers interviewed

AVAILABILITY		WHOLESALER CATEGORIES		
		ALL	SUPPLY WHOLESALE	SUPPLY RETAILERS
Had antimalarials in stock	% (N)	94.7% (95)	87.5% (16)	96.6% (89)
Had ACT in stock	% (N)	88.4% (95)	81.3% (16)	89.9% (89)
Always had at least one ACT in stock over the past 3 months ¹	% (N)	75.8% (95)	75.0% (16)	76.4% (89)
Had AMT in stock	% (N)	27.4% (95)	25.0% (16)	28.0% (89)
Had nAMT in stock	% (N)	33.7% (95)	31.3% (16)	34.8% (89)
Had RDT in stock	% (N)	86.3% (95)	87.5% (16)	87.6% (89)

ACT is for artemisinin combination therapy; AMT for artemisinin monotherapy; nAMT for non artemisinin monotherapy; RDT for rapid diagnostic test for malaria.¹Indicator calculated as [(Number of wholesalers with ACT in stock) – (Number of wholesalers with stock-out in past 3 months) + (Number of wholesalers who stocked other ACT than those surveyed during the period of stock out)]/ (Total Number of wholesalers surveyed. Source: ACTwatch Supply Chain Survey in 20 sub-districts, August-November 2009

In terms of the importance of first-line treatments for malaria in relation to other antimalarials within the distribution chain: ASMQ accounted for 63% of all antimalarial drugs stocked and 93% of all ACT stocked, with Malarine accounting for 58% of all antimalarials stocked and 86% of all ACT stocked; finally, chloroquine accounted for 13% of all antimalarial drugs stocked and for 77% of all nAMT. As for RDT, Malacheck represented 89% of all RDT stocked.

6.2.5 Antimalarial and RDT sales volumes

Antimalarial sales volumes for the week preceding the survey appeared to be low: amongst all wholesalers, the median number of adult equivalent treatment doses (AETDs) sold was 2 (IQR 0,10) for ACT and 0 (IQR 0,0) for both AMT and nAMT (Table 6-8). When restricting the calculation to wholesalers who stocked each corresponding antimalarial category, volumes were higher with 2.1 (IQR 0,10) doses of ACT, 0.4 (0,10) of AMT and 5.8 (IQR 0,16.7) doses of nAMT reported to have been sold over the week preceding the survey (Table 6-9).

Several factors may have contributed to these somewhat surprisingly low wholesale sales volumes. First, wholesalers reported selling antimalarials to end-users and they shared many common characteristics with retailers. As a result, their business many have overall not been very different from that of retailers. Second, malaria prevalence is relatively low in Cambodia so sales volumes may just be lower than one would expect to observe at wholesale outlets. Third, sales volumes were recalled for the week preceding the survey, which was implemented between August and November 2009 and antimalarial wholesalers may have sold the bulk of their stocks at the start of the malaria season in May or June, implying that the recall period may have been too short for capturing representative wholesale sales. Alternatively, data collection may have taken place too late in relation to the wholesale stocking cycle. However, asking wholesalers to recall their sales volumes over a longer period than a week would have likely introduced recall bias and/or many non-responses (the recall issue is assessed in Chapter 8 of this thesis).

Table 6-8: Sales volumes amongst all wholesalers

In adult equivalent treatment dose (AETD) for antimalarials and in test unit for RDT, among all wholesalers with sales volume data³²

ANTIMALARIAL CATEGORIES Formulation		WHOLESALER CATEGORIES		
		ALL N=93	SUPPLY WHOLESALEERS N=15	SUPPLY RETAILER N=83
ACT (All products were tablets)	Median	2.0	2.0	2.0
	IQR	0.0-10.0	0.0-10.0	0.0-10.0
AMT All	Median	0.0	0.0	0.0
	IQR	0.0-0.0	0.0-0.0	0.0-0.0
AMT Tablet	Median	0.0	0.0	0.0
	IQR	0.0-0.0	0.0-0.0	0.0-0.0
AMT Injectable	Median	0.0	0.0	0.0
	IQR	0.0-0.0	0.0-0.0	0.0-0.0
nAMT All	Median	0.0	0.0	0.0
	IQR	0.0-0.0	0.0-2.0	0.0-0.0
nAMT Tablet	Median	0.0	0.0	0.0
	IQR	0.0-0.0	0.0-2.0	0.0-0.0
nAMT Injectable	Median	0.0	0.0	0.0
	IQR	0.0-0.0	0.0-0.0	0.0-0.0
RDT	Median	0.0	10.0	0.0
	IQR	0.0-20.0	0.0-30.0	0.0-20.0

ACT is for artemisinin combination therapy; AMT is for artemisinin monotherapy; nAMT is for non artemisinin monotherapy; RDT is for rapid diagnostic test for malaria. IQR is for inter-quartile range; Source: ACTwatch Supply Chain Survey in 20 sub-districts, August-November 2009

³²For antimalarials: there were a total of 93 wholesalers with antimalarial sales volume data (reported or imputed or set as null if did not stock). Note on the imputation process: during the study, 100 wholesalers were identified, of which 95 were interviewed and 5 refused (Table 6-1). Out of the 95 interviewed, 3 wholesalers interrupted the interview before the drug inventory so sales volumes were set as missing for all antimalarial categories. Out of the 5 wholesalers that refused, 1 did not stock any antimalarial (only RDT) so sales volumes were set as zero, and for the other 4 wholesalers who stocked antimalarials sales volumes were set as missing. For 4 outlets that did not stock antimalarials at the time of the survey but stocked RDT only, sales volumes were set as zero for all antimalarial categories. For RDTs, there were 94 wholesalers with sales volumes and no imputation was required because sales volumes were never missing for those who participated in the inventory. Sales volumes were however set as missing for 6 wholesalers, including 5 who had refused to participate in the SCS and who stocked RDT and 1 who interrupted the interview before the inventory. At the level supplying retail outlets, median sales volumes estimated on the sample of 85 wholesalers for which volumes were not missing.

Table 6-9: Sales volumes amongst wholesalers with antimalarials in stock
 In adult equivalent treatment dose (AETD) for antimalarials and in test unit for RDT,
 amongst wholesalers stocking corresponding antimalarial drug category/RDT at the time of the survey.

ANTIMALARIAL CATEGORIES		WHOLESALE CATEGORIES		
		ALL	SUPPLY WHOLESALE	SUPPLY RETAIL LEVEL
ACT	Median	2.1	3.0	2.2
All	IQR	0.0-10.0	0.0-10.0	0.0-10.0
	(N)	(84)	(13)	(80)
AMT	Median	0.4	0.0	0.8
All	IQR	0.0-10.0	0.0-0.42	0.0-11.3
	(N)	(24)	(4)	(23)
nAMT	Median	5.8	2.6	6.7
All	IQR	0.0-16.7	0.0-83.3	0.0-16.7
	(N)	(32)	(5)	(31)
RDT	Median	0.0	10.0	0.0
	IQR	0.0-20.0	0.0-30.0	0.0-20.0
	(N)	(81)	(13)	(75)

ACT is for artemisinin combination therapy; AMT is for artemisinin monotherapy; nAMT is for non artemisinin monotherapy; RDT is for Rapid diagnostic test for malaria. IQR is for inter-quartile range; N is the number of wholesalers at a given level who stocked antimalarials for corresponding antimalarial category Source: ACTwatch Supply Chain Survey in 20 sub-districts, August-November 2009

6.2.6 Concentration in the distribution chain

During SSIs with wholesalers, most respondents reported facing competition from wholesalers located in their district or their province whilst some said that wholesalers located further away also competed, notably when the latter delivered antimalarials to retailers. In the context where many wholesalers operated at different levels of the chain, it was not possible to use traditional measures (e.g. HHI) for assessing concentration at terminal and intermediate levels of the chain.

An alternative approach for assessing concentration in the distribution chain was to look at the number of times each supplier is mentioned. A limitation to this approach within our study was that data were collected on retailers and wholesalers' top 2 supply sources by name, which could have made the market look artificially concentrated if retailers and wholesalers also used other suppliers. We investigated the potential of using data on the number of mentions for assessing concentration drawing on data on the total number of suppliers that each retailer and wholesaler reported buying antimalarial drugs from during the OS and SCS, supplemented by information on the name of each supplier they used collected during SSI with

retailers and wholesalers. OS and SCS data showed that the majority (71%) of retailers reported having a single supplier for antimalarial drugs whilst 23% reported using 2 suppliers and 6% 3 or more suppliers. Similarly, 63% of wholesalers reported using a single supplier for antimalarial drugs, 26% two suppliers and 11% three or more (Figure 6-3).

This was in tune with data collected during SSIs, where both retailers and wholesalers reported using one or two suppliers only for antimalarial drugs.

"I always buy from the same supplier" (Mobile provider #2, accessible market, MDRF stratum)

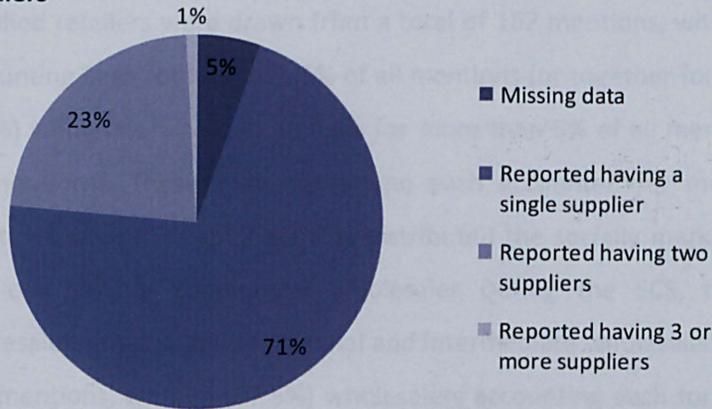
"I have always used the same 2 suppliers since I started, 8 years ago" (Wholesaler supplying retailers #1, MDRF stratum)

In cases where retailers and wholesalers reported using 2 suppliers, they commonly mentioned the non-governmental organisation Population Services International in Cambodia (PSI Cambodia) and a local supplier operating within their district or province. Reasons for this will be explored later in this chapter under product differentiation and non-price competition section.

Figure 6-3: Retailers and wholesalers' supply sources for antimalarials

As % of retailers and wholesalers interviewed

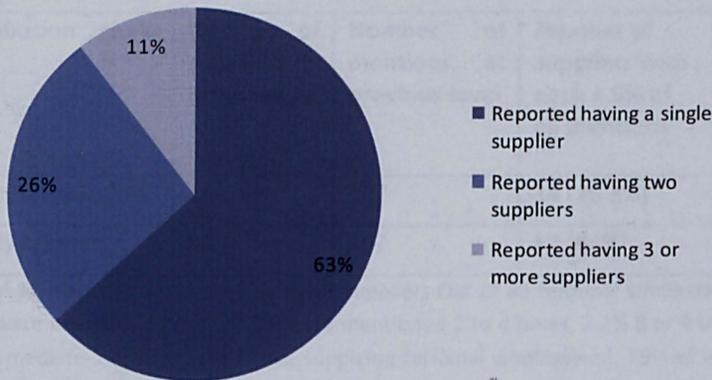
Retailers¹



Source: ACTwatch Outlet Survey in 38 sub-districts, June 2009

¹From the OS data, it was unclear why for 5% of retailers' supply sources data were missing. This may have reflected refusals from retailers to disclose the number of antimalarial suppliers they used or retailers may have forgotten or perhaps did not know from how many suppliers they had bought antimalarials from, especially if respondents were not the person in charge of buying antimalarials

Wholesalers



Source: ACTwatch Supply Chain Survey in 20 sub-districts, August to November 2009

In view of these findings, concentration within the distribution chain was explored using data on the number of times each unique supplier was mentioned at a given level of the chain.

Table 6-10 presents the results. The level supplying wholesalers was relatively more concentrated than the level supplying retailers. The 89 unique terminal wholesalers that supplied retailers were drawn from a total of 167 mentions, with 87 (97.8%) unique suppliers accounting each for less than 5% of all mentions (or together for 84% of all mentions) whilst 2 (2.2%) wholesalers accounted each for more than 5% of all mentions (or together for 16% of all mentions). These 2 suppliers who each accounted for more than 5% of all retailers' mentions were PSI Cambodia that distributed the socially marketed subsidized ACT and RDT and one private commercial wholesaler. During the SCS, the 16 unique intermediate wholesalers (that supplied terminal and intermediate wholesalers) were drawn from a total of 137 mentions, with 14 (87.5%) wholesalers accounting each for less than 5% of all mentions (or together for 26.3% of all mentions) whilst 2 (12.5%) wholesalers accounted each for more than 5% of all mentions (or together for 73.7% of all mentions) (Table 6-10). PSI Cambodia and the private commercial wholesaler were also those 2 suppliers with more than 5% of all mentions at higher levels. Overall, they accounted for 39.0% of all mentions, with PSI Cambodia accounting for 35.1% of all mentions.

Table 6-10: Concentration in the distribution chain for antimalarial drugs

Distribution chain level	Number of suppliers interviewed	Number of mentions at previous level	Number of suppliers with each < 5% of all mentions ¹	Number of suppliers with each ≥ 5% of all mentions ¹
Supply wholesalers	16	137	14 (26.3%)	2 (73.7%)
Supply retailers	89	167	87 (84%)	2 (16%)

¹As % of all mentions accounted by these suppliers. Out of 89 terminal wholesalers who supplied retailers directly, 67.4% were mentioned once, 29.2% were mentioned 2 to 4 times, 2.2% 8 or 9 times and 1.1% 18 times. Out of the 16 intermediate-1 wholesalers (those supplying terminal wholesalers), 75% of intermediate-1 suppliers accounted for 1.2% of all mentions whereas 12.5% of intermediate-1 suppliers accounted for 76.2% of mentions. Out of the 2 intermediate-2 wholesalers (those supplying intermediate-1 wholesalers), 1 accounted for 92.3% of all mentions whilst the other one for the remaining 7.7% of all mentions.

Source: ACTwatch Outlet Survey data for 20 sub-districts, June 2009 and ACTwatch Supply Chain Survey data, August-November 2009.

Finally, the relative importance of different antimalarial types flowing down the distribution chain was assessed by using sales volumes data collected for each antimalarial in stock at the time of the survey. We found that 57.4% of wholesalers who sold antimalarials the week before the survey reported the ACT ASMQ as their top selling antimalarial, 29.6% chloroquine,

7.4% artemether, 1.9% the ACT dihydroartemisinin and piperazine, and 1.9% the ACT artemisinin and piperazine and primaquine. Whilst these figures cannot be extrapolated to market shares per se, they provide a feel of the relative “popularity” of providers and products in the distribution chain. They indicated the overall predominance of PSI Cambodia, notably at the level supplying wholesalers, and of the recommended first line ACT ASMQ.

6.2.7 Barriers to market entry and exit

Wholesalers reported regulatory requirements to be the major obstacle for opening a drug business, followed by the lack of capital and access to capital, and lack of experience in running a drug business.

Many wholesalers appeared to have circumvented regulatory obstacles, even though during the SCS, around 82% of all businesses reported they had been visited by a pharmaceutical inspector in the year preceding the survey (Table 6-11). Around 39% of all wholesalers reported having a drug outlet license allowing them to wholesale pharmaceutical drugs (i.e. pharmacy license), although this proportion was 66.7% at the level supplying wholesalers and 36.8% at that supplying retailers. The possession of a license did not imply that it was currently valid. Less than 30% of all wholesale outlets had any up-to-date licenses and this proportion varied across chain levels with around 44% of wholesalers supplying wholesalers having an up to date license compared to 27% of those supplying retailers. Furthermore, only 10% of all wholesalers interviewed were *observed* to have the up-to-date license required to wholesale pharmaceuticals.

Table 6-11: Wholesale licensing & inspection

As % of all wholesalers for whom the information was available

REGISTRATION STATUS		WHOLESALER CATEGORIES		
		ALL	SUPPLY WHOLESALERS	SUPPLY RETAILERS
Reported having a license allowing wholesale of pharmaceuticals ¹	% (N)	38.7% (93)	66.7% (15)	36.8% (84)
Reported having a license allowing retail of pharmaceuticals ²	% (N)	65.6% (90)	93.3% (15)	63.1% (84)
Reported having an import permit	% (N)	1.1% (90)	7.1% (14)	0.0% (85)
Reported having a manufacturer license	% (N)	0.0% (92)	0.0% (16)	0.0% (86)
An up-to-date license from the MOH was observed ¹	% (N)	29.5% (95)	43.8% (16)	27.0% (89)
An up-to-date general business or trading license was observed	% (N)	31.6% (95)	52.1% (16)	27.0% (89)
Reported they had been visited by a pharmaceutical inspector in the past year	% (N)	82.4% (91)	86.7% (15)	81.2% (85)

¹pharmacy license authorising drug outlets to wholesale and retail. ²Pharmacy, depot A or B licenses authorising drug outlets to retail only. Of the 95 wholesalers interviewed, 36 reported to have a wholesale license (i.e. pharmacy license), 58 reported to NOT have a wholesale license, 1 refused to respond to this question. Among the 36 wholesalers who reported to have a wholesale license, 20 wholesalers displayed this license or showed them to interviewers, 16 did not. Of the 20 observed wholesale licenses, only 10 were up-to-date at the time of interview. Source: ACTwatch Supply Chain Survey data, August-November 2009.

Relatively more stringent regulatory barriers were perceived to prevent entry to the import market. The first obstacle related to the costs of registering and obtaining an import license and clearing customs. At the time of the study, only registered drugs that were registered with the Ministry of Health's (MOH) Department of Drug and Food (DDF) could be legally imported in Cambodia. Registering a drug required the submission of several documents, including documents on drug provenance (marketing authorisation in the country of origin, manufacturer contact details and good manufacturing practice -certificate) and qualitative and quantitative data on methods of preparation, ingredients, and clinical trial results. The drug registration process was reported to cost around US\$ 1720 (manufacturer's registration US\$ 1200, drug trade mark registration US\$ 50, drug quality control fee US\$ 250³³, fee to registration committee US\$ 220). Once a drug was registered, businesses reported that they

³³ US\$ 50 paid to the National Laboratory Control for Drug Quality Testing and US\$ 200 to the DDF for drug registration

had to obtain an import permit from the DDF for each shipment, at a cost of US\$ 50³⁴. When shipments were received, clearing customs required the submission of several other documents and the payment of 10% value-added tax (VAT). At times, storage costs at sea/airport would also apply. Finally, in addition to these formal fees, informal payments made to the authorities were also reported to be important cost components.

“On top of the shipment value, I have to pay 10% VAT and the rest. If you do not pay “the rest” then your shipment will take a long time to clear” (Wholesaler supplying retailers #1, Phnom Penh)

Institutional lags associated with each step of the importing process were said to be major hurdles to importing pharmaceutical products. Following regulatory changes in 2009, the time to obtain a permit was reported to have generally decreased significantly from 30-45 days to 1-3 days, depending on the number of permits to be processed by the DDF. However, wholesalers reported that this was “in principle” only, as registration could take up to 5 or 6 months. One respondent said they preferred the previous regulatory system through which it was possible to import with a temporary license whilst waiting for the final license. In addition, repeat applications required at each shipment were thought to be time-consuming. Obtaining customs clearance was also said to be a lengthy process.

“Sometimes, whilst I wait for authorization, regulatory authorities come with false excuses and I have to wait. It is not only at the Ministry of Health, it comes at each stage of the process” (Wholesaler supplying wholesalers #2, Phnom Penh).

The second obstacle to entering the import market was the lack of capital and access to capital for running an import business. One importer estimated that setting up a business like his would cost around US\$ 250,000, with 80% of the total cost going towards buying the initial drug stock, and the remainder mainly covering vehicles and furniture. Another importer argued that better access to capital was desperately needed, notably for importers not receiving credit from their suppliers.

³⁴ at the time of the study, this was a new regulation. Under previous regulatory arrangements, a permit fee of US\$ 80 was payable for a shipment including less than 50 different products and US\$ 100 for shipment of more than 50 different products. Permits were valid for a period of 6 months.

“My supplier does not give me credit so this business needs access to capital. When I import I have to pay as much as 30% of the total order value by teletransfer 30 days in advance [...] it is challenging because in Cambodia banking facilities are weak and there is a high risk of non-payment”. (Wholesaler supplying wholesalers #3, Phnom Penh)

The lack of capital was reported to be generally addressed with financial contributions from drug manufacturers, although it implied vertical restrictions imposed by suppliers on importers. For example, one importer explained that as his supplier had contributed to the costs of drug registration the minimum order value he could now import from that supplier was US\$ 200,000.

“Who pays what of the registration process is negotiated between the manufacturer and the importing company. When the manufacturer pays the full cost or a large share of the importation cost, it somewhat implies no discount or/and no credit or even restrictions imposed by the manufacturer, for example, on the product price or in terms of the minimum value that can be purchased”. (Wholesaler supplying wholesalers #2, Phnom Penh).

Following on the regulatory requirements and associated costs described above, importers were generally in some sort of sole distributionship agreement with overseas suppliers or in some kind of tacit “gentlemen’s agreement” with other drug importers such that each product was said to be imported by a single company.

Perhaps more importantly, the third and last barrier to entering the import market was related to the size of the market for malaria treatment in Cambodia, with the provision of malaria treatment perceived to be dominated by government providers who dispensed antimalarial drugs free of charge to patients and by the social marketing programme of subsidized ACT in the private sector implemented by PSI Cambodia.

“We do not stock the ACT artesunate and mefloquine because it is already sold by one supplier. It is not feasible to have several companies importing the same drugs, because the market is too small. In addition, antimalarial drugs in general are provided free at government health facilities and at highly subsidised prices at private shops. There is no incentive for private commercial businesses to import and distribute these drugs.” (Wholesaler supplying retailers #1, Phnom Penh)

This argument was somewhat supported by the OS and SCS data which showed that the ACT ASMQ that was available on the market was that imported by PSI Cambodia for the purpose of the social marketing. However, this was not the case for other antimalarial drugs, notably artesunate, which was found to originate from Vietnam and China, and chloroquine, from Thailand, India, Vietnam and China. In addition, 31.5% of AMT and 38.5% of nAMT were of unknown origin so additional manufacturers and therefore importers may have distributed these drugs, despite the reported government/PSI Cambodia crowding out effect. Antimalarial drugs of unknown provenance could have reflected the operations of unregistered businesses and/or the availability of unregistered products, perhaps counterfeit and substandard drugs.

6.3 Provider conduct: product differentiation and non-price competition

This section explores the key axes of product differentiation and non-price competition in the private sector distribution chain: it describes the inherent product characteristics perceived to be the most valued by retailers and wholesalers when choosing a supplier, and the strategies used by wholesalers operating at different levels of the chain to distinguish their products and services from those of other suppliers on non-price attributes, and to shape customers' stocking and pricing behaviours. The key strategies reportedly used to attract custom are described below and cover delivery services, credit facilities, reliable drug supplies, drug information and selling antimalarial drugs of perceived high quality.

6.3.1 Delivery services

During SSIs, most retailers and wholesalers reported that they chose suppliers that delivered antimalarial drugs directly to their outlets. The SCS data showed that less than one quarter of wholesalers delivered, with delivery services being less frequent at lower levels of the chain (Table 6-12).

Table 6-12: Wholesalers' delivery activities
As % of wholesalers for whom the information was available

BUSINESS PRACTICES		WHOLESALER CATEGORIES		
		ALL	SUPPLY WHOLESALEERS	SUPPLY RETAIL LEVEL
Deliver antimalarials to customers	%	23.7%	46.7%	23.0%
	(N)	(93)	(15)	(87)

Source: ACTwatch Supply Chain Survey data, August-November 2009.

During SSIs, wholesalers supplying wholesalers, notably those importing antimalarial drugs were reported to compete intensively with wholesalers operating at lower levels of the chain, through their wide-reaching and well organized delivery networks operated by sales teams travelling to sell drugs out of their vans or, more generally, take orders for supplies to be delivered the following month or couple of months.

“Big companies compete a lot; it is hard for us who do not have vans for delivering orders.”
(Wholesaler supplying wholesalers #1, MDRSC stratum)

OS data also showed that the probability of reporting a top supplier who delivered antimalarial drugs varied by retail outlet location (Table 6-13). For instance, retailers located in the MDRF stratum were significantly less likely to buy antimalarials from a top supplier that delivered compared to those in the MDRSC stratum (21.0% vs. 46.6%, $p < 0.0001$) (Table 6-13). Similarly, retailers located in remote areas were significantly less likely to report a top supplier for antimalarials that delivered compared to retailers located in more accessible areas (19.5% vs. 42.2%, $p = 0.001$) whilst retailers in moderately accessible markets were more likely to do so than retailers in other markets (43.4% vs. 29.1%, $p = 0.01$) (Table 6-13). Retailers in areas at lower risk of malaria were also more likely to receive antimalarial drugs from a supplier that delivered compared to those in areas at higher risk (43.3% vs. 29.3%, $p = 0.01$) (Table 6-13).

There were also significant differences in delivery services reported by different retail outlet types (Table 6-13), with a significantly higher percentage of pharmacies/clinical pharmacies that reported at least one top supplier who delivered antimalarial drugs compared to other provider types (74.4% vs. 24.2%, $p < 0.0001$), and significantly lower percentages of mobile providers (20.6% vs. 38.1%, $p < 0.05$) and village shops doing so (8.4% vs. 40.0%, $p < 0.001$) compared to other provider types (Table 6-13). This reflected the significantly higher proportion of village shops in remote areas compared to other outlets (62.4% vs. 30.7%, $p = 0.0001$) and that of mobile providers in the MDR Free stratum (63.4% vs. 45.6%, $p = 0.011$).

Table 6-13: Characteristics of retailers supplied by a wholesaler with delivery services
As % of retailers for whom the information on at least one of their top 2 supply sources for antimalarials was available

	N	Percentage of retailers reporting receiving antimalarials from at least one supplier who delivered*
Retail outlet location		
<i>Stratum</i>		
MDR Free stratum	296	21.0%*
MDR Suspected/Confirmed stratum	351	46.6%*
<i>Accessibility level</i>		
Accessible	158	40.9%
Moderately accessible	177	43.4%*
Remote	312	19.5%*
<i>Malaria transmission risk level</i>		
High malaria transmission risk area	107	31.0%
Moderate malaria transmission risk area	370	28.1%
Low malaria transmission risk area	170	43.3%*
Retail outlet category		
Pharmacies/Clinical Pharmacies	96	74.4%*
Drug stores	103	42.5%
Mobile providers	202	20.6%*
Grocery shops	91	23.4%
Village shops	155	8.4%*

*significant difference in suppliers' delivery services by retail outlet location and type (chi² test with Rao and Scott correction, p<0.05). Source: ACTWatch Outlet Survey for 38 sub-districts, June 2009

During SSIs, several retailers reported that they never received visits from importers' sales teams in general, either because the latter did not visit their area or did not stop at their shops.

"No importers distribute in this area; they stop at O'Krieng town and do not go farther" (Drug shop # 6, remote market, MDRF stratum)

"Sales representatives pass on the road but they do not stop at my shop" (Grocery store # 7, remote market, MDRF stratum)

Whilst it is unclear why sales teams did not stop at all shops within the areas they visited, one importer indicated that they did not distribute to all areas because of high travelling costs and low expected sales volumes.

“We rarely supply the province of Monduliri³⁵ because it is far and therefore expensive to serve these areas, and there are not enough customers” (Wholesaler supplying wholesalers #2, Phnom Penh).

These factors are likely to have influenced shopkeepers’ choice of suppliers and as a result they may have shaped the structure of the distribution chain, as more remote outlets were reported to buy antimalarial drugs from smaller suppliers operating locally.

“The largest share of my business is to sell antimalarials to patients, but I also wholesale for other retailers who are not served by importers because these retailers are located too far away for importers and in areas that are difficult to reach”. (Village shop #1, accessible market, MDRF stratum).

6.3.2 Credit facilities

Around 40% of all wholesalers offered credit to their antimalarial customers in the past 3 months, with little difference across chain levels, and those who did offered a median of 30 days credit (IQR 3-90) (Table 6-14).

During SSIs, credit was reported as a key strategy for attracting custom. For example, one wholesaler reported attracting customers by providing credit for at least 2 months as one month was thought to be too short for attracting customers. However, many wholesalers indicated that credit was offered to long-term customers only, a statement which was supported by providers operating at lower levels of the chain who reported they obtained credit from suppliers they had known for a long time.

Several providers also reported borrowing one or a couple of antimalarial drug packs from neighbouring shops in order to meet an immediate demand for a product out of stock and “paying back” one or two days after by returning the quantity borrowed of the corresponding product.

³⁵ Province in North-East Cambodia

Table 6-14: Wholesalers' credit facilities
As % of wholesalers for whom the information was available

CREDIT FACILITIES		WHOLESALER CATEGORIES		
		ALL	SUPPLY WHOLESALEERS	SUPPLY RETAIL LEVEL
Provided credit to customers in the past 3 months	%	39.6%	42.8%	40.0%
	(N)	(91)	(14)	(85)
Most common terms of credit offered in the past 3 months (number of days)	Median	30	30	30
	IQR	(3-90)	(10-75)	(3-90)

Source: ACTWatch Outlet Survey for 38 sub-districts, June 2009

The main reason for not offering credit mentioned during SSIs with wholesalers was the risk of non-payment. For example, a female wholesaler reported she did not provide credit because it would be impossible for a woman to chase customers to obtain payment, and indicated that not offering credit drove customers away to other shops.

6.3.3 Drug availability and stock reliability

OS and SCS data showed that few shopkeepers used more than one supply source for antimalarial drugs. During SSIs, retailers and wholesalers were asked about the reasons for having more than one supplier. Many respondents reported that they used more than one supplier as one of them was an importer selling one antimalarial type only such that they had to buy other products from a different supplier. In addition, importers were said to deliver on a monthly basis and wholesalers and retailers sometimes reported the need to buy supplies in-between sales team visits. In addition, importers were at times reported to be out of stock or have limited stocks, such that providers reported they had to rely on other supply sources for antimalarial drugs. PSI Cambodia's stock-outs were frequently mentioned as a reason for having a second supplier.

"I rarely buy from PSI because they don't come often, approximately once during the dry season and 2-3 times during the rainy season; and when they reach here they sometimes do not have a lot of stock left" (Wholesaler supplying wholesalers #5, MDRSC stratum)

Finally, shopkeepers, notably retailers, reported that they sometimes purchased antimalarials from government providers who were the only suppliers of those drugs.

6.3.4 Perceived drug quality

During SSIs, several respondents reported buying from PSI Cambodia because it was an NGO supported by the MOH to sell quality malaria treatment.

"I buy from PSI because there are a lot of fake and ineffective drugs in the market" (Wholesaler supplying retailers #3, MDRSC stratum)

"My supplier for Malarine is PSI because they are legal, they are an NGO. They sell products of high quality" (Wholesaler supplying retailers # 4, MDRF stratum)

The proportion of shopkeepers who reported PSI Cambodia as one of their top 2 suppliers for antimalarial drugs varied however by chain level and retailer type. The OS data showed that 14.3% of retailers reported buying antimalarial drugs directly from PSI Cambodia, with pharmacies/clinical pharmacies being significantly more likely to report PSI Cambodia as a top supplier compared to other retailer types (47.5% vs. 14.4%, $p < 0.0001$), whilst mobile providers were significantly less likely to do so (3.3% vs. 27.6%, $p = 0.001$). As for wholesalers, 65% of those supplying retailers and 75% of those supplying wholesalers reported PSI as one of their top 2 suppliers for antimalarial drugs.

Another signal of quality highly valued by a couple of shopkeepers was wholesalers that travelled in air-conditioned vans when taking orders and delivering orders. Finally, a few shopkeepers also indicated they preferred buying antimalarials with a DDF registration sticker on their packs, which they perceived as drugs of high quality.

6.3.5 Product promotion

Product promotion for antimalarial drugs was rare as it was generally only conducted by wholesalers that imported antimalarial drugs. All importers were reported to have promotion teams visiting customers at least once a month. Importers themselves indicated that they sometimes used different sales teams for different customers, sending sales representatives to retail outlets and medical representatives to private clinics and doctors. Promotion therefore appeared to be tailored to the customers and products, with relatively more technical promotion (e.g. action of the drug, side effects) to providers of treatment services (pharmacies/clinical pharmacies, mobile providers) compared to drug-only sellers.

Promotion activities conducted by manufacturers and importers including workshops or group training sessions were reported to have some positive influence on wholesalers and retailers business and stocking practices. For example, one importer of antimalarial drugs reported that drug manufacturers conducted promotion activities through medical congresses, during which importers gained the skills and information needed for increasing their sales.

“Manufacturers help boosting the sales by inviting company staff to workshop and seminars during which drugs are promoted to doctors.” (Wholesaler supplying wholesalers, #2, Phnom Penh).

A retailer explained that attending PSI Cambodia’s training session influenced his stocking decisions, leading him to stock the ACT ASMQ and stop selling other antimalarial drug types.

“Before I was invited to training by PSI, I stocked other drugs than Malarine. Then, PSI trained us and they said that their products were of better quality and that we should stock these”. (Village shop #1, accessible market, MDRF stratum).

By contrast, the role of sales representatives was reported to be mixed. One wholesaler said that sales representatives did not conduct any particular promotional activities and only asked whether additional stocks were needed whilst a couple of wholesalers explained that PSI Cambodia’s sales teams used vertical restraints.

“Sales reps do not do anything. They do not try to convince me to buy anything else. They just come and ask if I need supplies” (Wholesaler supplying retailers #9, MDRF stratum)

“My supplier’s sales teams have conditions: if you want to buy Malarine you need to buy condoms as well” (Wholesaler supplying wholesalers #3, MDRF stratum)

“Only PSI has restrictions. The sales representatives sell Malarine if we buy condoms as well. A lot of condoms” (Wholesaler supplying wholesalers #4, MDRF stratum)

Finally, one wholesaler expressed his scepticism about the rationale of the social marketing programme.

"I wonder whether the Government and PSI play tricks by doing marketing and ordering doctors to mainstream their products. I wonder if Government gains a profit to let PSI promote Malarine." (Wholesaler supplying retailers #1, MDRF stratum)

6.3.6 Suppliers' expertise and reputation and suppliers as sources of information

During SSIs, several retailers and wholesalers indicated that they bought antimalarials from suppliers that they perceived to have knowledge about malaria and to provide information on new drugs and treatment regimens.

"We buy from our regular supplier who is also a government doctor working at the referral hospital. He knows a lot, he informs us on how to use new drugs and how to dispense according to the weight of patients". (Pharmacy/clinical pharmacy #1, accessible market, MDRF stratum)

One retailer said that he bought antimalarials from a supplier because other retailers did so too.

"I have one regular supplier and I do not change. There is no particular reason, I just like buying from the same supplier every time. Also, other shopkeepers buy from him and I like to do the same" (Mobile provider # 2, accessible market, MDRF stratum).

6.4 Summary

In this chapter, the private commercial sector distribution chain for antimalarial drugs was described, including the general structure of the chain, wholesalers' characteristics, range of products stocked, concentration and entry/exit barriers at different levels of the chain. Key axes of product differentiation and non-price competition amongst wholesalers were analysed. The thesis now turns to the analysis of price setting and price competition in retail markets and in the private commercial sector distribution chain for antimalarial drugs.

CHAPTER 7 PRICING AND PRICE COMPETITION

7.1 Introduction

In Chapters 5 and 6, the structure of retail markets and of the private commercial sector distribution chain for malaria treatment was described and key aspects of product differentiation and non-price competition were highlighted. This chapter now turns to the analysis of price competition in retail markets and in the private commercial sector distribution chain. It uses quantitative data from the ACTwatch Outlet Survey (OS) and Supply Chain Survey (SCS) and qualitative data collected during Semi-Structured Interviews (SSIs) with retailers and wholesalers.

OS data showed that the median price of one adult equivalent treatment dose (AETD) of the ACT artesunate and mefloquine (ASMQ), the first line treatment for *P.f* malaria was US\$ 1.18 at pharmacies/clinical pharmacies and drug shops, US\$ 1.88 at mobile provider outlets, US\$ 1.61 at grocery stores and US\$ 1.64 at village shops (ACTwatch Group, 2009b) (see Table 2-3). These figures were 2 to 3 times higher than the recommended retail price (RRP) for Malarine (US\$ 0.61), the socially marketed subsidized ACT, and between 3.5 to 5 times higher than one AETD of chloroquine, the non-artemisinin based monotherapy (nAMT) recommended first line treatment for *P.v* and most sold non-ACT product (ACTwatch Group, 2009b) (Table 2-3). As for the median price of artemisin-based monotherapy (AMT), it was 2 to 3 times higher than that of the ACT ASMQ. When antimalarials in injectable form were considered, the median price of nAMT and AMT was 4 to 12 times and 12 to 17 times higher than that of ASMQ in tablet form respectively (author's own calculations) (Table 2-3). When the price of blood testing was included, the total cost of appropriate management of confirmed *P.f* malaria was around US\$ 2.00 (author's own calculations) (Table 2-3).

In this chapter, we investigate retailers and wholesalers price setting behaviours for antimalarial drugs and analyse the intensity of price competition in retail markets. The focus is on private providers' price setting decision because all antimalarial drugs dispensed at government-owned outlets were generally reported to be dispensed free of charge (ACTwatch Group, 2009b) and none of the government providers reported a private commercial wholesaler as one of their top 2 suppliers for antimalarial drugs (Chapter 6), indicating that they generally received antimalarial supplies at no cost. The chapter is structured as follows.

Section 7.2 describes providers' price setting behaviours as reported by retailers and wholesalers themselves during SSIs. Section 7.3 describes purchase prices and price mark-ups for different antimalarial categories as they flow down the distribution chain. Section 7.4 analyses the influence of market, outlet and product characteristics on retail price mark-ups.

7.2 Price setting behaviours

Almost all private retailers reported setting their prices themselves based on drug purchase prices and the cost of travelling to their supplier's outlet or that of paying private taxes for delivering their orders. Very few shopkeepers reported considering other costs. Retail private outlets were generally small and located at the front of providers' living premises such that operating a drug business was not reported to create additional costs aside from those of purchasing drug supplies. When shopkeepers did consider other costs, they mentioned drug license fees and in a few instances other local taxes. However, as described in Chapter 5, in practice few retailers were observed to have drug outlet licenses. Furthermore, the only tax mentioned was that paid monthly by providers who operated within *phsars* (tax amount ranged between US\$ 0.25 to US\$ 0.50) and turnover/revenue taxes were never mentioned.

When asked about how they set their price mark-ups, nearly all retailers said they sought to make a profit.

"I set my price on the basis of the purchase price, not upon whether people can pay or not, and I add 30% on top of the purchase price" (Mobile provider #8, remote market, MDRF stratum)

However, many shopkeepers argued that their price setting decision was constrained by the price set by other providers. Customers were said to shop around in search of the cheapest price such that charging higher prices was almost impossible without losing some or all customers.

"If I sell at a higher price, customers might decide to buy from another shop" (Drug shop #3, moderately accessible, MDRSC stratum)

"I charge 5,000 riel for antimalarial drugs, which is the same price as other shops, otherwise no one will buy from me" (Wholesaler supplying retailers #9, MDRF stratum)

This led some shopkeepers to consider other costs incurred by consumers when seeking care by setting their price as a function of the price charged at outlets located further away plus the cost of transport that customers would incur if they chose to seek care at those outlets. As a drug shopkeeper explained:

“Patients have to pay 10,000 riel [US\$ 2.5] to go to the health centre and come back here by taxi; this is why people come to my shop because I am not more expensive” (Drug shop #6, remote market, MDRF stratum)

There were, however, a few exceptions. One mobile provider argued that he was the “price leader” as he would set his price first whilst other shopkeepers would follow by charging the same price. Finally, a couple of shopkeepers reported that they competed intensely on price as they charged lower prices than other providers.

Recommended retail prices (RRP) on antimalarial drugs, other than Malarine, were not observed. Very few retailers reported setting their price for Malarine at the recommended level and those who did reported being constrained by customers’ knowledge about the RRP.

“It is written on the pack so I have no choice than follow. Customers know” (Drug Shop #10, accessible market, MDRF stratum).

Most shopkeepers reported that they did not follow the RRP because it was too low and did not provide a sufficient margin on top of their purchase price.

“It is not possible to respect a RRP of 2,500 riel [US\$0.61]. An appropriate profit is 2,000 riel. I buy 1 pack at around 1,700 riel from PSI so if I sell it to my customers at 2,500 riel the profit is just too small”. (Drug shop #3, moderately accessible, MDRSC stratum)

A couple of shopkeepers also argued that the RRP provided a “recommendation” for setting prices as opposed to an “obligation”.

Finally, all retailers refuted collaborating on price with other shopkeepers.

Several retailers mentioned varying their price as a function of the total amount spent by a customer. Retailers said they gave discounts to customers who bought antimalarial drugs

alongside other drugs or consumer goods and/or to customers perceived to be poor. A few retailers reported giving discounts to customers who bargained for lower prices, notably by arguing that drugs were cheaper at other local shops. Finally, many retailers said that they chose their supply sources for antimalarial drugs on the basis of wholesalers' selling prices, indicating that they would buy from suppliers offering the lowest price.

Wholesalers reported very similar price setting behaviours. Wholesalers said they set their price on the basis of the antimalarial purchase price, transport cost and profit opportunities, with many arguing their price setting behaviour to be constrained by the price charged at other shops. To maximise profit, wholesalers indicated choosing their supply sources on the basis of wholesale selling prices, as retailers did.

Several wholesalers reported that they varied their prices as a function of volume sold. This was consistent with SCS data, which showed that wholesalers would charge their minimum wholesale price to customers purchasing a median volume of 9 AETDs (IQR 6-12). However, some wholesalers also reported varying prices regardless of the volume sold, by charging a lower price for one antimalarial pack when selling to retailers than to patients.

"The importance of pricing is not the volume. It depends on whether the customer is another seller or a patient. The seller needs to make a profit when he resells to patients so I charge a lower price to sellers than I do to patient" (Wholesaler supplying retailers #9, Phnom Penh)

This was in line with the SCS data which showed that the minimum median volume sold wholesale was low, at 0.90 AETD (IQR 0.5-1) with little variation across chain levels (0.75 AETD at the level supplying retailers and 1 AETD at the level supplying wholesalers).

A couple of wholesalers also said that they would decrease the price of "slow moving" antimalarials or of those getting close to their expiry dates. Finally, all wholesalers denied collaborating on price with other wholesale shopkeepers.

Differences between wholesalers' price setting behaviours were however identified across chain levels, notably between wholesalers who did not import antimalarials and those who did. First, importers said that they considered a broader range of costs than those reported by other wholesalers, including freight and insurance costs, staff salaries, promotion costs, in-country transport costs and, at times, interest on trade credit.

"I add 45 to 55% on the CIF [cost, insurance and freight] price plus promotion cost" (Wholesaler supplying wholesalers # 1, Phnom Penh)

Second, importers reported giving discounts and bonuses, with discounts ranging from 2% to 10% depending on whether customers paid cash or credit, and bonus schemes such as "buy 10, get one free", sometimes combined with gifts such as "buy 30, get a fan".

Finally, one importer reported that his price mark-up was constrained by the intense competition his products faced from the socially marketed subsidized ACT, Malarine and the provision of free malaria treatment at government outlets.

In summary, retailers and wholesalers had similar price setting behaviours. Providers reported setting their price on the basis of antimalarial purchase price and their price mark-ups on the basis of transport costs. At the top of the chain, importers considered a broader range of costs when setting up their prices, including overhead and promotion costs amongst others. In addition, most providers admitted seeking profits, although many argued that their pricing decision was constrained by the price set by other shops. Second and third-degree price discrimination strategies were commonly reported by both retailers and wholesalers who varied prices on the basis of volume purchased and customers' characteristics. The next section describes antimalarial purchase prices and price mark-ups as antimalarial drugs flow down the private commercial distribution chain.

7.3 Purchase prices and price mark-ups

This section describes purchase prices and price mark-ups for different antimalarial drug categories and RDT as they flow down the private commercial distribution chain (Section 7.3.1), followed by purchase prices and mark-ups in retail markets (Section 7.3.2).

7.3.1 Wholesale purchase prices and price mark-ups

Table 7-1 presents median wholesale purchase prices for the different antimalarial categories and RDT across chain levels. The median price paid by wholesalers to purchase one AETD varied across antimalarial drug categories. AMTs had the highest median purchase price per AETD (US\$ 2.70), which was six times higher than the median price for ACT (US\$ 0.45) and thirty times higher than that for nAMT (US\$ 0.09). Within the AMT and nAMT drug categories,

there were also large variations in the price paid for different dosage forms. The median purchase prices for injectables were higher than those for tablets (US\$ 14.15 for AMT and US\$ 4.21 for nAMT compared to US\$ 2.26 for AMTs and US\$ 0.08 for nAMT respectively) (Table 7-1). For RDT, the median purchase price paid by wholesalers was US\$ 0.19 (Table 7-1).

Table 7-1: Wholesale purchase prices
In US\$ per antimalarial AETD and RDT unit

ANTIMALARIAL CATEGORIES formulation		WHOLESALE CATEGORIES		
		ALL N=78	SUPPLY WHOLESALE N=12	SUPPLY RETAILERS N=74
ACT	(n)	(132)	(22)	(127)
all products	Median	0.45	0.40	0.45
were tablets	IQR	0.40-0.57	0.33-0.47	0.40-0.57
AMT	(n)	(28)	(5)	(26)
all	Median	2.70	2.26	2.85
	IQR	2.20-12.70	2.17-16.42	2.26-11.32
AMT	(n)	(15)	(2)	(14)
tablet	Median	2.26	2.21	2.26
	IQR	1.96-2.45	2.17-2.26	1.96-2.45
AMT	(n)	(13)	(3)	(12)
injectable	Median	14.15	16.41	12.74
	IQR	10.19-16.98	1.79-17.44	10.19-16.98
nAMT	(n)	(29)	(6)	(28)
all	Median	0.09	0.08	0.10
	IQR	0.07-1.00	0.08-0.85	0.06-3.57
nAMT	(n)	(23)	(5)	(18)
tablet	Median	0.08	0.08	0.08
	IQR	0.06-0.11	0.08-0.09	0.06-0.11
nAMT	(n)	(6)	(1)	(6)
injectable	Median	4.21	4.46	4.21
	IQR	3.96-4.46	4.46-4.46	3.96-4.21
RDT	(n)	(71)	(11)	(68)
	Median	0.19	0.05	0.19
	IQR	0.05-0.22	0.05-0.20	0.07-0.22

ACT is for artemisinin combination therapy; AMT is for artemisinin monotherapy; nAMT is for non-artemisinin monotherapy; RDT is for rapid diagnostic tests for malaria; (n) is number of product observations; N is number of wholesalers for whom information was available; IQR is for interquartile range.

Source: ACTwatch Supply Chain Survey, August-November 2009.

Table 7-2 and Table 7-3 present median wholesale mark-ups on the different antimalarial categories and RDT in percent and absolute terms respectively. As it was relatively common for wholesalers to vary prices, high, mid and low mark-ups are presented.

The median mid percent mark-up for ACT was around 41%, and was generally higher than that for other antimalarial types: 17% for AMT and 29% for nAMT. However looking at tablets alone, the median mid percent mark-up for nAMTs was similar to that of ACTs (42% and 41% respectively). In absolute terms, mark-ups per AETD were the highest on AMT (US\$ 0.50), followed by ACT (US\$ 0.19) and nAMT (US\$ 0.07). On Malarine, the median percent mid mark-up was 41.7%, equivalent to US\$ 0.19 in absolute terms.

There were variations in absolute median mid mark-ups across dosage forms: on AMT, the median absolute mark-up was US\$ 0.31 for tablets compared to US\$ 2.83 for injectables, and on nAMT it was US\$ 0.04 for tablets compared to US\$ 0.68 for injectables. These variations reflected higher purchase prices for injectables. For RDT, the median wholesale percent mark-up was 33%, equivalent to US\$ 0.05 in absolute terms. The median RDT percent mark-up was 63% among wholesalers supplying wholesalers compared to 33% among wholesalers supplying retailers.

Table 7-2: Wholesale percent price mark-ups

In % on top of one antimalarial AETD and RDT unit purchase price

ANTIMALARIAL CATGORIES formulation	WHOLESALE CATEGORIES									
	ALL N=77			SUPPLY WHOLESALEERS N=11			SUPPLY RETAILERS N=73			
Mark-up (%)	Mid	Low	High	Mid	Low	High	Mid	Low	High	
ACT ¹ (n)	(129)			(19)			(124)			
all products	Median	41.2	29.4	47.1	39.0	28.6	47.0	39.1	29.4	47.1
were	IQR	25.0-	15.0-	25.0-	29.4-	17.6-	38.9-	25.0-	15.0-	25.0-
tablets		66.7	55.3	76.5	61.8	47.1	76.5	66.7	55.3	76.5
AMT (n)	(28)			(5)			(26)			
all	Median	16.7	16.0	18.3	19.3	16.7	22.0	18.0	16.0	19.2
	IQR	7.3-	4.9-	9.3-	16.7-	16.7-	16.7-	8.4-	5.3-	10.9-
		29.2	24.9	38.1	29.9	29.9	29.9	29.9	29.9	42.9
AMT (n)	(15)			(2)			(14)			
tablet	Median	16.7	14.3	16.7	18.0	16.7	19.0	13.7	10.7	17.5
	IQR	6.2-	4.6-	7.7-	16.7-	16.6-	16.6-	6.2-	4.6-	7.7-
		25.0	16.7	33.3	19.3	16.7	22.0	25.0	16.7	33.3
AMT (n)	(13)			(3)			(12)			
injectable	Median	20.0	16.7	20.0	29.9	29.9	30.0	22.5	18.3	24.9
	IQR	11.8-	5.3-	14.2-	3.4-	3.4-	3.4-	13.0-	9.7-	15.4-
		42.9	36	42.9	976.0	976.0	976.0	49.4	39.4	46.4
nAMT (n)	(29)			(6)			(28)			
all	Median	29.3	20.7	31.6	25.1	16.7	32.0	28.8	22.8	29.9
	IQR	14.0-	11.6-	18.6-	19.4-	9.1-	22.2-	12.9-	12.8-	18.1-
		60.0	42.9	100.0	42.8	20.7	58.7	70.0	47.8	100.0
nAMT (n)	(23)			(5)			(22)			
tablet	Median	42.3	25.0	42.9	29.3	16.7	38.0	37.2	26.0	40.4
	IQR	20.0-	14.0-	20.0-	20.9-	9.1-	25.0-	20.0-	16.7-	20.0-
		100.0	60.0	122.2	42.9	20.7	58.8	100.0	60.0	122.2
nAMT (n)	(6)			(1)			(6)			
injectable	Median	15.6	11.3	20.0	19.4	16.7	22.0	15.6	11.3	19.9
	IQR	5.9-	5.9-	5.9-	19.4-	16.7-	22.2-	5.9-	5.9-	5.9-
		25.0	25.0	25.0	19.4	16.7	22.2	25.0	25.0	25.0
RDT ¹ (n)	(67)			(10)			(64)			
	Median	33.3	25.0	35.7	62.5	50.0	75.0	33.3	25.0	36.4
	IQR	18.8-	13.1-	19.7-	25.0-	25.0-	25.0-	20.0-	13.6-	20.0-
		81.3	62.5	93.8	300.0	300.0	300.0	75.0	50.0	87.5

ACT is for artemisinin combination therapy; AMT is for artemisinin monotherapy; nAMT is for non-artemisinin monotherapy; RDT is for rapid diagnostic tests for malaria; (n) is number of product observations; N is number of wholesalers for whom information was available; IQR is for inter-quartile range.

¹Note on calculation of ACT percent mark-up: at the time of the study, ASMQ and RDT sold in the private sector were imported into Cambodia with the financial support of the Global Fund. In-country distribution and sales were conducted by PSI Cambodia. In the analysis of price data, PSI Cambodia's purchase price was set to 0 so the percent mark-up could not be calculated for PSI Cambodia and was set to missing and therefore excluded from this table. Source: ACTwatch Supply Chain Survey, August-November 2009

Table 7-3: Wholesale absolute price mark-ups
In US\$ per antimalarial AETD and per RDT

ANTIMALARIAL CATEGORIES formulation	WHOLESALE CATEGORIES								
	ALL N=78			SUPPLY WHOLESALERS N=12			SUPPLY RETAILERS N=74		
Mark-up (US\$)	Mid	Low	High	Mid	Low	High	Mid	Low	High
ACT ¹ (n) (all products were tablets)	(132)			(22)			(127)		
Median	0.19	0.16	0.24	0.20	0.14	0.27	0.19	0.16	0.24
IQR	0.13-0.34	0.07-0.27	0.15-0.37	0.13-0.33	0.07-0.24	0.19-0.37	0.13-0.35	0.08-0.30	0.14-0.38
AMT All (n)	(28)			(5)			(26)		
Median	0.50	0.38	0.53	0.57	0.57	0.57	0.49	0.38	0.60
IQR	0.26-2.64	0.19-2.83	0.38-2.64	0.42-5.20	0.38-5.21	0.48-5.21	0.24-2.83	0.19-2.83	0.38-2.83
AMT Tablet (n)	(15)			(2)			(14)		
Median	0.31	0.22	0.38	0.40	0.37	0.43	0.30	0.21	0.38
IQR	0.17-0.40	0.11-0.38	0.19-0.48	0.38-0.42	0.36-0.38	0.38-0.48	0.17-0.40	0.11-0.38	0.19-0.48
AMT injectables (n)	(13)			(3)			(12)		
Median	2.83	2.83	2.83	5.21	5.21	5.21	2.83	2.83	2.83
IQR	1.27-5.20	0.71-5.10	1.42-5.66	5.21-17.46	5.21-17.46	5.21-17.46	1.34-5.43	1.1-5.15	1.70-5.66
nAMT All (n)	(29)			(6)			(28)		
Median	0.07	0.04	0.08	0.04	0.02	0.06	0.08	0.06	0.08
IQR	0.03-0.20	0.01-0.20	0.04-0.21	0.01-0.18	0.00-0.14	0.02-0.21	0.03-0.20	0.02-0.22	0.03-0.21
nAMT Tablet (n)	(23)			(5)			(22)		
Median	0.04	0.03	0.07	0.04	0.01	0.05	0.05	0.03	0.07
IQR	0.02-0.11	0.01-0.1	0.02-0.11	0.01-0.04	0.00-0.02	0.02-0.06	0.02-0.11	0.01-0.1	0.02-0.11
nAMT injectables (n)	(6)			(1)			(6)		
Median	0.68	0.50	0.87	0.87	0.74	1.00	0.68	0.50	0.87
IQR	0.25-1.00	0.25-1.00	0.25-1.00	0.87-0.87	0.74-0.74	1.00-1.00	0.25-1.00	0.25-1.00	0.25-1.00
RDT ¹ (n)	(71)			(11)			(68)		
Median	0.05	0.05	0.06	0.05	0.04	0.05	0.05	0.05	0.06
IQR	0.02-0.13	0.02-0.12	0.02-0.14	0.01-0.14	0.01-0.14	0.01-0.14	0.02-0.14	0.02-0.12	0.02-0.14

ACT is for artemisinin combination therapy; AMT is for artemisinin monotherapy; nAMT is for non-artemisinin monotherapy; RDT is for rapid diagnostic tests for malaria; (n) is number of product observations; N is number of wholesalers for whom information was available; IQR is for inter-quartile range.

¹Note on calculation of ACT absolute mark-up: at the time of the study, ASMQ and RDT sold in the private sector were imported into Cambodia with the financial support of the Global Fund. In-country distribution and sales were conducted by PSI Cambodia. In the analysis of price data, PSI Cambodia's purchase price was set to 0 so the percent mark-up could not be calculated for PSI Cambodia and was set to missing. However, in absolute terms, PSI Cambodia's price mark-ups were calculated as: selling price-purchase price, which equals selling price Source: ACTwatch Supply Chain Survey, August-November 2009

7.3.2 Retail purchase prices and price mark-ups

Median purchase prices paid by commercial retailers for their supplies are presented in Table 7-4 for each antimalarial category and for RDT.

On ACT, drug shops and pharmacies/clinical pharmacies reported paying a significantly lower median purchase price compared to other retailers: at drug shops, the median price was US\$ 0.60 and the median difference with all other retailer types was US\$ -0.23 (95% ci -0.38 to 0.08); at pharmacies/clinical pharmacies, the median price was US\$ 0.68 and the median difference was US\$ -0.14 (95% ci -0.26 to -0.03). By contrast, mobile providers reported a median purchase price of US\$ 1.10 or US\$ 0.28 (95% ci 0.13 to 0.44) higher than the median price reported by all other retailers.

For Malarine in particular, the median purchase price was higher than the RRP of US\$0.61, except for drug shops where it was US\$ 0.60; between other retailers, it ranged between US\$ 0.69 for pharmacies/clinical pharmacies to US\$ 1.10 for village shops and differences in purchase prices were significant. Compared to all other retailer types, prices were US\$ 0.27 (95% ci -0.45 to -0.12) lower for drug shops and US\$ 0.14 (95% ci -0.25 to -0.04) lower for pharmacies/clinical pharmacies; by contrast, compared to prices at all other retailer types, prices were US\$ 0.29 (95% ci 0.12 to 0.49) and US\$ 0.24 (95% ci 0.08 to 0.45) higher for mobile providers and village shops respectively.

For AMT tablets, mobile providers reported a median purchase price significantly higher than any other retailer types (median price US\$ 2.64, and median difference US\$ 0.11, 95% ci 0.19 to 0.34). In injectable form, the median AMT price was not statistically different across outlet types, ranging between US\$ 12.71 at pharmacies/clinical pharmacies and US\$ 16.95 at village shops.

Finally, the nAMT median price was significantly lower at pharmacies/clinical pharmacies than at other retailer types (median price US\$ 0.14, median difference US\$ -0.14, 95% ci -0.85 to 0.04).

For RDT, the median purchase price ranged from US\$ 0.21 at grocery shops to US\$ 0.29 at mobile providers. When comparing the median purchase price at each outlet category with

that at all other outlets, the median purchase price was significantly higher at pharmacies/clinical pharmacies (median difference of US\$ 0.04, 95% ci 0.01-0.10).

Several explanations for these observed differences are possible. As described in Chapter 5, pharmacies/clinical pharmacies and drug shops were more likely to operate in accessible markets compared to other retailer types, suggesting that they were likely to be served by a chain made of fewer intermediaries – which under the assumption of “multiple” marginalization³⁶ would enable them to buy ACT at lower prices. In addition, they were together responsible for two-thirds of antimalarial volumes sold whilst they represented one quarter of all antimalarial retail outlets. They were therefore likely to purchase larger volumes than other retailer types, enabling them to extract higher discounts from their suppliers. By contrast, mobile providers reported buying ACT and AMT tablets at a significantly higher price, which is not surprising as they were significantly less likely to report a top supplier that delivered, suggesting that they were served by a chain made of more intermediaries.

³⁶ In economic theory, *double* marginalization occurs when mark-ups are added on top of purchase prices at two stages of the distribution chain. In a case of multiple chain levels, this phenomenon could be referred as “multiple marginalization”.

Table 7-4: Retail purchase prices
In US\$ per antimalarial AETD and per RDT

ANTIMALARIAL CATEGORIES formulation		RETAILER CATEGORIES				
		PHARMACIES/ CLINICAL PHARMACIES N=81	DRUG STORES N=82	MOBILE PROVIDERS N=102	GROCERY STORES N=82	VILLAGE SHOPS N=76
ACT	(n)	(126)	(98)	(106)	(53)	(64)
all	Median	0.68*	0.60*	1.10*	0.78	0.94
	IQR	0.47-1.06	0.38-0.94	0.71-1.32	0.59-1.18	0.59-1.52
AMT	(n)	(36)	(39)	(53)	(30)	(36)
all	Median	2.45	2.64	3.01	2.64	2.56
	IQR	2.23-12.71	2.36-12.71	2.64-14.12	2.45-3.01	2.26-2.82
AMT	(n)	(15)	(29)	(26)	(25)	(31)
Tablet	Median	2.44	2.45	2.64*	2.56	2.52
	IQR	1.70-2.45	2.26-2.84	1.88-2.82	2.45-2.82	2.26-2.64
AMT	(n)	(21)	(9)	(20)	(5)	(5)
Injectable	Median	12.71	16.48	15.54	15.82	16.95
	IQR	3.53-17.51	12.72-18.83	11.77-16.95	11.77-16.95	9.89-16.95
AMT	(n)	-	(1)	-	-	-
Suppository	Median	-	14.12	-	-	-
	IQR	-	14.12-14.12	-	-	-
nAMT	(n)	(18)	(16)	(23)	(13)	(16)
all	Median	0.14*	0.14	3.26	0.16	0.34
	IQR	0.10-0.23	0.11-0.94	0.23-4.94	0.16-0.34	0.11-4.15
nAMT	(n)	(21)	(13)	(10)	(10)	(14)
tablet	Median	0.14	0.11	0.18	0.16	0.27
	IQR	0.10-0.23	0.11-0.16	0.14-0.34	0.16-0.19	0.11-3.57
nAMT	(n)	-	(3)	(13)	(3)	(2)
injectable	Median	-	3.95	4.45	4.45	3.71
	IQR	-	3.95-5.93	3.46-5.44	3.36-4.45	3.71-5.93
RDT	(n)	(56)	(32)	(59)	(20)	(18)
	Median	0.23*	0.28	0.29	0.21	0.28
	IQR	(0.19-0.28)	(0.20-0.35)	(0.24-0.47)	(0.21-0.26)	(0.24-0.47)

ACT is for artemisinin combination therapy; AMT is for artemisinin monotherapy; nAMT is for non-artemisinin monotherapy; RDT is for rapid diagnostic tests for malaria; (n) is number of product observations; N is number of retailers for whom information was available; IQR is for inter-quartile range. * Difference between median price at given outlet and all other retailer types pooled is statistically different from zero, Hodges-Lehmann median difference at p=0.05. Source: ACTwatch Outlet Survey in 38 sub-districts, June 2009

Tables 7-5 and 7-6 present retail price mark-ups in percent and absolute terms respectively.

On ACT, the median percent mark-up was significantly lower at village shops than at other retailer types (28.6%, mean difference -10.7%, 95% ci -20.0 to 2.9) (Table 7-5). However, in absolute terms, the difference between mark-ups at village shops and other outlet types was not statistically different (median difference US\$ -0.01, 95% ci -16.8 to 0.02), with mark-ups ranging between US\$ 0.28 at pharmacies/clinical pharmacies to US\$ 0.54 at mobile providers (Table 7-6). This reflected the higher price paid by village shops to purchase ACT (Table 7-4), notably Malarine (US\$ 0.24 higher than at other retailer types).

On Malarine specifically, the median percent mark-up was significantly higher at drug shops compared to other outlet types (66.7%, median difference 20.0%, 95% ci 4.17 to 41.27) (Table 7-5). The median price mark-up was 50.0% at mobile provider outlets, 42.9% at village shops, 40.0% at pharmacies/clinical pharmacies and 25.0% at grocery stores (Table 7-5). In absolute terms, the median mark-up on Malarine was significantly lower at pharmacies/clinical pharmacies compared to other shops (US\$ 0.24; median difference of US\$ 0.18, 95% ci -0.20 to -0.02) (Table 7-6). The median absolute mark-up was US\$ 0.51 at drug stores, US\$ 0.47 at mobile provider outlets, US\$ 0.24 at grocery stores and US\$ 0.35 at village shops (Table 7-6).

For AMT in tablet form, pharmacies/clinical pharmacies reported the lowest median price mark-up, both in percent and absolute terms (respectively 15.4%, median difference -27%, 95% ci -54.2 to -12.3; and US\$ 0.38, median difference US\$ -0.75, 95% ci -1.17 to -0.38) (Tables 7-5 and 7-6). By contrast, village shops had a significantly higher median mark-up compared to other retailer types (median differences of 26.9%, 95% ci 10.0 to 46.15 and US\$ 0.75, 95% ci 0.34 to 1.13) (Tables 7-5 and 7-6). On AMT injectables, the median mark-up difference was, in percent terms, the highest between village shops and other outlet types (23.8%, 95% ci 1.68 to 40.0), but the difference in absolute terms was not statistically different (Tables 7-5 and 7-6). The second largest and significant percent mark-up difference was observed between mobile providers and other provider types (17.1%, 95% ci 1.38 to 39.4), which was equivalent in absolute terms to a median mark-up of US\$ 3.53 (95% ci 0.94 to 6.21) and which was higher at mobile providers than at other shops.

On nAMT, village shops reported a significantly higher median mark-up in absolute terms on nAMT tablets (US\$ 0.38, median difference US\$ 0.23, 95% ci 0.01 to 2.96). For the few observations of nAMT in injectable form, a significantly higher median mark-up, both in percent and absolute terms, was observed at drug stores. Finally, on chloroquine, the recommended first-line treatment for *P.v*, median mark-up differences both in volume and value terms were not statistically different across retailer types. The median percent mark-up was 61.3% at pharmacies/clinical pharmacies, 100.0% at drug stores, 100.0% at mobile provider outlets, 185.7% at grocery stores and 100.0% at village shops; the median absolute mark-up was US\$ 0.08 at pharmacies/clinical pharmacies, US\$ 0.12 at drug stores, US\$ 0.21, at mobile provider outlets, US\$ 0.30 at grocery stores and US\$ 0.13 at village shops (Tables 7-5 and 7-6). On RDT, grocery shops reported a significantly lower price mark-up both in percent and absolute terms than all other retailer types (11.1%, median difference -16.6%, 95% ci -7.9 to 30.3; median absolute mark-up US\$ 0.02, median difference US\$ -\$0.06, 95% ci -0.02--0.09).

Table 7-5: Retail percent price mark-ups

In % on top of one antimalarial AETD and RDT unit purchase price

ANTIMALARIAL CATEGORIES formulation		RETAILER CATEGORIES				
		PHARMACIES ² N=77	DRUG STORES N=75	MOBILE PROVIDERS N=101	GROCERY STORES N=57	VILLAGE SHOPS N=72
ACT	(n)	(119)	(85)	(104)	(51)	(59)
all products	Median	40.0	50.0*	50.0	40.0	28.6*
were tablets	IQR	20.0-80.0	25.0-106.9	25.0-66.7	20.0-60.0	14.3-55.6
AMT	(n)	(32)	(39)	(46)	(29)	(33)
All	Median	16.7*	29.2	42.9	33.3	60.0*
	IQR	7.1-42.9	16.7-55.5	25.0-71.4	20.0-41.2	42.9-84.6
AMT	(n)	(19)	(28)	(26)	(25)	(29)
Tablet	Median	15.4*	37.1	33.3	29.2	60.0*
	IQR	7.7-25.9	16.7-90.5	25.0-66.7	16.7-41.2	37.1-87.5
AMT	(n)	(13)	(9)	(20)	(4)	(4)
Injectable	Median	28.0	29.0	50.0*	38.5	47.1*
	IQR	7.1-42.9	16.7-41.2	25.0-77.8	20.0-42.9	42.9-66.7
AMT	(n)		(1)			
Suppository	Median	-	6.7	-	-	-
	IQR	-	6.7-6.7	-	-	-
nAMT	(n)	(18)	(16)	(23)	(13)	(15)
All	Median	53.8*	100.0	127.3	177.8	100.0
	IQR	7.1-100.0	66.7-150.0	50.0-185.7	33.3-185.7	66.7-150.0
nAMT	(n)	(18)	(13)	(10)	(10)	(13)
Tablet	Median	53.8	100.0	100.0	185.7	366.7
	IQR	7.1-100.0	66.7-115.5	80-233.3	33.3-185.7	66.7-366.7
nAMT	(n)		(3)	(13)	(3)	(2)
Injectable	Median	-	191.7*	150.0	33.3	216.7
	IQR	-	191.7-275.0	50.0-185.7	17.6-177.8	66.7-366.7
RDT	(n)	(54)	(32)	(57)	(20)	(18)
	Median	36.4	33.3	33.3	11.1*	33.3
	IQR	11.8-150.0	20.0-135.0	0.0-114.0	11.1-33.3	20.0-58.0

ACT is for artemisinin combination therapy; AMT is for artemisinin monotherapy; nAMT is for non-artemisinin monotherapy; RDT is for rapid diagnostic tests for malaria; (n) is number of product observations; N is number of retailers for whom information was available; IQR is for inter-quartile range. * Difference between median price at given outlet and all other retailer types pooled is statistically different from zero, Hodges-Lehmann median difference at p=0.05. Source: ACTwatch Outlet Survey in 38 sub-districts, June 2009

Table 7-6: Retail absolute price mark ups
In US\$ per antimalarial AETD and per RDT

ANTIMALARIAL CATEGORIES formulation		RETAILER CATEGORIES				
		PHARMACIES/ CLINICAL PHARMACIES N=77	DRUG STORES N=75	MOBILE PROVIDERS N=101	GROCERY STORES N=57	VILLAGE SHOPS N=72
ACT	(n)	(119)	(85)	(104)	(51)	(59)
all products	Median	0.28*	0.48	0.54	0.37	0.35
were tablets	IQR	0.16-0.55	0.24-0.78	0.24-0.71	0.12-0.47	0.24-0.55
AMT	(n)	(32)	(39)	(46)	(29)	(33)
All	Median	0.62	1.20	1.81	0.98	1.69
	IQR	0.07-3.30	0.56-2.64	0.75-7.53	0.56-1.50	1.09-2.26
AMT	(n)	(19)	(28)	(26)	(25)	(29)
tablet	Median	0.38*	0.75	0.75	0.94	1.51*
	IQR	0.00-0.56	0.38-1.13	0.38-1.13	0.38-1.13	1.09-2.08
AMT	(n)	(13)	(9)	(20)	(4)	(4)
injectables	Median	3.30	4.52	8.47*	2.35	9.04
	IQR	0.85-8.47	2.82-7.06	4.24-11.30	1.88-6.78	4.24-11.30
AMT	(n)		(1)			
suppository	Median	-	0.94	-	-	-
	IQR	-	0.94-0.94	-	-	-
nAMT	(n)	(18)	(16)	(23)	(13)	(15)
All	Median	0.08*	0.13	2.47*	0.30	0.41
	IQR	0.00-0.23	0.11-0.47	0.23-5.93	0.21-0.30	0.13-7.71
nAMT	(n)	(18)	(13)	(10)	(10)	(13)
tablet	Median	0.11*	0.23	0.23	0.30	0.38*
	IQR	0.02-0.24	0.18-0.40	0.18-0.40	0.15-0.30	0.12-2.97
nAMT	(n)		(3)	(13)	(3)	(2)
injectables	Median	-	10.88*	5.93	1.48	13.60
	IQR	-	10.88-11.37	2.47-6.92	0.59-7.90	3.95-13.60
RDT	(n)	(59)	(40)	(62)	(25)	(20)
	Median	0.08	0.14	0.12	0.02*	0.12
	IQR	0.02-0.17	0.06-0.24	0.00-0.24	0.02-0.09	0.05-0.18

ACT is for artemisinin combination therapy; AMT is for artemisinin monotherapy; nAMT is for non-artemisinin monotherapy; RDT is for rapid diagnostic tests for malaria; (n) is number of product observations; N is number of retailers for whom information was available; IQR is for inter-quartile range. * Difference between median price at given outlet and all other retailer types pooled is statistically different from zero, Hodges-Lehmann median difference at p=0.05. Source: ACTwatch Outlet Survey in 38 sub-districts, June 2009

In summary, our results showed that mark-ups varied significantly across providers, antimalarial generic type and dosage form. Pharmacies/clinical pharmacies reported the lowest median mark-up on the subsidized ACT in absolute terms; the lowest mark-up on AMT tablets in both percent and absolute terms; and, the lowest percent mark-up on nAMT in general and in absolute terms on nAMT tablets. By contrast, drug shops reported the highest percent mark-up on subsidized ACT and the highest mark-up, in both percent and absolute terms, on nAMT injectables; village shops reported the highest median percent mark-up on AMT tablets and injections, and the highest median absolute margin on AMT tablets; finally, mobile providers reported the highest mark-up on AMT injections in absolute terms and the

second highest on AMT tablets. Determinants of retail price mark-ups are analysed in the next section.

7.4 Determinants of antimalarial retail price mark-ups

This section analyses the determinants of antimalarial retail price mark-ups. It was of interest to analyse wholesalers' price setting behaviours as well, however, in the context of overlapping chain levels and their implications for defining wholesaler markets and measuring market concentration (Section 6.2.6), such analysis could not be conducted. Similarly, as RDT sales volume data were not collected during the OS, it was not possible to calculate a concentration measure for that market in order to analyse retailers' price setting decisions for RDT.

For the analysis retailers' pricing behaviour for antimalarial drugs, three measures were available, namely antimalarial price, percent mark-up and absolute mark-up. We chose to focus the analysis on percent mark-up for two reasons. First, as highlighted in Section 7.2 retail prices are largely influenced by purchase prices and therefore by pricing decisions of economic actors operating at higher levels of the chain (e.g. manufacturers). Mark-ups therefore capture retailers' price setting behaviour by isolating it from pricing decisions made upstream in the chain. Similarly, percent mark-ups were preferred to their absolute equivalent as they offered a measure of retailers' decisions "standardized" by price level. This section is structured as follows. Section 7.4.1 presents a series of hypotheses on antimalarial retail percent mark-up variations drawing on the theoretical and empirical literatures and results presented in the previous two chapters in terms of product differentiation and non-price competition. In Section 7.4.2, the methods used for hypothesis testing are described. Section 7.4.3 presents the results, which are then discussed in Section 7.4.4.

7.4.1 Hypotheses on antimalarial retail percent mark-ups

Table 7-7 presents the set of hypotheses tested in the analysis of retail percent mark-ups. The development of these hypotheses draws on the Industrial Organization (IO) literature, empirical findings from the literature (Chapter 3) and results presented in this thesis (Chapters 5, 6 and 7).

Table 7-7: Hypotheses about retail percent mark-up variations

No.	Hypothesis of higher percent mark-ups:	Rationale
1.	In more concentrated markets	Traditional Structure-Conduct-Performance sequence
2.	In more remote markets	Higher costs of wholesale supplies (Goodman et al., 2009)
3.	In markets at lower risk of malaria transmission	Lower antimalarial availability (PSI, 2007); May reflect lower contestability than in markets at higher risk of malaria transmission
4.	At pharmacies/clinical pharmacies and mobile providers	Higher overhead costs (mobile providers travel to patients' home); Consumer preferences (Chapter 5)
5.	At outlets that have been operating for longer	Consumer preferences (Chapter 5)
6.	At outlets that do not have a top supplier that delivers orders	Higher costs of wholesale supplies (Chapters 6 and 7)
7.	On unbranded products	Empirical findings from previous studies (Chapter 3)
8.	On products sold in injectable form	Consumer preferences (Chapter 5); May reflect service fee for administering injections
9.	On products with lower sales volumes	Higher mark-ups on "slow moving" products

7.4.2 Methods for hypothesis testing

Hypothesis testing was conducted through bivariate and multivariable analyses. The bivariate analysis was exploratory, focusing on generic types that each accounted for 5% or more of the total market in volume terms. The 5 antimalarial generic types were the ACT ASMQ; the ACT DHA+PP; the AMT artesunate; and nAMTs chloroquine and quinine. Median percent mark-up differences were analysed across categorical predictor variables, including market accessibility levels, market's malaria transmission risk level, outlet type, wholesale deliveries, antimalarial brand status and dosage form. Relationships between percent mark-ups and continuous variables, including HHI calculated on antimalarial sales volumes and values, outlet's length of time in operation and sales volumes for particular product during the week preceding the survey were explored by looking at the correlation coefficients between mark-ups and these variables.

To assess the marginal effect of each of the predictors on price mark-ups, a multivariable analysis was conducted. A regression model was developed using the ordinary least squares (OLS) method. The STATA survey estimation command *svy:regress* was used to adjust for the potential clustering of drug price observations within outlets (with primary sampling units set as retail outlets), control for design-based heteroscedasticity and produce robust variance estimates (StataCorp., 2009). Markets with a single antimalarial outlet - "singleton strata" -

were treated as single sampling units with their variance imputed using the average of the variances from strata with several antimalarial outlets (StataCorp., 2009). Price mark-up observations were included for all antimalarial generic types, except for primaquine for which there was a single observation. Mark-ups were logged to reflect their skewed distribution and regressed on market, outlet and product characteristics. The analysis was conducted using the Herfindahl-Hirschman Index (HHI) calculated on public and private antimalarial sales volumes and sales values in turn.

7.4.3 Results

Tables 7-8 and 7-9 present the results of the bivariate analysis between percent mark-ups and market, outlet and product characteristics. Few significant differences in percent mark-ups were identified across these characteristics. As already mentioned mark-ups on ACT were significantly higher at drug stores compared to all other provider types and conversely significantly lower at village shops. The bivariate analysis also showed significant differences between mark-ups on artesunate, with higher mark-ups at village shops and at outlets that did not report a supplier that delivered orders, and significantly lower mark-ups in outlets operating in accessible markets rather than in more remote markets. Finally, correlations between percent mark-ups and market concentration measures were very small and not statistically significant.

Table 7-8: Relationships between retail mark-ups and market, outlet and product characteristics

	ACT				AMT		nAMT			
	ASMQ		DHA+PP		Artesunate		Chloroquine		Quinine	
	n	Median	n	Median	n	Median	n	Median	n	Median
Market characteristics										
MDRF stratum	134	42.8%	22	150.0%	52	37.1%	23	100.0%	2	50.0%
MDRSC stratum	224	42.8%	26	33.3%	70	37.1%	31	100.0%	6	127.3%
Accessible	131	40.0%	6	38.1%	43	20.0%*	42	100.0%	11	185.7%
Moderately accessible	160	42.8%	24	33.3%	37	50.0%	28	100.0%	2	100.0%
Remote	67	42.8%	6	21.4%	42	41.2%	10	150.0%	15	127.3%
Low transmission risk	145	50.0%	14	33.3%	35	42.8%	21	66.7%	9	177.8%
Moderate transmission risk	134	40.0%	15	33.3%	53	33.3%	21	150.0%	7	127.3%
High transmission risk	79	42.8%	7	55.5%	34	42.8%	12	100.0%	12	150.0%
Outlet types										
Pharmacy/Clinical Pharmacy	98	40.0%	13	33.3%	13	16.7%*	17	61.3%	1	7.1%*
Drug Shop	73	55.6%*	9	25.0%	29	25.0%	12	100.0%	3	191.7%*
Mobile Provider	90	42.8%	6	60.0%	27	33.3%	8	100.0%	14	150.0%
Grocery Store	47	40.0%	4	25.0%	25	33.3%	9	185.7%	4	33.3%*
Village Shop	50	25.0%*	4	20.0%	28	60.0%*	8	100.0%	6	185.7%
Outlet's supplier delivers¹										
Yes	163	45.8%	12	33.3%	46	23.1%	19	88.7%	7	127.8%
No	195	40.0%	24	33.3%	76	42.8%*	35	100.0%	21	150.0%
Antimalarial brand status²										
Branded	358	42.8%	36	33.3%	26	28.6%	12	66.7%	2	33.3%
Unbranded	0	-	0	-	96	37.1%	42	100.0%	26	150.0%
Antimalarial dosage form										
Tablet	358	42.8%	36	33.3%	109	37.1%	54	100.0%	8	100.0%

ACT is for artemisinin combination therapy; AMT is for artemisinin monotherapy; nAMT is for non-artemisinin monotherapy; ASMQ is for artesunate and mefloquine; DHA+PP is for dihydroartemisin and piperazine; MDRF stratum is for stratum without multi-drug resistance; MDRSC stratum is for stratum with suspected or confirmed multi-drug resistance; ¹ At least one of the top 2 suppliers mentioned by retailers was reported to offer delivery services for antimalarials; ² Branded innovator or branded generic. Unbranded are all generics; *Hodges-Lehmann median difference between the median price mark-up at given outlet and median price at all other retailer types is statistically different from zero at $p \leq 0.05$. Source: ACTwatch Outlet Survey in 38 sub-districts, June 2009

Table 7-9: Relationships between retail mark-ups, market concentration, sales volume and outlet's length of time in operation

	Market concentration		Outlet's characteristics	
	HHI on antimalarial sales volumes	HHI on antimalarial sales values	Sales volume the week preceding the survey	Outlet's length of time in operation
Correlation coefficient with percent mark-ups	0.033	-0.003	-0.022	-0.041

*significant at the 5% level. Source: ACTwatch Outlet Survey in 38 sub-districts, June 2009

These relationships may however be confounded by the associations between market characteristics, outlet types and wholesale deliveries. For example, village shops were more likely to operate in the MDRF stratum, in which markets were more likely to be remote and village shops were less likely to report a top supplier for antimalarials that delivers.

In order to disentangle the effects of the different predictors on retail mark-ups and measure their relative and marginal importance, an OLS log-linear regression model was developed and the following price mark-up equation was estimated:

$$\text{Log MARK-UP} = \beta_0 + \beta_1 \text{HHI} + \beta_2 \text{STRATUM} + \beta_3 \text{ACCESSIBILITY} + \beta_4 \text{RISK} + \beta_5 \text{OUTLET_TYPE} + \beta_6 \text{SUPPLIER_DELIVERS} + \beta_7 \text{TIME_IN_OPERATION} + \beta_7 \text{GENERIC_TYPE} + \beta_8 \text{BRAND_STATUS} + \beta_{22} \text{DOSAGE_FORM} + \beta_{23} \text{VOLUMES_SOLD} + \epsilon$$

Where all variables are described in Table 7-10 and where ϵ is the error term.

In order to disentangle the effects of the different predictors on retail mark-ups and measure their relative and marginal importance, an OLS log-linear regression model was developed. The model is described in Table 7-10. Correlations between predictor variables used in the model are available in Appendix 12.

Table 7-10: Description of the regression model for all antimalarial price percent mark-ups

VARIABLE	DEFINITION	MEAN
Outcome variable		
LOG_MARK-UP_AETD	Log of percent mark-up	3.81
Predictor variables		
HHI_VOLUME	Hirschman Herfindahl index on private and public sector antimalarial sales volumes by market ¹	0.33
HHI_VALUE	Hirschman Herfindahl index on private and public sector antimalarial sales values by market ¹	0.32
SALES_VOLUME	Antimalarial volume sold the previous week (AETD)	2.07
LENGTH_OF_OPERATION	Number of years respondents have been in operation in that business (years)	10.9
MARKET'S ACCESSIBILITY LEVEL		
ACCESSIBILITY_LOW (omitted)	1 if market is remote	0.23
ACCESSIBILITY_MODERATE	1 if market is moderately accessible	0.43
ACCESSIBILITY_HIGH	1 if market is accessible	0.33
MARKET'S MALARIA TRANSMISSION RISK		
RISK_HIGH (omitted)	1 if market is at high malaria transmission risk	0.23
RISK_MODERATE	1 if market is at moderate malaria transmission risk	0.39
RISK_LOW	1 if market is at low malaria transmission risk	0.38
STRATUM		
MDRF_STRATUM(omitted)	1 if stratum is MDR-Free	0.39
MRDSC_STRATUM	1 if stratum is MDR-Suspected/Confirmed	0.61
OUTLET TYPE		
PHARMACY/CLINICAL PHARMACY (omitted)	1 if outlet is pharmacy/clinical pharmacy	0.24
DRUG_STORE	1 if outlet is drug store	0.22
MOBILE_PROVIDER	1 if outlet is mobile provider	0.24
GROCERY_STORE	1 if outlet grocery store	0.13
VILLAGE_SHOP	1 if outlet is village shop	0.16
WHOLESALE DELIVERIES		
TOP_SUPPLIER_DELIVERS	1 if at least one top supplier delivers	0.41
TOP_SUPPLIER_DOES_NOT_DELIVER (omitted)	1 if none of the top 2 suppliers deliver	0.59
GENERIC TYPE		
ARTESUNATE+MEFLOQUINE (omitted)	1 if antimalarial is artesunate+mefloquine	0.49
DIHYDROARTEMISININ +PIPERAQUINE	1 is antimalarial is dihydroartemisin+piperaquine	0.05
ARTEMISININ+PRIMAQUINE+PIPERAQUINE	1 if antimalarial is artemisinin+primaquine+piperaquine	0.03
CHLOROQUINE	1 if antimalarial is chloroquine	0.07
QUININE	1 if antimalarial is quinine	0.12
MEFLOQUINE	1 if antimalarial is mefloquine	0.01
SULPHADOXINE-PYRIMETHAMINE	1 if antimalarial is sulphadoxine-pyrimethamine	0.24
ARTESUNATE	1 if antimalarial is artesunate	0.15
ARTEMETHER	1 if antimalarial is artemether	0.06
DIHYDROARTEMISININ	1 if antimalarial is dihydroartemisinin	0.01
BRAND STATUS		
BRANDED (omitted)	1 if antimalarial is branded innovator or generic	0.73
UNBRANDED	1 if antimalarial is unbranded generic	0.27
DOSAGE FORM		
TABLET (omitted)	1 if antimalarial is in tablet form	0.89
INJECTABLE	1 if antimalarial is in injectable form	0.10

MRDSC_STRATUM is for stratum with suspected and confirmed multi-drug resistance; MDRF_STRATUM is for stratum without multi-drug resistance; ¹geographical definition of retail markets was set as the commune (Section 5.2.4). Source: ACTwatch Outlet Survey data in 38 sub-districts, June 2009

The model estimated using the HHI calculated on antimalarial sales volumes had a R^2 of 0.1436 (Table 7-11). Retail percent mark-ups were significantly affected by antimalarial generic type and brand status. Compared to the ACT ASMQ, retail mark-ups on artesunate alone were 50.5% lower ($p < 0.001$) and on chloroquine 67.8% higher ($p < 0.001$). Percent mark-ups were 41.3% higher on unbranded antimalarials than on branded products ($p = 0.002$).

Sales volumes for the week before the survey and outlet's length of operation had relatively small effects on price mark-ups with levels of significance just outside the 5% cut-off: an increase in one AETD sold was associated with mark-ups 0.9% ($p = 0.063$) lower, and similarly an increase in one year in outlet's length of operation with mark-ups 1% ($p = 0.077$) lower.

Market concentration, accessibility, malaria transmission risk, outlet type and wholesale supplies had no significant influence on retail mark-ups (p -values > 0.1).

The model estimated using the HHI calculated on antimalarial sales values had a R^2 of 0.1453, and the results were similar to those described above (Table 7-11).

Table 7-11: OLS log-linear regression model of antimalarial retail price percent mark-ups

Independent variable	Model using HHI calculated on private & public antimalarial sales volumes (n=641, F<0.0001, R ² =0.1436)			Model using HHI calculated on private & public antimalarial sales values (n=641, F<0.0001, R ² =0.1453)		
	Coefficient	Standard Error	P value	Coefficient	Standard Error	P value
HHI_VOLUME	-0.228	0.193	0.237			
HHI_VALUE				-0.302	0.211	0.153
MDRSC_STRATUM	-0.026	0.136	0.848	-0.015	0.137	0.913
ACCESSIBILITY_MODERATE	0.011	0.171	0.949	-0.015	0.170	0.928
ACCESSIBILITY_HIGH	-0.129	0.140	0.313	-0.137	0.128	0.285
RISK_MODERATE	-0.220	0.139	0.114	-0.222	0.140	0.112
RISK_LOW	-0.125	0.139	0.373	-0.125	0.141	0.378
DRUG_STORE	0.161	0.157	0.304	0.160	0.155	0.304
MOBILE_PROVIDER	0.126	0.156	0.420	0.129	0.156	0.407
GROCERY_STORE	-0.104	0.173	0.546	-0.106	0.172	0.537
VILLAGE_SHOP	0.137	0.215	0.524	0.132	0.212	0.534
LENGTH_OF_OPERATION	-0.010	0.005	0.077	-0.0100	0.006	0.076
TOP_SUPPLIER_DELIVERS	0.052	0.107	0.625	0.045	0.107	0.670
SALES_VOLUMES	-0.009	0.005	0.063	-0.010	0.005	0.055
INJECTABLE	0.187	0.260	0.473	0.183	0.259	0.480
DIHYDROARTEMISININ +PIPERAQUINE	0.097	0.267	0.718	0.070	0.257	0.785
ARTEMISININ+PRIMAQUINE+PIPERAQUINE	0.403	0.229	0.080	0.309	0.230	0.181
CHLOROQUINE	0.679	0.171	<0.001	0.683	0.171	<0.001
QUININE	0.097	0.267	0.718	0.226	0.311	0.467
MEFLOQUINE	-0.378	0.246	0.125	-0.391	0.235	0.097
SULPHADOXINE-PYRIMETHAMINE	0.169	0.224	0.452	0.263	0.229	0.251
ARTESUNATE	-0.505	0.142	<0.001	-0.514	0.141	<0.001
ARTEMETHER	-0.338	0.297	0.257	-0.338	0.298	0.257
DIHYDROARTEMISININ	-0.651	0.801	0.417	-0.648	0.794	0.415
BRANDED	-0.413	0.133	0.002	-0.417	0.133	0.002
CONSTANT	4.444	0.275	<0.001	4.483	0.283	<0.001

MRDSC_STRATUM is for stratum with suspected and confirmed multi-drug resistance; Shaded cells correspond to variables which were not relevant to the model

Out the nine hypotheses described in Table 7-7, only one was verified, with percent mark-ups higher on unbranded drugs than on branded products. In addition, our model predicted that compared to the ACT ASMQ, retail percent mark-ups were higher on chloroquine and lower on artesunate. These results suggest an inverse relationship between percent mark-ups and drug purchase prices, which is in line with findings from previous studies (Section 3.4.3).

Other results were, from a classical economic theory perspective, surprising. Our model showed that retail price mark-ups were not significantly affected by market characteristics, notably market concentration measured by the HHI. However, given the heterogeneity of the markets under study (i.e. across strata and in terms of concentration, accessibility and malaria transmission risk levels), mark-ups could be affected by particular predictors in different ways and different intensities in markets with different characteristics. Therefore, the following potential interaction effects were investigated: effect of HHI on retail percent mark-ups across strata, accessibility and risk levels (HHI*STRATUM, HHI*ACCESSIBILITY, HHI*RISK); effect of accessibility/risk on mark-ups across strata and risk/accessibility levels (ACCESSIBILITY*STRATUM, RISK*STRATUM, ACCESSIBILITY*RISK)³⁷.

The following equation was estimated:

$$\begin{aligned} \text{Log MARK-UP} = & \beta_0 + \beta_1 \text{HHI} + \beta_2 \text{STRATUM} + \beta_3 \text{ACCESSIBILITY} + \beta_4 \text{RISK} + \beta_5 \text{HHI} * \text{STRATUM} + \\ & \beta_6 \text{HHI} * \text{ACCESSIBILITY} + \beta_7 \text{HHI} * \text{RISK} + \beta_8 \text{STRATUM} * \text{ACCESSIBILITY} + \beta_9 \text{STRATUM} * \text{RISK} + \\ & \beta_{10} \text{ACCESSIBILITY} * \text{RISK} + \beta_{11} \text{OUTLET_TYPE} + \beta_{12} \text{SUPPLIER_DELIVERS} + \beta_{13} \text{TIME_IN_OPERATION} + \\ & \beta_{14} \text{GENERIC_TYPE} + \beta_{15} \text{BRAND_STATUS} + \beta_{16} \text{DOSAGE_FORM} + \beta_{17} \text{VOLUMES_SOLD} + \varepsilon \end{aligned}$$

The model was estimated by including all interaction groups at once and by testing the statistical significance of their effect on retail percent mark-up using the F-test (adjusted Wald test). Where the effect of an interaction group was not statistically significant, the group was dropped and the model re-run to assess the effect on the remaining interaction groups and other estimates. Interaction groups with no significant effect on retail mark-ups were dropped one at the time and the process was repeated until the best model fit was identified.

As before, the model was estimated using the HHI (our measure of market concentration) calculated on all private and public sector antimalarial sales volumes and then on all private

³⁷ to illustrate, STRATUM*ACCESSIBILITY is the interaction group including six interactions: interactions between each stratum (STRATUM_MDRSC and STRATUM_MDRF) and each of the 3 different levels of accessibility (ACCESSIBILITY_HIGH, ACCESSIBILITY_MODERATE; ACCESSIBILITY_LOW).

and public sector antimalarial sales values. The inclusion of interaction parameters between variables leads to different coefficient estimates for all variables and their interpretation is different to that in a model that does not include interactions (Kirkwood and Sterne, 2003). Appendix 13 provides a description of our calculation steps. Coefficients, standard errors and p-values of linear combinations of predictor variables were calculated using STATA 11 post-estimation command `lincom` (StataCorp., 2009). Results are presented in Table 7-12.

Table 7-12: OLS log-linear regression model of antimalarial retail price percent mark-ups, considering interactions between predictor variables

Predictors	Model using HHI calculated on private & public antimalarial sales volumes (n=641, F<0.0001, R ² =0.1748)			Model using HHI calculated on private & public antimalarial sales values (n=641, F<0.0001, R ² =0.1898)		
	Coefficient	Standard Error	P value	Coefficient	Standard Error	P value
HHI_VOLUME	-0.485	0.220	0.028			
HHI VALUE						
MDRSC_STRATUM	-0.500	0.150	0.001	-0.121	0.196	0.536
ACCESSIBILITY_MODERATE	-0.157	0.276	0.571	-0.716	0.194	<0.001
ACCESSIBILITY_HIGH	-0.177	0.226	0.443	1.150	0.311	<0.001
ACCESSIBILITY_MODERATE*HHI_VOLUME	1.527	0.484	0.002	-0.262	0.190	0.169
ACCESSIBILITY_HIGH*HHI_VOLUME	-0.400	0.439	0.362			
ACCESSIBILITY_MODERATE*HHI_VALUE				-	-	-
ACCESSIBILITY_HIGH*HHI_VALUE				-	-	-
MDRSC_STRATUM*ACCESSIBILITY_HIGH ¹	0.660	0.232	0.005	0.788	0.269	0.004
RISK_MODERATE	-0.208	0.139	0.135	0.095	0.200	0.637
RISK_LOW	-0.121	0.142	0.395	0.019	0.215	0.929
RISK_MODERATE*ACCESSIBILITY_MODERATE	-	-	-	-0.711	0.311	0.023
RISK_MODERATE*ACCESSIBILITY_HIGH	-	-	-	-0.110	0.271	0.685
RISK_LOW*ACCESSIBILITY_MODERATE	-	-	-	-0.707	0.323	0.029
RISK_LOW*ACCESSIBILITY_HIGH	-	-	-	0.345	0.281	0.221
DRUG_STORE	0.104	0.153	0.496	0.041	0.158	0.794
MOBILE_PROVIDER	0.022	0.149	0.880	0.069	0.152	0.649
GROCERY_STORE	-0.184	0.169	0.277	-0.180	0.166	0.279
VILLAGE_SHOP	0.043	0.215	0.841	0.053	0.193	0.783
LENGTH_OF_OPERATION	-0.010	0.005	0.082	-0.008	0.006	0.151
TOP_SUPPLIER_DELIVERS	0.061	0.101	0.544	0.013	0.106	0.903
SALESVOLUMES	-0.009	0.005	0.065	-0.009	0.005	0.090
INJECTABLE	0.192	0.266	0.471	0.255	0.247	0.304
DIHYDROARTEMISININ +PIPERAQUINE	0.097	0.267	0.718	0.097	0.245	0.690
ARTEMISININ+PRIMAQUINE+PIPERAQUINE	0.403	0.229	0.080	0.337	0.220	0.126
CHLOROQUINE	0.745	0.170	<0.001	0.682	0.166	<0.001
QUININE	0.097	0.267	0.718	0.289	0.305	0.344
MEFLOQUINE	-0.378	0.246	0.125	-0.438	0.261	0.094
SULPHADOXINE-PYRIMETHAMINE	0.169	0.224	0.452	0.113	0.230	0.623
ARTESUNATE	-0.489	0.140	<0.001	-0.504	0.136	<0.001
ARTEMETHER	-0.307	0.303	0.312	-0.324	0.290	0.264
DIHYDROARTEMISININ	-0.643	0.702	0.360	-0.469	0.720	0.516
BRANDED	-0.376	0.128	0.004	-0.356	0.127	0.005
CONSTANT	4.634	0.278	<0.001	4.302	0.274	<0.001

MDRSC_STRATUM is stratum with suspected and confirmed multi-drug resistance; STRATUM_MDRSC*ACCESSIBILITY_MODERATE omitted. STRATUM_MDRSC*ACCESSIBILITY_MODERATE is used for estimating the difference between (i) effect of being sold in moderately accessible market compared to accessibility low market in MDRSC stratum and effect of being sold in moderately accessible market compared to accessibility low market in MDRF stratum [(mark-up_{access_mod} - mark-up_{access_low})_{MDRSC} - (mark-up_{access_mod} - mark-up_{access_low})_{MDRF}] and (ii) difference between effect of being sold in MDRSC compared to MDRF in moderately accessible market and effect of being sold in MDRSC compared to MDRF in accessibility low market [(mark-up_{MDRSC} - mark-up_{MDRF})_{ACCESS MOD} - (mark-up_{MDRSC} - mark-up_{MDRF})_{ACCESS LOW}]. The model estimated that (mark-up_{access_mod} - mark-up_{access_low})_{MDRSC} = (mark-up_{access_mod} - mark-up_{access_low})_{MDRF stratum}, and that mark-up_{MDRSC} - mark-up_{MDRF ACCESS MOD} = (mark-up_{MDRSC} - mark-up_{MDRF})_{ACCESS LOW}. Respectively these effects are included in the model as ACCESSIBILITY_MODERATE and STRATUM_MDRSC; “-” correspond to interactions for which the combined effect on retail percent mark-up was not statistically significant.

Model of price mark-ups for all antimalarials estimated using HHI calculated on sales volumes. The model had a R² of 0.1748. Compared to the model without interactions, similar results were obtained in terms of the marginal effect of antimalarial generic type, and brand status on retail percent mark-ups. In addition, retail mark-ups were significantly and differently affected by concentration and by strata in markets at different levels of accessibility.

An increase of 0.1 in the HHI in moderately accessible markets was associated with percent mark-ups 13.7% higher (p<0.001) whilst in remote and accessible markets it was associated with mark-ups 4.9% (p=0.028) and 5.8% lower respectively (p=0.052) (Table 7-13).

Table 7-13: Effect of HHI on retail percent mark-ups across accessibility levels
All antimalarials, HHI calculated on public and private sales volumes

Effect of a increase (+0.1) in HHI across market accessibility levels	Coefficient	P-value
ACCESSIBILITY_LOW	-0.485	0.028
ACCESSIBILITY_MODERATE	1.370	<0.001
ACCESSIBILITY_HIGH	-0.577	0.052

Steps undertaken for calculating coefficients described Appendix 13.

In moderately accessible markets, the effect of concentration on retail mark-ups is in line with the predictions of classical economic theory, with higher mark-ups in more concentrated markets. By contrast, in remote markets and accessible areas, lower retail mark-ups in more concentrated markets may have reflected the importance of the role played by government in the provision of antimalarial drugs through better access to public sector healthcare services in these areas (in remote markets, this may have reflected the provision of malaria treatment by VMWs)³⁸. In accessible markets, lower mark-ups in more concentrated markets may have reflected the greater contestability of accessible markets compared to remote ones and a strategy used by established shopkeepers to deter entry and maintain market power. Finally, private providers may have competed on quality instead of price if it can be assumed that consumers were more quality sensitive than price sensitive. In more concentrated markets, lower mark-ups could therefore reflect the lower costs being associated with less intense competition on quality.

³⁸ Government providers were treated as one provider in each market and their sales volumes were summed.

Perhaps, more importantly, retail mark-ups in remote and moderately accessible markets in the MDRF stratum were 50% ($p < 0.001$) higher than those in the MDRSC stratum (Table 7-14). This result may have reflected higher transport costs for getting antimalarial supplies in remote and moderately accessible market segments of the MDRF stratum compared to those of the MDRSC stratum. As shown in Chapter 6, retailers located in the MDRF stratum were less likely than those in the MDRSC stratum to report that one of their top 2 suppliers for antimalarials delivered orders (Table 6-13). Also remote markets in the MDRF stratum were on average more remote than those in the MDRSC stratum. In the former, shopkeepers had to travel for 6 hours (IQR 5.0-8.2) to reach the closest commercial centres whilst in the latter for 4.5 hours (IQR 4.7-5.0).

Table 7-14: Effect of strata on retail percent mark-ups across market accessibility levels
All antimalarials, HHI calculated on public and private sales volumes

Effect of strata across accessibility levels	Coefficient	P-value
ACCESSIBILITY_LOW	-0.500	<0.001
ACCESSIBILITY_MODERATE	-0.500	<0.001
ACCESSIBILITY_HIGH	0.159	0.342

MDRSC is stratum with suspected and confirmed multi-drug resistance; MDRF is stratum without multi-drug resistance; Effect in MDRSC stratum compared to baseline MDRF stratum; Steps undertaken for calculating coefficients described Appendix 13.

Model of price mark-ups for all antimalarials estimated using HHI calculated on sales values.

The model had a R^2 of 0.1898 (Table 7-12). Compared to the previous model, similar results were obtained in terms of the relative and marginal effects of antimalarial generic type, brand status and strata³⁹ on retail percent price mark-ups. There were also 3 additional important results.

First, retail mark-ups were *not* significantly affected by market concentration as measured by the HHI in this study. Second, retail mark-ups were affected significantly and differently by accessibility in markets at different levels of malaria transmission risk (Table 7-15). Retail percent mark-ups were:

- 115.0% ($p < 0.001$) higher in moderately accessible segments than in remote segments in high transmission risk markets.
- 43.8% ($p = 0.02$) higher in moderately accessible segments than in remote segments in moderate risk markets.

³⁹ Results on effect of strata on price mark-ups detailed in Appendix 13, Table A.13.1

These results are difficult to interpret. They may have reflected the focus of malaria control activities in high risk and remote market segments, through the provision of free diagnosis and treatment, which as suggested during SSIs, tempered the exercise of market power.

Table 7-15: Effects of accessibility on retail percent mark-ups across malaria risk levels
All antimalarials, HHI calculated on public and private sales values

Effects of accessibility across markets at different risk of malaria transmission	Coefficient	P-value
RISK_HIGH		
ACCESSIBILITY_LOW (omitted)		
ACCESSIBILITY_MODERATE	1.150	<0.001
ACCESSIBILITY_HIGH	-0.262	0.169
RISK_MODERATE		
ACCESSIBILITY_LOW (omitted)		
ACCESSIBILITY_MODERATE	0.438	0.020
ACCESSIBILITY_HIGH	-0.372	0.100
RISK_LOW		
ACCESSIBILITY_LOW (omitted)		
ACCESSIBILITY_MODERATE	0.442	0.120
ACCESSIBILITY_HIGH	0.083	0.718

Steps undertaken for calculating coefficients described Appendix 13.

Third, retail mark-ups were affected significantly and differently by malaria transmission risk in markets at different levels of accessibility (Table 7-16). Retail percent price mark-ups were:

- 115.0% ($p < 0.001$) lower in high risk than in moderate risk segments in remote markets. Again, this may have reflected competitive pressures from public sector supply on retailers' pricing decisions, as suggested during SSIs.
- 61.6% ($p = 0.020$) and 68.7% ($p = 0.011$) higher in high risk than in moderate and low risk segments respectively in moderately accessible markets. This may have reflected lower transport costs for getting antimalarial supplies in low risk and moderately accessible markets given that shopkeepers in these market segments were more likely to report a supplier for antimalarial drugs with delivery services (Table 6-13)

Table 7-16: Effects of malaria transmission risk on retail mark-ups across market accessibility levels

All antimalarials, HHI calculated on public and private sales values

Effects of transmission risk in markets at different accessibility levels	Coefficient	P-value
ACCESSIBILITY_LOW		
RISK_HIGH (omitted)		
RISK_MODERATE	1.150	<0.001
RISK_LOW	0.019	0.929
ACCESSIBILITY_MODERATE		
RISK_HIGH (omitted)		
RISK_MODERATE	-0.616	0.027
RISK_LOW	-0.687	0.011
ACCESSIBILITY_HIGH		
RISK_HIGH (omitted)		
RISK_MODERATE	-0.015	0.935
RISK_LOW	0.083	0.718

Steps undertaken for calculating coefficients described Appendix 13.

The final models were re-estimated for the ACT ASMQ alone in order to assess the extent to which the retail mark-up variations explained by our model were influenced by antimalarial generic drug type. The focus is on ASMQ as it was at the time of the study the first line treatment for *P.f* and the most commonly dispensed antimalarial drug. Table 7-17 describes the model. Table 7-18 presents the results, supplemented by additional Tables in Appendix 13 for the calculation of coefficients. The results are interpreted for the model estimated using HHI calculated on sales volumes first followed by the model using HHI calculated on sales values.

Model of price mark-ups for ACT ASMQ only estimated using HHI calculated on sales volumes. The model had a R^2 of 0.1460 (Table 7-18) and most of the results were similar to those of the model estimated on all antimalarial drugs presented in Table 7-12, although the marginal effects of accessibility levels and concentration on ASMQ mark-ups were larger.

Retail mark-ups were 53.5% higher on ASMQ sold in remote and moderately accessible segments in MDRF markets than those in MDRSC markets ($p < 0.001$) (Appendix 13, Table A.13.2). An increase of 0.1 in the HHI increased mark-ups by 17.6% in moderately accessible markets ($p < 0.001$) whilst in remote areas it decreased mark-ups by 9.8% ($p = 0.002$) (Appendix 13, Table A.13.3).

Table 7-17: Description of the regression model of ASMQ retail percent price mark-ups only

VARIABLE	DEFINITION	MEAN
Outcome variable		
LOG_MARK-UP_AETD	Log of percent mark-up	3.76
Predictor variables		
HHI_VOLUME	Hirschman Herfindahl index on private and public sector antimalarial sales volumes by market ¹	0.33
HHI_VALUE	Hirschman Herfindahl index on private and public sector antimalarial sales values by market ¹	0.32
SALES_VOLUME	Antimalarial volume sold the previous week (AETD)	1.76
LENGTH_OF_OPERATION	Number of years respondents have been in operation in that business (years)	10.4
MARKET'S ACCESSIBILITY LEVEL		
ACCESSIBILITY_LOW (omitted)	1 if market is remote	0.20
ACCESSIBILITY_MODERATE	1 if market is moderately accessible	0.44
ACCESSIBILITY_HIGH	1 if market is accessible	0.36
MARKET'S MALARIA TRANSMISSION RISK		
RISK_HIGH (omitted)	1 if market is at high malaria transmission risk	0.21
RISK_MODERATE	1 if market is at moderate malaria transmission risk	0.37
RISK_LOW	1 if market is at low malaria transmission risk	0.41
STRATUM		
MDRF_STRATUM (omitted)	1 if stratum is MDR-Free	0.36
MDRSC_STRATUM	1 if stratum is MDR-Suspected/Confirmed	0.63
OUTLET TYPE		
PHARMACY/CLINICAL PHARMACY (omitted)	1 if outlet is pharmacy/clinical pharmacy	0.27
DRUG_STORE	1 if outlet is drug store	0.23
MOBILE_PROVIDER	1 if outlet is mobile provider	0.23
GROCERY_STORE	1 if outlet grocery store	0.13
VILLAGE_SHOP	1 if outlet is village shop	0.14
WHOLESALE DELIVERIES		
TOP_SUPPLIER_DELIVERS	1 if at least one top supplier delivers	0.45
TOP_SUPPLIER_DOES_NOT_DELIVER	1 if none of the top 2 suppliers deliver	0.55

¹ Market definition is presented in Chapter 5. Source: ACTwatch OS data in 38 sub-districts, June 2009

Table 7-18: OLS log-linear regression of ASMQ retail price percent mark-ups, considering interactions between predictor variables

Predictors	Model using HHI calculated on private & public antimalarial sales volumes (n=336, F<0.0000, R ² =0.1460)			Model using HHI calculated on private & public antimalarial sales values (n=336 F<0.0000, R ² =0.1348)		
	Coefficient	Standard Error	P value	Coefficient	Standard Error	P value
HHI_VOLUME	-0.980	0.319	0.002			
HHI_VALUE				-0.128	0.245	0.959
MDRSC_STRATUM	-0.536	0.159	0.001	-0.723	0.189	<0.001
ACCESSIBILITY_MODERATE	-0.77	0.315	0.015	0.965	0.359	0.008
ACCESSIBILITY_HIGH	-0.70	0.316	0.027	-0.343	0.286	0.232
ACCESSIBILITY_MODERATE*HHI_VOLUME	2.537	0.656	<0.001			
ACCESSIBILITY_HIGH*HHI_VOLUME	0.647	0.659	0.327			
ACCESSIBILITY_MODERATE*HHI_VALUE				-	-	-
ACCESSIBILITY_HIGH*HHI_VALUE				-	-	-
MDRSC_STRATUM*ACCESSIBILITY_HIGH	0.794	0.256	0.002	0.969	0.288	0.001
RISK_MODERATE	-0.062	0.150	0.682	0.228	0.300	0.447
RISK_LOW	0.108	0.163	0.509	0.362	0.342	0.291
RISK_MODERATE*ACCESSIBILITY_MODERATE	-	-	-	-0.557	0.400	0.166
RISK_MODERATE*ACCESSIBILITY_HIGH	-	-	-	-0.047	0.373	0.899
RISK_LOW*ACCESSIBILITY_MODERATE	-	-	-	-0.866	0.432	0.047
RISK_LOW*ACCESSIBILITY_HIGH	-	-	-	0.154	0.401	0.701
DRUG_STORE	0.314	0.204	0.126	0.235	0.200	0.240
MOBILE_PROVIDER	-0.126	0.184	0.484	-0.013	0.186	0.941
GROCERY_STORE	-0.186	0.214	0.385	-0.153	0.213	0.473
VILLAGE_SHOP	-0.402	0.202	0.048	-0.354	0.225	0.118
LENGTH_OF_OPERATION	-0.012	0.005	0.027	-0.009	0.007	0.140
TOP_SUPPLIER_DELIVERS	0.187	0.130	0.153	0.096	0.136	0.481
SALESVOLUMES	0.002	0.012	0.896	0.006	0.013	0.659
CONSTANT	4.503	0.304	<0.001	3.832	0.321	<0.001

MRDSC_STRATUM is stratum with suspected and confirmed multi-drug resistance; STRATUM_MDRSC*ACCESSIBILITY_MODERATE omitted. STRATUM_MDRSC*ACCESSIBILITY_MODERATE is used for estimating the difference between (i) effect of being sold in moderately accessible market compared to accessibility low market in MDRSC stratum and effect of being sold in moderately accessible market compared to accessibility low market in MDRF stratum $[(\text{mark-up}_{\text{access_mod}} - \text{mark-up}_{\text{access_low}})_{\text{MDRSC}} - (\text{mark-up}_{\text{access_mod}} - \text{mark-up}_{\text{access_low}})_{\text{MDRF}}]$ and (ii) difference between effect of being sold in MDRSC compared to MDRF in moderately accessible market and effect of being sold in MDRSC compared to MDRF in accessibility low market $[(\text{mark-up}_{\text{MDRSC}} - \text{mark-up}_{\text{MDRF}})_{\text{ACCESS_MOD}} - (\text{mark-up}_{\text{MDRSC}} - \text{mark-up}_{\text{MDRF}})_{\text{ACCESS_LOW}}]$. The model estimated that $(\text{mark-up}_{\text{access_mod}} - \text{mark-up}_{\text{access_low}})_{\text{MDRSC}} = (\text{mark-up}_{\text{access_mod}} - \text{mark-up}_{\text{access_low}})_{\text{MDRF}} + \text{STRATUM_MDRSC}$, and that $(\text{mark-up}_{\text{MDRSC}} - \text{mark-up}_{\text{MDRF}})_{\text{ACCESS_MOD}} = (\text{mark-up}_{\text{MDRSC}} - \text{mark-up}_{\text{MDRF}})_{\text{ACCESS_LOW}} + \text{ACCESSIBILITY_MODERATE}$. Respectively these effects appear in the model as ACCESSIBILITY_MODERATE and STRATUM_MDRSC; “-” corresponds to interactions for which the combined effect on retail percent mark-ups was not statistically significant.

There were three additional results. The first is that retail mark-ups were significantly and differently affected by accessibility in the MDRF and MDRSC strata. In the MDRF stratum, being sold in a remote market increased retail mark-ups by 77.2% compared to moderately accessible markets ($p=0.015$) and by 70.5% compared to accessible markets ($p=0.027$) (Table 7-19). In MDRSC stratum, being sold in a remote market also increased retail mark-ups by 77.2% compared to moderately accessible markets ($p=0.015$) (Table 7-19). As supposed earlier, shopkeepers operating in remote markets and in the MDRF stratum may have faced higher transport costs for getting ASMQ supplies as they were less likely to report a supplier who delivered orders (Table 6-13).

Table 7-19: Effects of accessibility on ASMQ retail percent mark-ups across strata ASMQ only, HHI calculated on public and private sales volumes

Effect of accessibility on retail mark-ups across the 2 strata	Coefficient	P-value
MDRF_STRATUM		
ACCESSIBILITY_MODERATE	-0.772	0.015
ACCESSIBILITY_HIGH	-0.705	0.027
MDRSC_STRATUM		
ACCESSIBILITY_MODERATE ¹	-0.772	0.015
ACCESSIBILITY_HIGH	0.089	0.789

MDRSC_STRATUM is stratum with suspected and confirmed multi-drug resistance; MDRF is stratum without multi-drug resistance; Steps undertaken for calculating coefficients described Appendix 13.

¹see footnote Table 7-12.

The second result is that retail mark-ups on ASMQ were significantly affected by outlet type, with mark-ups 40.2% lower at village shops than at pharmacies/clinical pharmacies ($p=0.048$) (Table 7-18). Retail mark-ups at village shops were significantly lower than at drug shops (F-test=0.03) but not significantly different than at grocery stores or mobile provider outlets. Overall, mark-ups on ASMQ were the highest at pharmacies/clinical pharmacies and drug shops, although it did not translate into higher consumer prices as has reported in Table 3-3 (ACTwatch Group, 2009b) because these providers paid significantly lower prices for their ASMQ supplies than other provider types did (Table 7-4). In the case of pharmacies/clinical pharmacies this likely reflected the situation where these providers were significantly more likely to report PSI Cambodia as a top supplier compared to other retailer types (Section 6.3.4).

The third and last result is that an increase of 1 year in outlet's length of operation decreased mark-ups by 1.2% ($p=0.027$) (Table 7-18). This is in contradiction with our hypothesis that long-established providers may use market power to charge higher mark-ups. Providers in operation for longer may have charged lower mark-ups in order to deter potential competitors from entering the market. Conversely, these providers may have been in operation for longer

because they charged lower mark-ups thereby increasing demand for their products and being overall more successful. Finally, they may also have been motivated by other objectives than profit maximization such as for example serving their communities.

Model of price mark-ups for ACT ASMQ only estimated using HHI calculated on sales values.

The model had a R^2 of 0.1348 (Table 7-18) and, again, most results were similar to those obtained with the model considering all antimalarial drugs (Table 7-12). For instance, retail mark-ups were significantly higher in remote and moderately markets of the MDRF stratum than in those of the MDRSC stratum, although with a larger marginal effect (72.3%, $p < 0.001$) (Appendix 13, Table A.13.4). The only difference between the two models was that the interaction group ACCESSIBILITY*RISK had no significant effect on ASMQ mark-ups (F-test=0.07). Finally, compared to the model of ASMQ mark-ups that considered the HHI calculated on antimalarial sales volumes, outlet type and outlet's length of operation had no significant effect on retail percent mark-ups.

Table 7-20 summarises the results of the quantitative analysis of retail percent mark-ups on all antimalarial drugs and on ASMQ. There were 7 key results:

- Higher antimalarial mark-ups in market segments in which shopkeepers were less likely to report a supplier with delivery services (i.e remote, MDRF, higher risk segments) (Table 6-13).
- Higher ACT mark-ups at pharmacies/clinical pharmacies and drug shops than at other retail outlet types. This did not however translate into higher consumer prices (Table 3-3) because these providers purchased ACT at lower prices than other retailer types (Table 7-4). This may have reflected higher proportions of pharmacies/clinical pharmacies and drug shops reporting a supplier who delivered orders (Table 6-13), with pharmacies/clinical pharmacies significantly more likely to report PSI Cambodia as one of their top two suppliers for antimalarial drugs (Section 6.3.4).
- Lower mark-ups in high risk segment of remote markets and similarly lower mark-ups in remote segments of high risk markets - perhaps reflecting the effect of government supply in these areas on retailers' pricing.

- Evidence of a positive relationship between concentration and mark-ups in moderately accessible segment whilst a negative relationship was observed in remote and accessible segments – in the latter the evidence was relatively weak (as shown by p-values) and the effects relatively small.
- Higher antimalarial retail mark-ups on unbranded antimalarials than on branded products as has been observed in other settings (Section 3.4.3).
- Higher price percent mark-ups on ASMQ than on artesunate (an AMT), but with higher purchase prices this translated to higher absolute price mark-ups on artesunate (2 to 5 times higher) and higher consumer prices (2 to 3 times higher) compared to ASMQ (Table 2-3).
- Retail price percent mark-ups on injectable antimalarial were not statistically different than on antimalarial tablets. However, evidence showed that absolute price mark-ups on AMT injection were 6 to 26 times higher than on ASMQ tablet, which translated into higher consumer prices (Tables 2-3 and 7-6)

Table 7-20: Summary of the effects of market, outlet and product characteristics on retail percent mark-ups

Model ¹	HHI calculated on antimalarial sales volumes		HHI calculated on antimalarial sales values	
	ALL ANTIMALARIALS	ASMQ only	ALL ANTIMALARIALS	ASMQ only
Predictor variable & statistically significant effect on price mark-ups:				
In more concentrated markets (+0.1 in HHI)	+13.7% (p<0.001) in moderately accessible segments -5.8% (p=0.052) in accessible segments -4.9% (p=0.028) in remote segments (Table 7-13).	+17.6% (p<0.001) in moderately accessible segments -9.8%(p=0.002) in remote segments (Appendix 13 Table A.13.3)	-	-
In more remote markets	-	+77.2% (p=0.015) compared to moderate accessible markets in MDRF and MDR segments +70.5% (p=0.027) compared to accessible markets in MDRF segment (Table 7-19)	-115% (p<0.001) compared to moderately accessible markets in high risk segments -43.8% (p=0.02) compared to moderately accessible markets in moderate risk segments (Table 7-15)	-
In markets at higher risk	-	-	-115%(p<0.001) compared to moderate risk markets in remote segments; +61.6% (p=0.027) compared to moderate risk markets and +68.7% (p=0.011) compared to low risk markets in moderately accessible segments (Table 7-16)	-
In the MDRF stratum	+50.0 (p<0.001) in remote and moderately accessible markets compared to those in MDRSC (Table 7-14)	+53.5% (p<0.001)in remote and moderately accessible markets compared to those in MDRSC (Appendix 13, Table A.13.2)	+71.6% (p<0.001) in remote and moderately accessible segments compared to those in MDRSC (Appendix 13, Table A.13.1)	+72.3% (p=0.001) in remote and moderately accessible segments compared to those in MDRSC (Appendix 13, Table A.13.4)
Pharmacy/clinical pharmacy	-	+40.2%(p=0.048) compared to village shops (Table 7-18)	-	-
In outlets in operation for longer (+1 year)	-	-1.2% (p=0.027) (Table 7-18)	-	-
ACT AMSQ	-74.5% (p<0.001) compared to chloroquine +48.9% (p<0.001) compared to artesunate (Table 7-12)		-68.2% (p<0.001) compared to chloroquine and +50.4% (p<0.001) compared to artesunate	
Branded	-35.6% (p=0.004) compared to unbranded(Table 7-12)		-37.6%(p=0.004) compared to unbranded to	

ACT ASMQ is artemisinin combination therapy artesunate and mefloquine; MDRSC is multi-drug resistance confirmed or suspected; MDRF is multi drug resistance free; Shaded cells correspond to predictors that were not relevant to the model. Source: ACTwatch Outlet Survey data, 38 sub-districts, June 2009

7.5 Summary

This chapter has described retailers' and wholesalers' price setting behaviour as perceived by providers themselves, presented purchase prices and price mark-ups for different antimalarial categories and for RDT and analysed retail percent mark-up determinants. Results indicated that retail percent price mark-ups were affected by market, product and outlet characteristics but to different degrees in different segments of the market. These results demonstrated the heterogeneity of retail markets for malaria treatment and highlighted the influence of distribution chain structure and wholesalers' conduct. These results will be discussed in Chapter 9. The thesis now turns to a comparative analysis of different methods for studying antimalarial wholesalers and retailers.

CHAPTER 8 COMPARATIVE ANALYSES OF DIFFERENT METHODS FOR STUDYING ANTIMALARIAL RETAILERS AND WHOLESALERS

8.1 Introduction

The aim of this chapter is to compare different methods for identifying and sampling wholesalers and measuring retail and wholesale sales volumes. We focus on these 2 particular methodological issues because they are important first steps in the study of competition in markets for malaria treatment. In Chapter 3, the review of methods for identifying and sampling wholesalers found that the “bottom-up” approach, which consists of asking providers to identify their supply sources, has been the common approach for identifying wholesalers but that key challenges emerge with regards to whether all providers had been identified and how a representative sample can be drawn under this uncertainty. As for measuring sales volumes, there is limited evidence on which of the reviewed methods may provide the most accurate estimates at retail and wholesale outlets.

This chapter is structured in 2 parts. The first part looks at a range of methods for identifying and sampling wholesale providers whilst the second focuses on methods for measuring retail and wholesale sales volumes. In the first part, four different methods for identifying and sampling antimalarial wholesalers are assessed, including the use of official lists of registered drug providers, key informant interviews, the “bottom-up” method and the snowball census. The focus is on wholesalers rather than retailers because the former have been less researched and the relevance of methods appropriate for identifying and sampling retailers is unknown at higher levels of the chain. In the second part, two methods for measuring antimalarial sales volumes are compared, namely the recall method that was used during the ACTwatch Outlet Survey (OS) and Supply Chain Survey (SCS) and the retail audit technique, which are together referred as the Sales Level Survey (SLS). The focus is on both wholesale and retail outlets because few studies have measured sales volumes at either level and the relative effectiveness of each method is unknown. Each of the 2 parts of this chapter describes the range of methods to be assessed, the data collection process, and the results in terms of the strengths and weaknesses of the different methods.

8.2 Comparing four methods for identifying and sampling wholesalers

8.2.1 Introduction

In Chapter 3, six methods for identifying and sampling providers were reviewed: use of existing lists of providers, key informant interviews, outlet census, provider interviews, review of sales receipts and household survey. Provider listings, key informant interviews, provider interviews and review of sales receipts have been used for identifying both wholesale and retail outlets whilst outlet census and household survey have been used for identifying retailers only. However, there is limited evidence on the relevance of each of these methods and on how they compare to one another. This gap is addressed in the next sections.

8.2.2 Methods for data collection and analysis

At the retail level, the census method appears to be the most reliable approach for measuring the number of antimalarial providers in a given area. Both formal and informal providers operating at the time of the census can be captured. The census relies however on the inclusion of all relevant types of outlets that may stock antimalarials and the diligence of survey fieldworkers in visiting all outlets. The census is also a costly method and is therefore generally conducted in small areas and rarely at national level as it would require extensive resources.

Overall, the appropriateness of the census method for identifying wholesalers is questionable. We do not know which outlets may act as wholesalers given that retailers often also wholesale and we do not know where outlets may be located, for example, in which towns, or which parts of towns. In Cambodia, only in the capital city, Phnom Penh, were wholesalers concentrated in one area called Olympic. Using the census for identifying and sampling wholesalers therefore implies that large areas would need to be scrutinised, a process which would likely be relatively costly. As for the household survey, it is relevant for identifying retailers visited for treating malaria symptoms but unlikely to be so for wholesalers who may trade bulk quantities only, notably at higher levels of the chain.

When developing this study, two other methods, which were not identified during the review described in Chapter 2, were considered, namely the use of customer lists and exit interviews

outside wholesale shops to identify the wholesale businesses that purchased from higher level wholesalers.

The use of customer lists may be limited by the availability of such lists, although one could argue that they may be more frequently found at wholesale than at retail outlets given that wholesalers may deliver orders to their customers and therefore keep customers' names and addresses (Rik Bosman and Prashant Yadav, personal communications,). However, in Cambodia, the proportion of wholesalers who reported delivering antimalarials to customers varied across chain levels and overall only a small proportion of wholesalers did so (around one-fifth at the level supplying retailers and less than half at the level supplying other wholesalers) (Chapter 6). The availability of customer lists for identifying wholesalers was therefore doubtful. Furthermore, if such lists were kept, wholesalers could be reluctant to share them with interviewers, for confidentiality issues and fear that their lists could be shared with competitors. Finally, where accessible, customer lists could be out dated or with incomplete information. The use of such lists was therefore considered to be generally inappropriate.

As for exit interviews outside wholesale shops, the main challenge in Cambodia was that antimalarials were often reported by wholesalers themselves to represent a small share of their total business, implying that interviewers may have to wait many days outside a shop before they can identify a wholesale antimalarial customer.

"Customers for antimalarials do not come every day but every 5 to 10 days" (Wholesaler supplying retailers #9, MDRF stratum)

Other challenges with exit interviews are that not all shopkeepers may accept having interviewers standing outside their shops,,and customers may be in a rush when leaving the shop or reluctant to share information on their name, address and products purchased (although such reluctance can be an issue for any provider survey). Perhaps, more importantly, the main challenge shared by the use of customer lists and exit interviews is that a sample of higher level wholesalers must first be identified in order to use these approaches!

In summary, outlet census, household survey, use of customer lists and exit interviews can be ruled out as feasible and effective methods for identifying and sampling antimalarial wholesalers.

As for the use of outlet sales receipts, which have been used for identifying wholesalers in Kenya (Tavrow et al., 2003), their relevance will be explored in the second part of this chapter because they can also potentially be used for measuring sales volumes.

In this context, the first part of this chapter explores the relevance of the remaining potential options for identifying and sampling wholesalers: using official lists and conducting key informant interviews, supplemented with two methods developed for addressing the peculiar challenge of identifying and sampling wholesale businesses: the “snowball census technique” and the “bottom-up” method (Chapter 4 and described in more detail later in this chapter).

The appropriateness of each method for identifying and sampling wholesalers is explored through a SWOT analysis by assessing strengths, weaknesses, opportunities and threats of each approach. For the purpose of this study, the strengths and weaknesses of a particular method refer to its practical implementation pros and cons. For example, one of the strengths (implementation pro) of using existing lists of providers available from commercial organizations (e.g. IMS Health) would be that data for identifying and sampling providers are easily collected, whilst a weakness (implementation con) would be the cost of purchasing these data. Opportunities and threats relate to the nature of the data collected such that for example using existing lists offers the opportunity for collecting additional information on each outlet, for example, providers’ characteristics, whilst a threat may be that the list is incomplete because data have been collected for a particular type of outlet or geographical area.

For the comparative analysis, key findings from the SWOT analysis are summarised using a spider diagram for each method, which was developed using a rough ranking of relative performance of each method in comparison of the other 3 methods on two dimensions: the nature of data collected (shape of the chain for antimalarial drugs; total wholesalers in the chain serving the study areas; number of antimalarial wholesalers operating in a particular area, antimalarial wholesaler level of operation; antimalarial wholesaler’s name and location; informal wholesalers) and implementation speed and cost.

The next sections describe in turn the use of official lists, key informant interviews, snowball census technique and bottom-up approach for identifying and sampling wholesalers. Then, the 4 methods are compared.

8.2.3 Results

8.2.3.1 Using official lists

The appropriateness of official lists for identifying and sampling wholesalers was assessed using two sets of lists.

The first set, kept at the Ministry of Health's (MOH) headquarters in Phnom Penh, included 3 lists: (i) a list of companies registered to import pharmaceutical drugs and medical equipment; (ii) a list of import permits delivered to registered importers before each shipment; and (iii) a list of antimalarial drugs registered for importation and in-country distribution and sales, which included, for each registered drug, the name of the local company that had completed the drug registration process. For locally manufactured drugs, the registration process was, at the time of this study, conducted by the manufacturer and for drugs manufactured outside Cambodia by one importer on behalf of the manufacturer (Chapter 6).

The second set of lists, which were available from MOH's provincial health departments (PHDs), included the lists of drug outlets registered to wholesale and/or retail pharmaceutical drugs in each province. At the time of this study, there were no other sources of drug outlet lists, such as, for example, those developed by commercial institutions or previous studies.

The collection of the first set of lists was conducted in May 2009 and repeated in October 2009 in order to capture potential updates of the lists that could have occurred since the earlier visit. Official lists collected in Khmer were translated into English by a local researcher before the analysis.

Of the first set of lists kept at the MOH's headquarters, two were successfully collected: (i) the list of companies registered to import pharmaceutical drugs and medical equipment and (iii) the list of registered pharmaceutical drugs. As for (ii), the list of import permits delivered to registered companies before each shipment, it could not be accessed. Reasons for this were unclear but Government authorities may have been suspicious of the ways this list would be used and of the overall objectives of our study. All the collected lists were in English.

Of the 2 available lists at the MOH's headquarters, the list of registered importers provided, for each company, information on the name of the company, name of the pharmacist in

charge in the company, address and telephone number of the company, MOH registration number and registration date of expiration. There were 156 importers listed. For several importers, the registration's expiry date had passed, with for example 4 importers for which registration had expired in 1999. From this list, it was not possible to tell whether these importers were not registered anymore or whether they were registered and the registration date of expiry had not been updated. The list was collected in August 2009 but was dated November 2008 so it may also have omitted importers who had recently received registration or were in the process of receiving registration. It was also not possible to distinguish companies that imported antimalarial drugs from those that imported other pharmaceutical drugs in general or medical equipment.

The list of antimalarial drugs provided information on the product brand name, active ingredient(s) and strength, dosage form, pack size, manufacturer name, country of manufacture, registration date and registration expiry date. The list was dated 23rd July 2009, implying that the information it contained had been updated relatively recently at the time of this study.

Using this list, it was possible to calculate the number of antimalarials manufactured locally and the number that were imported. From there, whilst the list did not provide information on the name of the importer, it was possible to approximate the number of companies that imported antimalarial drugs, by using our knowledge about importers' business practices in Cambodia. Out of 26 antimalarial drugs registered, 6 were produced locally and 20 imported. Semi-structured interviews (SSIs) with wholesalers had revealed that those who imported antimalarial drugs acted as the local agent of one foreign manufacturer, each generally producing one antimalarial product (Chapter 6). This therefore implied that 20 wholesalers imported antimalarial drugs. However, for 3 antimalarials manufactured overseas, registration and expiry dates were missing and for 11 registration expiry dates had passed by several years. Taking this into account, there were 6 registered importers of antimalarials drugs at the time of the study. However, 2 were registered to import artemisinin monotherapies (AMT), for which registration had been revoked following the ban on AMT in November 2008. Accounting for this, the number of registered antimalarial importers was estimated to be 4.

As for the lists available at PHDs, 8 lists out of a total of 24 were collected. Due to financial and time constraints, lists were collected during the SCS that took place in 16 of the 24 malaria endemic provinces. Consequently, 8 provinces were not visited and lists could not be collected.

Furthermore, for the 16 provinces visited, we collected lists for 8 provinces and for the other 8 lists were not accessible: in 7 provinces, PHDs were closed or the relevant officer in charge was not available at the time of our visits and in 1 province, Bantey Meanchey, there was no PHD and the registration of drug outlets was handled in the neighbouring province of Siem Reap, from where, however, there was no available list of registered outlets for Bantey Meanchey province. Available lists were in Khmer and translated into English by a local researcher before analysis. The information provided by the lists was relatively consistent across provinces, although the overall layout varied. Lists were generally stratified by district, providing information on district population, number of outlets registered, and outlet name, name of person in charge, name of owner, address and license expiry date. One list also provided information on outlets that awaited registration and another on the type of service provided, such as drug sales only (e.g. pharmacies) or drug sales and treatment services (e.g. clinical pharmacy). Information on license expiry date was sometimes missing or expiry dates had passed. Furthermore, in many cases, some districts were actually missing from the lists. It could have been that no outlets were registered in these areas or the lists for particular districts may have been kept separately. Table 8-1 presents the number of registered outlets identified by province and district. From the lists, it was not possible to distinguish outlets that wholesale drugs from those that retail only.

Table 8-1: Registered drug outlets in lists collected at Provincial Health Departments

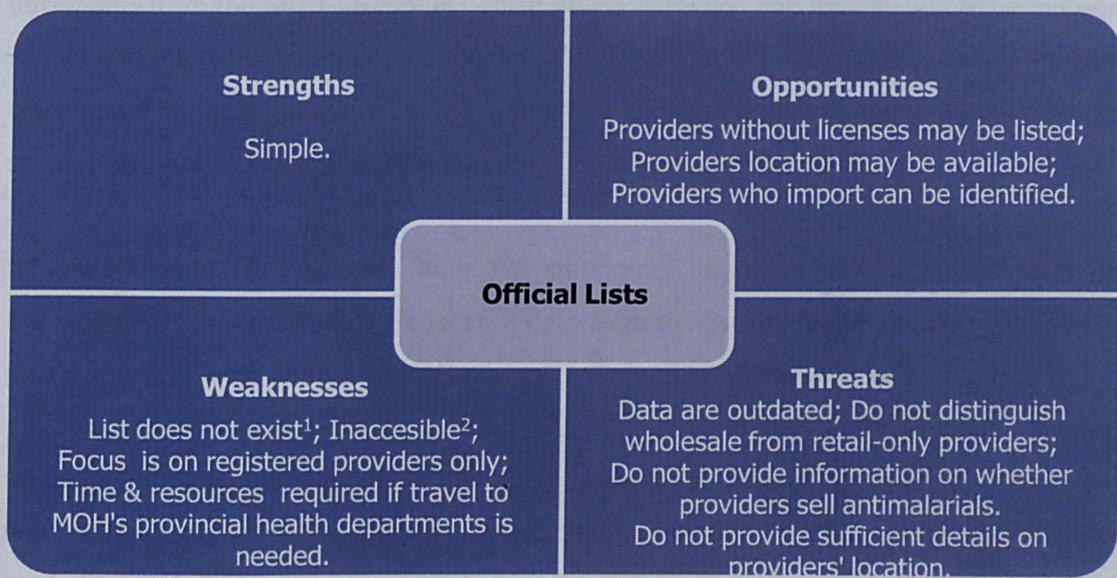
Province	District	Number of registered retail and/or wholesale outlets listed
Phnom Penh	Chamkar Morn	147
	Toul Kork	78
Kampong Cham	Chamkar Leu	13
	Prey Chhor	17
Kratie	Kracheh	0
	Sambour	0
Steung Treng	Thalabarivat	n/c
	Steung Treng	2
Siem Reap	Siem Reap	49
	Varin	n/c
	Puok	2
	Kralanh	1
	Angkor Chum	n/c
Kampong Thom	Stoung	n/c
	Prasat Sambo	n/c
	Steung Sen	18
	Santuk	n/c
	Baray	4
Preah Vihear	Tbaeng Meanchey	11
	Rovieng	n/c
	Choam Ksant	6
Koh Kong	Koh Kong	3

n/c = not collected, in the case of an area for which the list of registered outlets was missing.

Surprisingly, in a couple of provinces, lists were also available for outlets that operated without licenses. PHD and district authorities reported developing these lists for informational purposes and in efforts towards regulating and/or working with private drug providers. These lists provided the same scope of information as those for registered outlets. The reliability of the data they provided was, however, as questionable as that of official lists.

The SWOT analysis for the use of official lists for identifying and sampling antimalarial drug wholesalers is presented in Figure 8-1, which summarises this section's findings. It shows that collecting official lists is a simple process but that it requires financial and human resources and time if lists are not centrally kept. Furthermore, lists may not always exist nor be accessed. Official lists of outlets that operate without a license can be available, albeit in rare occasions, and providers' location is, at times, available. Official list data are however generally outdated, and do not distinguish between outlets that sell drugs wholesale and handle antimalarial drugs to others that do not. These are clearly important limitations if a representative sample of antimalarial wholesalers is to be drawn from official lists for the purpose of a research study.

Figure 8-1: Using official lists: a SWOT analysis



¹one provincial department did not keep lists of registered outlets. ²Ministry of Health provincial departments could not be visited and the list of import permits could not be accessed at the Ministry of Health

The next section explores the appropriateness of key informant interviews (KIs) for identifying and sampling wholesalers as well as the potential for combining key informant interviews with official lists.

8.2.3.2 Conducting key informant interviews

Table 8-2 gives an overview of interviews conducted with 10 key informants in order to identify and sample antimalarial wholesalers. The topic guide used for conducting these interviews is available in Appendix 4.

Table 8-2: Overview of key informant interviews

Interview date & location	Informant's organization identifiers	Number of informants interviewed
March 2008 – Workshop to launch the ACTwatch Study in Nairobi, Kenya	CNM	3
	PSI Cambodia	2
April/May 2009 – Cambodia	CNM	1
	DDF	3
	PSI Cambodia	1

CNM is for National Centre for Ministry of Health's National Centre for Parasitology, Entomology and Malaria Control; PSI Cambodia for Population Services International Cambodia Country Office. DDF is for of the Department of Drugs and Food

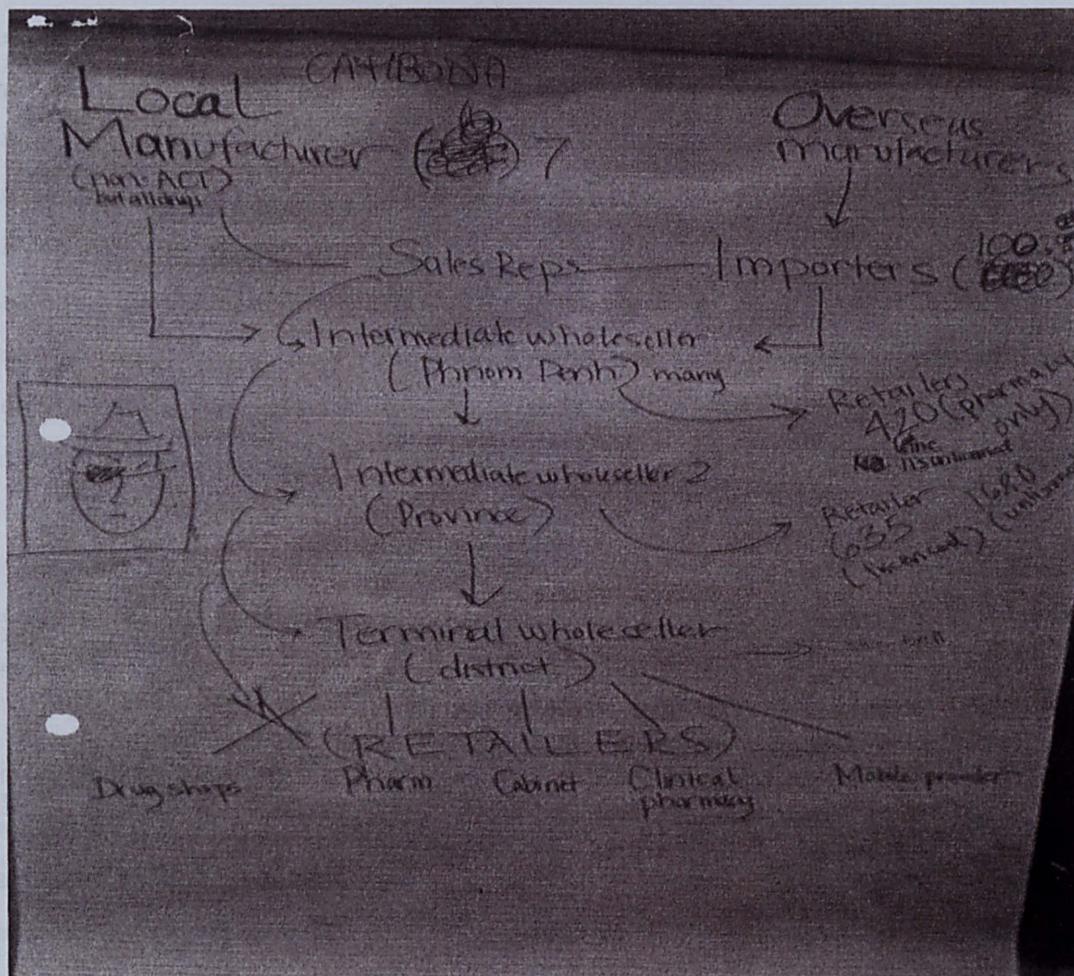
In March 2008, during the ACTwatch study launch meeting, 5 interviews were conducted with informants from the MOH's National Centre for Parasitology, Entomology and Malaria Control (CNM) and Population Services International in Cambodia (PSI Cambodia). These informants were asked to draw on a large white paper board the structure of the private commercial sector distribution chain for antimalarial drugs in Cambodia (Figure 8-2).

Informants reported that more than 100 companies imported pharmaceutical drugs into Cambodia, which somewhat corroborated data from the list of registered importers handling pharmaceutical drugs and/or medical equipment (i.e. 156 companies listed).

Whilst informants did not know the exact number of private commercial importers of antimalarial drugs, they thought that few companies imported such drugs because the social marketing programme was perceived to crowd-out the private commercial sector through the distribution of subsidized products to most private commercial outlets in Cambodia. Similarly, at lower levels of the chain, informants were unable to provide the exact number of outlets selling antimalarial drugs but estimated that 2735 drug outlets operated in Cambodia. This included 942 registered businesses, of which 635 were reported to operate in provincial towns and 307 in Phnom Penh, and around twice as many operating without licenses (1793 outlets), including 1680 in provincial towns and 113 in Phnom Penh (Figure 8-2). Informants described

the distribution chain for antimalarial drugs as having 4 levels from factory gates/ports of entry down to retailers, with companies located at the top of the chain delivering drugs right down to the bottom of the chain through teams of sales representatives. They also indicated that informal trade of antimalarial drugs was widespread, illustrated by the face of the bandit on the left hand side of Figure 8-2.

Figure 8-2: The private commercial sector distribution chain for pharmaceutical drugs in Cambodia: findings from key informant interviews.



Note: "Intermediate wholesaler 2 (Province)" should read as "Intermediate wholesaler 1 (Province)" and "Intermediate wholesale (Phnom Penh)" should read as "Intermediate wholesaler 2 (Phnom Penh)".

Source: Key informant interviews, ACTwatch Study Launch, Nairobi, Kenya, March 2008.

In April/May 2009 5 additional interviews were conducted with public and private sector informants who were identified in consultation with the Clinton Health Access Initiative (CHAI) offices in Cambodia and through the snowball sampling technique⁴⁰ for their expert knowledge on the overall structure and characteristics of the private commercial sector distribution chain for antimalarial drugs.

All these informants were asked about the structure of the distribution chain and at each level the number of providers stocking antimalarial drugs. Figure 8-2 shows that the chain was thought as having 4 mutually-exclusive categories (MECs), including intermediate-3 suppliers (importers), intermediate-2 suppliers (based in Phnom Penh), intermediate-1 suppliers (based in provincial towns) and terminal suppliers. Intermediate-3 suppliers were reported to supply all wholesale levels and retailers located at district level, but not retailers operating in Phnom Penh or at provincial level who instead were served by intermediate-2 and intermediate-1 wholesalers only. Whilst it was not surprising that importers did not supply antimalarial drugs to retailers located in Phnom Penh (because there is no malaria in the capital city), it was surprising that importers were not reported to serve retailers in provincial towns where malaria was endemic. Figure 8-2 also suggests that intermediate-2, intermediate-1 and terminal wholesalers operated at distinct geographical levels (i.e. Phnom Penh, provincial towns and districts) with each level serving retailers within their geographical “catchment” area. These findings were different to those presented in Chapter 6, which reported 5 MECs of wholesalers, importers serving provincial and district areas and in practice overlapping levels of operation (e.g. terminal wholesalers operating at intermediate 1 or/and intermediate 2 level(s)).

To estimate the number of providers stocking antimalarial drugs at each level, one informant working at the MOH’s Department of Drugs and Food (DDF) used the list of companies registered to import pharmaceutical products and medical equipment to identify those handling antimalarials. Of the 156 registered importers, our DDF informant estimated that 50 companies imported antimalarials whilst the remaining occasionally imported when answering government procurement bids. Phone interviews were then conducted with the 50 import companies in order to verify the accuracy of the information. We talked to 24 of the 50 importers but could not reach the remaining 26 because either no one answered our calls or phone numbers were incorrect and new numbers could not be found. A total of 8 registered

⁴⁰The snowball sampling technique consists of asking initial respondents to identify new study participants, who are subsequently invited to take part in the study. This technique is repeated with each respondent until no new participants are identified.

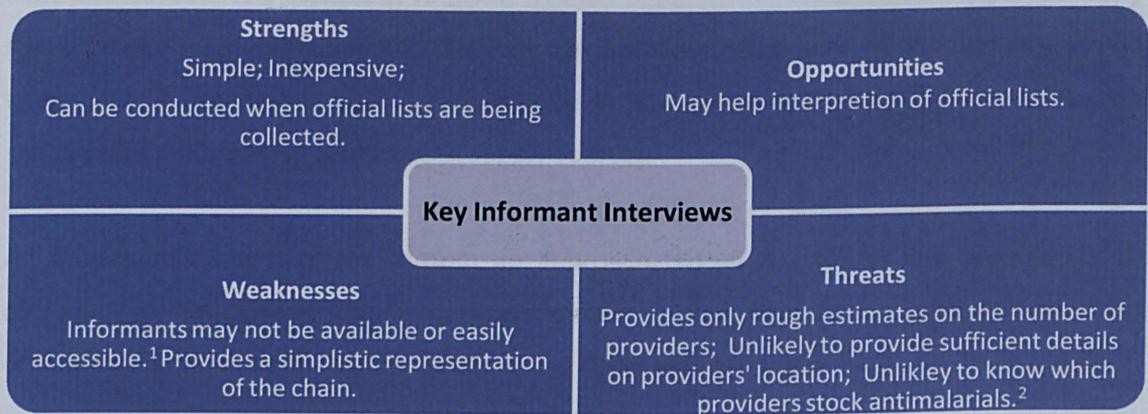
companies reported that they imported antimalarial drugs, a number higher than that identified by using official lists alone (i.e. 4 importers). This approach may have however overestimated the number of antimalarial drug importers because during phone interviews the reliability of information collected was questionable as it was not always possible to speak to the person in charge.

At lower levels of the chain, DDF officials estimated that 2809 outlets sold pharmaceutical drugs nationwide, including 1389⁴¹ registered outlets and 1420 that may have operated without a license. Such numbers may have been based on data from official lists kept at provincial level and transferred to the MOH central office, although this was not certain. It was also not possible to collect information on the number of provinces upon which these estimates were based nor to conduct phone interviews with a sample of these outlets in the absence of outlet identifiers (name, location and telephone numbers). Overall, these estimates were somewhat similar from those collected in March 2008 during the first set of KKIs (i.e. 2735 outlets, with 1793 operating without a license), although a higher number of outlets were estimated to be registered by the DDF than by other key informants.

The SWOT analysis for the use of KKIs for identifying and sampling antimalarial drug wholesalers is presented in Figure 8-3. Key informant interviews provided some information on the structure of the chain, although it differed on several aspects to the evidence presented in Chapter 6. KIIs are a useful method for estimating the number of wholesalers, notably when combined with official lists. However, this method is not well suited for identifying and sampling wholesalers operating at lower levels of the chain. Informants are generally not able to estimate the number of wholesalers operating at intermediate and lower levels of the chain nor provide detailed information on providers' names, locations and contact details so key informant interviews are not on their own a suitable approach for developing a sampling frame.

⁴¹ Includes 519 pharmacies, 126 depots A, 568 depots B and 176 pharmacies 'provisional' managed by civil servants who are pharmacists and that should only be opened outside government working hours

Figure 8-3: Key informant interviews: a SWOT analysis



¹ for example, in the case of informants located at provincial level; ² unless combined with additional interviews such as for example phone interviews with providers. However, phone interviews rely on the knowledge of respondents available to answer calls.

An alternative method that addresses some of the issues concerned with identifying and sampling antimalarial wholesalers through official lists and/or KKIs is to ask retailers stocking antimalarials to identify their supply sources for antimalarial drugs. This is the approach referred as the “bottom-up” method that was used during the SCS (see Chapters 4 and 6) and which is assessed in the next section.

8.2.3.3 The bottom –up approach

During the SCS, a bottom-up approach was used for sampling wholesalers of antimalarial drugs (see Chapter 4). Briefly, retailers stocking antimalarials were identified through a census of all outlets that potentially sold antimalarials and they were asked to identify their 2 most important supply sources for antimalarial drugs and provide information on each supplier’s business name, location (town, physical address and/or location identifiers) and contact details (telephone number). All supply sources mentioned by retailers who operated in the sampled 20 sub-districts were then visited and, in turn, asked about their top 2 supply sources for antimalarials. This process was repeated until the top of the chain was reached.

In order to verify that important suppliers had not been missed through the ‘bottom-up approach’ we also asked retailers and wholesalers interviewed during OS and SCS about the total number of suppliers they bought antimalarial drugs from in the past 3 months. Results presented in Chapter 6 showed that 94% of retailers and 89% of wholesalers reported buying

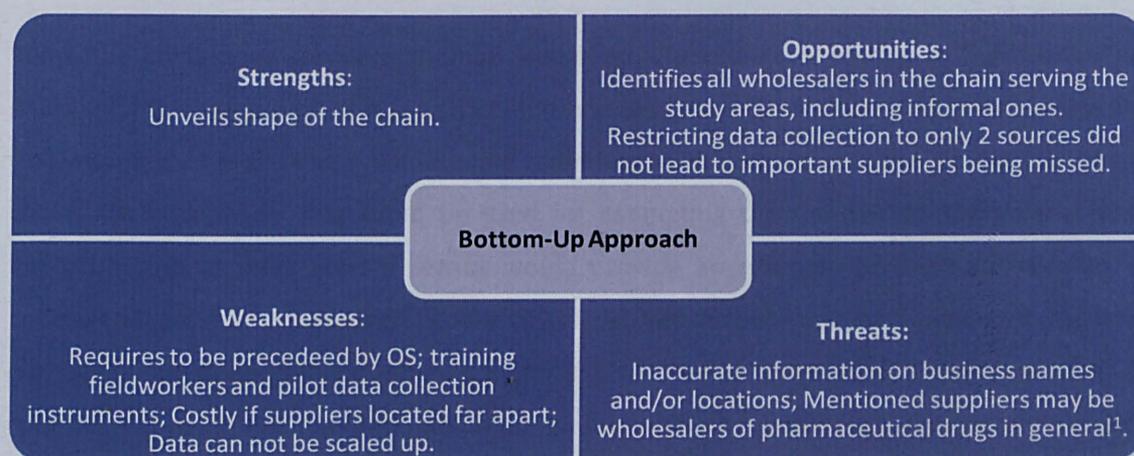
antimalarials from one or two suppliers only. To assess how many suppliers have been missed in cases where outlets reported 3 or more wholesale sources, providers were asked during semi-structured interviews (SSIs) to name all their suppliers for antimalarial drugs. We found that all suppliers identified during SSIs that had not been mentioned during the surveys had been identified by other shopkeepers during OS or SCS, indicating that collecting only 2 supply sources was sufficient for capturing all supply sources.

An important strength of the bottom up approach is that it provides the opportunity to identify informal providers in a more systematic manner than lists or KIs and this was corroborated during semi-structured interviews (SSIs) with providers.

“The Government has asked supply sources X and Y to stop [selling] artesunate but we can still order it and the suppliers deliver it secretly” (Wholesaler supplying wholesalers #4, MDRF stratum)

The bottom-up approach was however not without challenges as identified during the SWOT analysis (Figure 8-4).

Figure 8-4: The bottom-up approach: a SWOT analysis



¹ in some cases, suppliers that had been mentioned to stock antimalarial drugs at the previous level reported they did not stock antimalarial drugs.

First, in the absence of an existing updated list of antimalarial retailers, the bottom-up approach requires data from an OS, implying that significant financial resources were required. The SCS was implemented for around US\$ 15,000 (although more would have been required if wholesalers had been located farther apart) to which an additional US\$ 50,000 might have

been spent for conducting the OS⁴². It also required significant planning as the OS needed to be conducted sufficiently in advance in order for supply source data to be available at the time of the start of the SCS. However, the OS could not take place too much in advance of the start of the SCS because supply sources could have changed rapidly. During our study, this was not an issue as the OS was conducted at the start of the malaria season in June 2009 and supply source data were available by the end of July 2009, with the SCS conducted between August–November 2009.

Second, supply chain surveyors sometimes had to ask local informants for assistance in locating outlets in which the mentioned suppliers were reported to work. This is because retailers had often identified their suppliers for antimalarial drugs by the name of the person with whom they generally dealt rather than the name of the outlet, or because outlets' location identifiers were poorly informative. Chapter 6 showed that 14% of the 127 terminal wholesalers that had been identified as "unique" were actually duplicates and a further 8% could not be found. Whilst during the SCS this was not an issue because all terminal wholesalers mentioned were surveyed, it could have been problematic if one had wanted to select a sample from this list. Training data collectors in recording information and piloting data collection therefore appear as crucial aspects of the implementation phase of the bottom-up approach.

Third, the bottom-up approach method identified wholesalers operating in the distribution chain serving a sample of 20 sub-districts but one may have been interested in estimating the total number of antimalarial wholesalers operating in the whole country. At the top of the chain, KIs and official lists could be used for estimating the number of antimalarial drug importers and at retail level a census would provide an estimate of the total number of antimalarial providers operating at sub-district level, which could then be scaled up to the total number of sub-districts in the whole country and provide an estimate of the total number of retailers. However, this approach would not be appropriate at wholesale level because scaling up the number of mentioned wholesalers in each sub-district by the total number of sub-districts would overestimate the size of the wholesaler population because each wholesaler

⁴² Information on the actual amount spent by PSI Cambodia for implementing the OS was not available. In 2008, a research agency estimated the total cost of implementing both ACTwatch Household and Outlet Surveys at US\$ 80,490 (PSI Cambodia, personal communication,). Assuming the two surveys were conducted in the same sub-districts at the same time and accounting for fixed and semi-fixed costs of training data collectors, transportation and supervision, we estimated the cost of the OS at roughly US\$ 50,000.

may serve more than one sub-district. The snowball census method, which is discussed in the next section, was developed with the aim of addressing this “scaling-up” issue.

8.2.3.4 The snowball census

The snowball census method was used for identifying the total number of antimalarial wholesalers who operated in each district visited during the SCS with the aim of estimating the total number of antimalarial wholesalers operating in the country.

The snowball census consisted of creating a list of all antimalarial wholesale sources mentioned during the SCS conducted at the previous level, and then using the snowball technique approach to identify others in the district engaged in wholesale antimalarial/RDT trade. To verify that these suppliers were involved in antimalarial trade, data collectors visited each supplier and completed a simple table covering the business name, owner name, contact details (i.e. address and telephone number), whether they wholesale antimalarials, and the type of business (e.g. whether they stock drugs only or drugs and other consumer goods).

A total of 95 wholesalers were invited to participate in the snowball census, of which 34% refused to participate⁴³. Several factors may have contributed to this refusal rate. First, the snowball census questions were asked at the end of the supply chain survey and respondents may have been impatient to go back to their business. Second, wholesalers may have been comfortable talking about their business but uncomfortable talking about other similar businesses operating in their area, whom they may have perceived to be competitors.

Of those who participated in the snowball census, 62% did not identify any other antimalarial drug wholesalers, 22% identified one other antimalarial wholesaler, 6% identified two, 5% three and 5% four or six. Overall, 51 new antimalarial wholesalers were identified through the snowball census in addition to the 100 wholesalers identified through the bottom-up approach (Appendix 14). Therefore combined with the bottom-up approach that provides a list of antimalarial wholesalers operating in different areas, the snowball census method can be used to identify all antimalarial wholesalers operating in a particular area. However, it becomes unclear how these data can be used for estimating the total number of wholesalers in the whole country because wholesalers in a given area may operate at different levels of the chain.

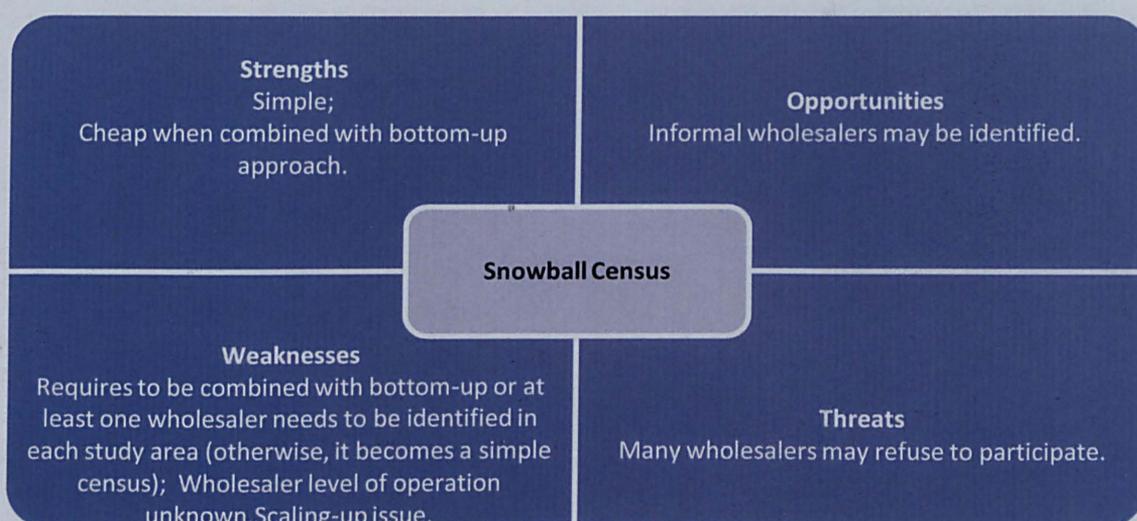
⁴³ Of 95 wholesalers interviewed, 32 refused to participate in the snowball census.

The snowball census therefore only partially addressed the limitation of the bottom-up method in relation to the data not being scalable. Furthermore, the snowball census method did not provide information on the level of the distribution chain at which the snowballed wholesalers operated. Last but not least, many providers appeared to be uncomfortable with the snowball method, which was reportedly perceived by some wholesalers as an act of denunciation.

"I can't tell you the name of other antimalarial wholesalers within the district. I am sorry. This is because if I tell you their names health or trade inspectors may go and visit them. Something bad will happen if these wholesalers do not have a license." (Fieldworker #1's written comment on the snowball census section of a wholesaler SCS questionnaire).

Figure 8-5 presents the SWOT analysis for the snowball census. In sum, the snowball census is easy and cheap to implement but it needs to be combined with a survey of providers unless another approach can be used to identify at least one wholesaler in each study area. It also has the potential to identify informal suppliers. However, the main weakness of the snowball census is that it does not provide any information on the level(s) of the chain at which snowballed wholesalers operate. Many wholesalers may also refuse to participate and therefore limit the completeness of the survey. Finally, there are challenges in scaling up the number of wholesalers operating in a given area to the whole country.

Figure 8-5: Snowball census: a SWOT analysis

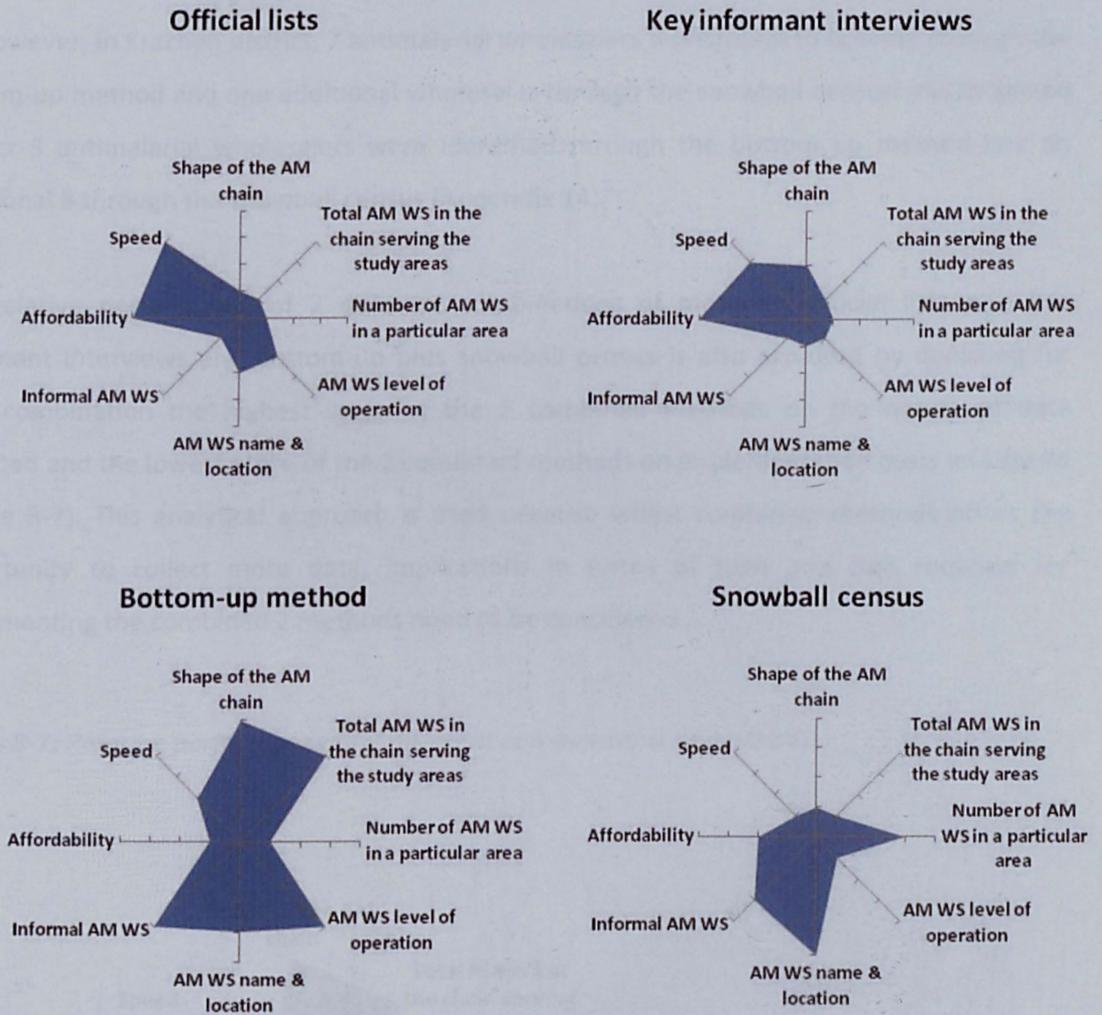


8.2.3.5 Comparing methods for identifying and sampling antimalarial wholesalers

Given that there is no gold standard method for identifying and sampling wholesalers, it is not possible to be certain that all relevant providers have been identified when using a particular method. It is however possible to compare the relative performance of each method and combination of methods. This is done in Figure 8-6 where official lists, key informant interviews, bottom-up approach and snowball census have each been assessed against 8 dimensions, which are considered as key for identifying and sampling wholesalers in a study of the private commercial sector distribution chain for antimalarial drugs.

Two dimensions relate to the implementation of each method, including (i) affordability and (ii) speed. An additional 6 dimensions relate to the nature of data collected, including (iii) the shape of the chain, (iv) total antimalarial wholesalers in the chain, (v) number of antimalarial wholesalers operating in a particular area, (vi) wholesalers' level(s) of operation, (vii) wholesalers' name and location, and (viii) informal wholesalers. For each dimension, the methods were rated by the author using a scale of 1 to 4, with 1 assigned to dimensions against which methods performed poorly and 4 to those against which they performed well (see Appendix 15 for a rationale of scores).

Figure 8-6: Relative performance of 4 different methods for identifying and sampling antimalarial wholesalers.

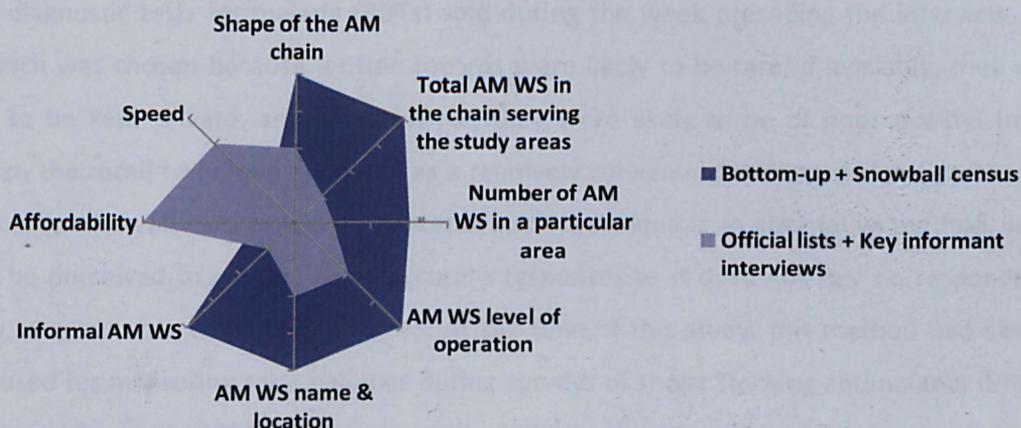


WS if for wholesaler; AM is for antimalarial

Official lists and KIIs are expected to be quicker and cheaper to implement than the census-like snowball census and the bottom-up approach that requires a structured survey for identifying antimalarial supply sources. However, the data official lists and key informant interviews provide are likely to be inaccurate and/or incomplete in terms of outlet's location, whether outlets wholesale or retail, and whether they stock antimalarials. For example, in Kratie province, there were no drug outlets on official lists for Kracheh and Sambo districts (Table 8-1). However, in Kracheh district, 7 antimalarial wholesalers were found to operate through the bottom-up method and one additional wholesaler through the snowball census; and in Sambo district 3 antimalarial wholesalers were identified through the bottom up method and an additional 8 through the snowball census (Appendix 14).

The relative performance of 2 different combinations of methods, official lists plus key informant interviews and bottom-up plus snowball census is also explored by depicting for each combination the highest score of the 2 combined methods on the nature of data collected and the lowest score of the 2 combined methods on implementation costs and speed (Figure 8-7). This analytical approach is used because whilst combining methods offers the opportunity to collect more data, implications in terms of time and cost required for implementing the combined 2 methods need to be considered.

Figure 8-7: Relative performance of 2 different combinations of methods



8.2.4 Conclusion

The bottom-up approach and the snowball census appear as a superior method to official lists and KIs for identifying and sampling wholesalers. However, the implementation of bottom-up and snowball census methods is more costly and more time consuming. In addition, during our study, the value added of the snowball census was small as we encountered many refusals from wholesalers. However, in other settings where providers are willing to identify fellow sellers (personal communication, ACTwatch Group), the bottom-up and snowball approach is likely to be the most suitable method for identifying and sampling antimalarial wholesalers, providing that time and financial resources are not an issue.

8.3 Comparing two methods for measuring retail and wholesale sales volumes

8.3.1 Introduction

Section 3.3.4 identified 4 methods for measuring private sector sales of pharmaceutical drugs in low income settings, namely reviewing providers' sales records, asking providers to recall their sales volumes, conducting exit interviews with customers and retail audits. The review pointed out that none of these approaches could be treated as the "gold standard" providing the most precise estimate.

During the OS and SCS, shopkeepers were asked to recall the volumes of antimalarials and rapid diagnostic tests for malaria (RDTs) sold during the week preceding the interview. This approach was chosen because written records were likely to be rare; if available, they were likely to be kept private; and, if accessible, they were likely to be of poor quality. In this context, the recall technique appeared as a relatively convenient and inexpensive method for measuring sales volumes. However, the retail audit technique is an alternative method, which could be perceived to provide more accurate responses as it does not rely on respondents' ability to remember their sales volumes. At the time of this study, this method had already been used for measuring sales volumes during surveys of shops stocking antimalarial drugs in Tanzania (Alba et al., 2010a, Goodman et al., 2009) but limited information was available on how it would compare with the recall method.

In this context of uncertainty on how best to estimate sales volumes at private commercial outlets in a low income setting, the remainder of this chapter aims to assess the degree of

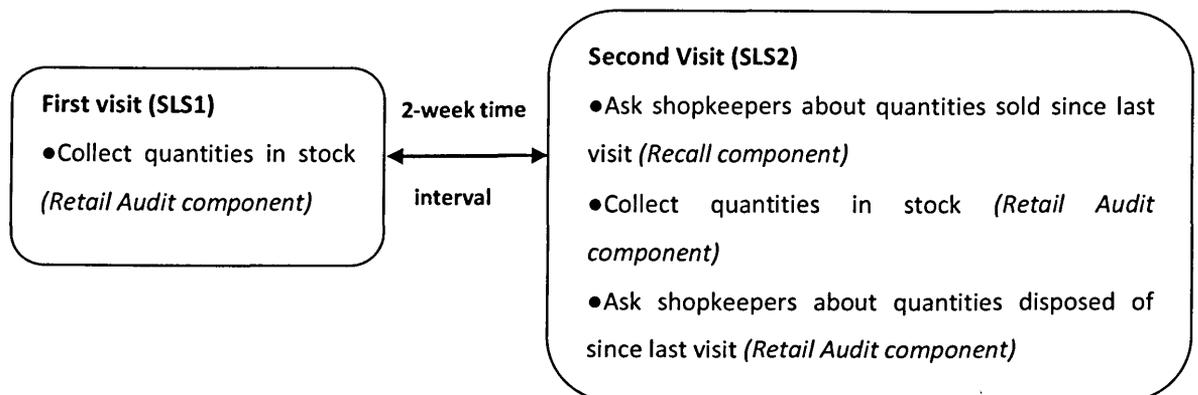
agreement between sales volume estimates measured through the recall and retail audit techniques, and explore the relative strengths and weaknesses of each method from an implementation perspective. It first presents the methods for data collection and analysis, and sales volume estimates obtained through the recall and retail audit methods and discusses the two different methods. The potential of using written sales records for collecting sales volume data is also assessed.

8.3.2 Methods for data collection and analysis

8.3.2.1 The Sales Level Survey

Sales volume data were collected through the recall method and through the retail audit method, together referred to as the Sales Level Survey (SLS). Figure 8-8 gives an overview of the design of the SLS.

Figure 8-8: Design of the Sales Level Survey



The retail audit technique consisted of visiting each sampled outlet 2 times with a 2-week time interval between each visit. At the first visit, referred to as the Sales Level Survey 1 (SLS1), data on quantities stocked of each product were collected. At the second visit, referred to as the Sales Level Survey 2 (SLS2), data on quantities stocked and quantities delivered between 1st and 2nd visits, quantities thrown away/transferred to other shops or sent back to wholesalers or confiscated were collected for each product in stock, including products in stock at either or both visits. To collect these data, respondents were asked to check any available written records or sales receipts and in the absence of records, to recall these quantities.

The recall technique consisted of asking retailers and wholesalers to recall the quantities sold during the 2 week time interval between SLS1 and SLS2. It was implemented at the start of SLS2 before collecting stock data in order to minimise bias as recall may have been influenced by the process of counting stocks. A time interval of 2 weeks between the two visits at each outlet was chosen based on (i) the existing literature in which a 2-week time interval was considered to be reasonable for capturing wholesale deliveries (Goodman et al., 2009, Alba et al., 2010a) and (ii) the public health literature in which a recall period of a maximum of 2 weeks has generally been used for collecting data such as fever episodes in household surveys (PSI, 2008a, CMS 2007, CMBS 2004).

The SLS was implemented in the same private commercial wholesale and retail outlets. At wholesale level, it took place during the SCS, with SLS1 taking place at the end of the SCS and SLS2 two weeks later as a standalone survey. At retail level, the SLS was conducted as a standalone survey. All types of antimalarial drugs in all dosage forms and package types and RDTs were surveyed. For antimalarials, data were collected in terms of both full packs and loose tablets (i.e. those kept in containers/tins). When collecting stock data for antimalarials stored in half-full containers, interviewers counted the number of tablets left in each container, or they used a ruler for measuring the height of the container, height of tablets left in the container and number of tablets in a full container (either by asking providers to estimate the quantity of tablets in a full container or by looking at the packaging information). These data were then used to estimate the number of tablets stocked⁴⁴. RDT data were collected in terms of single RDT units.

For interviewing wholesalers, data collection instruments used during the SCS, including the information sheet and questionnaire, were adapted and SLS-related sections added (Appendix 4). For interviewing retailers, a small questionnaire, like that used during the SCS, was developed to collect outlet identifiers and a minimum set of respondent characteristics (name, location identifier and range of products sold). Inventory sheets used at wholesale outlets were adapted to collect data at retail outlets (Appendix 4). To record data on products in stock at SLS2 but not in stock at SLS1, new inventory sheets were developed for both wholesale and retail outlets. All retail audit data collection tools were piloted, for SLS1 during the pilot of the SCS and for SLS2 as a standalone pilot few weeks later. A team of two interviewers entered each business, informed shopkeepers about the study objective and obtained consent.

⁴⁴ By calculating: $(\text{height of tablets left in the container} * \text{number of tablets in full container}) / \text{height of the container}$

Interviews were conducted in Khmer, with the person most involved in the management of the business. It was preferable, but not essential, to interview the same person at each SLS interview. However, it was only essential to get consent once at SLS1 to cover both visits, although it may have been necessary to read the information sheet again at SLS2 if the respondent was different than at SLS1. Interviews were conducted in the premises, with breaks each time a customer arrived. Interviewers then asked whether they could return after 2 weeks and if so they arranged an appointment, making use of a calendar for scheduling the next visit. Two weeks later, on the day and time of the arranged appointment, interviewers returned to each business. If they could not return at the agreed time or day, they called the business using the business' contact details collected at SLS1 and scheduled a new appointment on the same day or following day or two.

Sampling wholesalers and retailers. The aim was to explore whether 2 methods for measuring sales volumes, namely the recall method and retail audit method, agree sufficiently that they can be used interchangeably. In order to identify the threshold at which a difference between estimates would be considered of importance, discussions with other researchers interested in private sector antimalarial sales volumes in low income countries were conducted. During these discussions, recall and retail audit methods were perceived to 'disagree' if an average difference of 10% between estimates obtained through the 2 different methods was found. In other words, the null hypothesis was set as no difference between methods for measuring sales volumes where no difference in practical terms was considered to be any difference less than 10%. At the time of our study there was no evidence available from past studies on the standard deviation of the difference in sales volume estimates obtained through the 2 different methods. A range of sample sizes was therefore calculated at varying standard deviation, accounting for a drop-off or "attrition rate" of 40%⁴⁵ (Table 8-3). The sample size calculation was performed using the STATA 11 command *sampsi*. In light of our aim and after careful consideration of the logistical and financial implications of the different sample sizes, 60 outlets were to be sampled in each sector as this was sufficient for detecting a mean difference at or above 10%, with a standard deviation of 20 (at the 5% significance level with power 90%) (Table 8-3).

⁴⁵ Attrition rate of 40% accounts for outlets not stocking antimalarials or rapid diagnostic tests at the time of the study, duplicates, refusals and drop-off in-between visits.

Table 8-3: Sample size calculations for the Sales Level Survey

Mean of the percent variations between RC and RA estimates, in %	Standard deviation	Sample size 1: number of retail or wholesale outlets required	Sample size 2: Sample size 1 accounting for a "drop off" rate of 40%
10	15	24	34
	20	43	60
	25	66	92
	30	95	133

RC is for Recall; RA is for Retail Audit technique

Wholesale outlets were sampled from the list of outlets to be surveyed during the SCS. All 68 wholesalers who operated in areas that could be visited 2 times with a 2-week time interval were selected (Appendix 16). This number is higher than the target sample size of 60 outlets for logistical reasons, allowing a larger sample to be visited at no additional cost. Wholesale outlets not found, not stocking antimalarials or not available at the time of the SLS were not replaced. The wholesale sample was similar to that of the SCS: outlets had a median of 2 workers (IQR 2-2), had been in operation for 10 years (IQR 4-13) and around 70% employed a member of staff with health qualifications, with nurse/midwife being the most commonly reported qualification type.

Retail outlets were sampled from the list of outlets interviewed during the OS, excluding outlets located in sub-districts visited during the SCS, in order to avoid re-visiting the same outlets and therefore mitigating respondent fatigue and refusals⁴⁶. The geographical location of each sub-district and the number of outlets stocking antimalarials at the time of the OS were also used to select areas in which all outlets could each be visited 2 times with a 2-week time interval⁴⁷, accounting for one repeat visit at outlets busy or closed at first and/or second visits. A total of 107 retailers were sampled (Appendix 17). Sampled retailers included pharmacies/clinical pharmacies (13%), drug shops (21%), mobile providers (20%), grocery stores (26%) and village shops (20%). They shared similar characteristics with those of the whole OS sample: staff with health qualifications were more commonly found at pharmacies (84.6%), drug shops (76.2%) and mobile providers (70.0%) than at grocery and village shops

⁴⁶ Retail outlets may have already been visited for the SCS in the situation where they also engaged in wholesale trade and supplied other retailers in the sub-districts; retailers may have also participated in semi-structured interviews.

⁴⁷ A random sample would have complicated logistics and supervision and increased the amount of financial resources required.

(13.0% and 11.8% respectively) and the most commonly reported health qualifications were nurses/midwives. A median of 2 people (IQR 1-2) worked at the sampled outlets and shops had been in operation for a median of 8 years (IQR 2-15). The sample size was larger than the sample targeted initially as additional outlets could be visited at no additional cost and provide adequate fieldwork to data collectors. The retail sample was also bigger than the wholesale sample because a higher rate of “attrition” was expected amongst retailers who operated in harder-to-reach areas. Retail outlets not found, not stocking antimalarial or not available at the time of the SLS were not replaced.

Of the 67 wholesalers initially sampled, 58.2% participated in the SLS: at first visit, 9.0% refused to participate, 1.5% were not available, 7.5% not found and 13.4% were duplicates; At second visit, 10.4% refused to participate (Table 8-4). Of the 107 retailers initially sampled, 61.7% participated in the SLS: at first visit, 24.3% were not eligible to participate because they did not stock antimalarials (clearly a limitation of using existing lists for sampling providers as described in the first part of this chapter!), 7.5% were not found, 4.7% refused to participate; at second visit 1.9% refused to participate (Table 8-4).

Table 8-4: From initial to final samples: overview of the SLS at wholesale and retail outlets

	Number of wholesale outlets surveyed, as % of initial sample	Number of retail outlets surveyed, as % of initial sample
Initial sample	67 (100%)	107 (100%)
First visit (SLS1):		
Completed	46 (68.7%)	68 (63.5%)
Not eligible ¹	0 (0.0%)	26 (24.3%)
Closed at time of visit/Not available	1 (1.5%)	5 (4.7%)
Not found	5 (7.5%)	8 (7.5%)
Duplicated	9 (13.4%)	0 (0.0%)
Second visit (SLS2):		
Completed	39 (58.2%)	66 (61.7%)
Refusals	7 (10.4%)	2 (1.9%)
Final sample	39 (58.2%)	66 (61.7%)

¹ respondent not eligible if did not stock antimalarials at time of visit

Measuring wholesale and retail sales volumes. For each antimalarial observation, volume estimates collected in tablet or pack units (or through the partially full container/ tin approach) through the retail audit technique (RA) and the recall method (RC) were converted into adult equivalent treatment doses (AETD) following the approach described in Chapter 4 (Section 4.5). RDTs were kept as single units, as collected.

RA estimates were calculated as:

RA sales volume estimate= (Total quantities stocked at SLS1) + (Quantities delivered between SLS1 and SLS2) – (Quantities disposed of between SLS1 and SLS2) – (Total quantities stocked at SLS2).

Antimalarials/RDT observations without a pair of RA RC estimates (that is one RA estimate and one RC estimate) were dropped. This situation may have occurred in the case of respondents who refused to disclose sales volume information through one or both methods or because of incomplete product information (e.g. missing strength data) that impeded the calculation of AETD. In outlets stocking more than one type of antimalarial/RDT (that is with more than one pair of RC and RA estimates), the outlet's total sales volume was estimated by calculating the sum of all RC estimates and that of all RA estimates in order to obtain for each outlet one estimate of total sales volume measured through the recall method and one estimate through the retail audit method. We found that surveyed antimalarials were available in tablet and injectable forms only. Tablets were commonly stocked in packs, and injectables were generally in individual ampoules. Tablets kept in tins/containers were rare and found at retail outlets only.

SLS at wholesale outlets. A total of 104 different antimalarial products were surveyed (that is the number of different antimalarials in stock at the time of visit). Sales volumes were estimated for 73.1% antimalarial products through the recall method and for 78.8% through the retail audit method (Table 8-5). Missing sales volume data were due to, for the recall method, wholesalers' inability or refusal to recall their sales volumes or, for the retail audit method, wholesalers' refusal to let interviewers record stock data or inability to recall quantities received or disposed (Table 8-5). Furthermore, during the retail audit method, sales volumes were initially calculated for 90.4% of all antimalarials surveyed but for 12% sales volumes were found to be negative and were excluded from the analysis, as they clearly indicated data collection errors (e.g. quantities stocked at first visit were higher than quantities

stocked at second visit although shopkeepers did not report any quantities received). For RDT, 34 different products were surveyed and sales volumes were estimated for 76.5% of these through the recall method and for 85.3% through the retail audit method. Again, missing data were due to wholesalers' refusals or inability to recall either their sales volumes or quantities received and/or disposed (Table 8-5).

Table 8-5: Data collected on wholesale sales volumes using recall and retail audit methods as % of total number of products surveyed

Product type surveyed	Number of products surveyed ¹	
	Antimalarials	RDT
Total number (%)	104 (100%)	34 (100%)
Recall method (RC)		
Sales volumes estimated	76 (73.1%)	26 (76.5%)
- Not remembered	17 (16.3%)	7 (21.6%)
- Refused	11 (10.6%)	1 (2.9%)
Retail Audit method (RA)		
Sales volumes estimated (excluding negatives)²	82 (78.8%)	29 (85.3%)
Sales volumes estimated (including negatives)	94 (90.4%)	31 (91.2%)
Stock data collected	96 (92.3%)	31 (91.2%)
- Refused	8 (7.7%)	3 (8.8%)
Received quantities collected	103 (99.0%)	33 (97.1%)
- Refused	1 (1.0%)	1 (2.9%)
Disposed quantities collected	101 (97.1%)	33 (97.1%)
- Refused	3 (2.9%)	1 (2.9%)

¹ At the second visit of the Retail Audit method during which the Recall method was implemented. ² negative sales volume estimates were obtained when calculating (quantities in stock at 1st visit + quantities received in-between the 2 visits – quantities at 2nd visit – quantities disposed in-between the 2 visits), e.g. quantities stocked at first visit were higher than quantities stocked at second visit although shopkeepers did not report any quantities received. These negative estimates were excluded from the analysis.

Overall, wholesale sales volumes were estimated through both methods for 62 antimalarials and 23 RDTs (data not shown). The total volumes of antimalarial/RDT sold at each outlet was estimated by calculating the sum of all RC and the sum of all RA estimates in order to obtain a single pair of RC and RA total sales volume estimates, corresponding to the sample size that will be used during the analysis. We obtained 34 pairs of recall and retail audit estimates for antimalarials and 23 for RDT (data shown in section 8.3.3, Table 8-7).

SLS at retail outlets. A total of 143 antimalarial products were surveyed and sales volumes were estimated, through the recall method for 91.0% of these and through the retail audit method for 80.4% (Table 8-6). For RDT, 42 different products were surveyed and sales volumes were estimated for 97.6% through the recall method and for 83.3% through the retail audit technique (Table 8-6).

Table 8-6: Data collected on retail sales volumes using recall and retail audit methods.

	Number of products surveyed ¹ as % of total number of products surveyed	
	Antimalarials	RDT
Total surveyed	143 (100%)	42(100%)
Recall method (RC)		
Sales volumes estimated	130 (91.0%)	41 (97.6%)
- Not remembered	4 (2.8%)	1 (2.4%)
- Missing ²	10 (7.0%)	-
Retail Audit method (RA)		
Sales volumes estimated (excluding negatives)³	115 (80.4%)	35 (83.3%)
Sales volumes estimated (including negatives)	121 (84.6%)	39 (92.9%)
Stock data collected	121 (84.6%)	39 (92.9%)
- Refused	12 (8.4%)	3 (7.1%)
- Missing ²	10 (7.0%)	-
Received quantities collected	133 (93.0%)	42 (100.0%)
- Missing ²	10 (7.0%)	-
Disposed quantities collected	133 (93.0%)	42 (100.0%)
- Missing ²	10 (7.0%)	-

¹ At the second visit of the Retail Audit method during which the Recall method was implemented. ² missing strength data impeded calculation of data in terms of adult equivalent treatment doses. ³ negative sales volume estimates were obtained when calculating (quantities in stock at 1st visit + quantities received in-between the 2 visits – quantities at 2nd visit – quantities disposed in-between the 2 visits), e.g. quantities stocked at first visit were higher than quantities stocked at second visit although shopkeepers did not report any quantities received. These negative estimates were excluded from the analysis.

Overall, retail sales volumes were estimated through both methods for 113 antimalarials and 33 RDT (data not shown). At each retail outlet, we calculated the total volume sold estimated through the 2 different methods as the sum of all RC and the sum of all RA estimates so as to obtain a single pair of RC and RA estimates per outlet. We obtained 58 pairs of recall and retail audit estimates for antimalarials and 33 for RDT. At one retail outlet, however, the total volume sold was surprisingly high and well above other retailers' total sales volumes (although it may have been accurate if the retailer also engaged in wholesale sales). This outlying observation obscured the interpretation of results so it was excluded from the main analysis,

which was run on 57 pairs of antimalarial estimates and 33 pairs of RDT estimates (data shown in section 8.3.3, Table 8-7). Results including the “outlier” are however reported in a footnote to result Table 8-7.

Comparing sales volumes obtained through RC and RA. The level of agreement between RA and RC methods was explored following the Bland-Altman approach (Bland and Altman, 1986, Altman and Bland, 1983, Bland and Altman, 2010).

- 1) The first step was to calculate, for each outlet, the difference between RA and RC sales volume estimates. Formally:

$$RA_i - RC_i \quad (a)$$

where RA_i and RC_i are sales volumes estimated through the 2 different methods at outlet i .

- 2) The second step was to estimate the bias of the measurement by 2 methods, which is the mean of the differences between the 2 different methods, and its standard deviation. Formally:

$$\overline{RA - RC} = \frac{1}{n} \sum_{i=1}^n (RA_i - RC_i) \quad (b_1)$$

$$SD = \sqrt{\frac{1}{n-1} \sum (x_i - \bar{x})^2} \quad (b_2)$$

where x_i the difference between RA and RC in outlet i , or $(RA_i - RC_i)$, $\bar{x} = \overline{RA - RC}$ the mean of the differences between RA and RC across all outlets, n the total number of outlets with a pair of RA and RC estimates and SD the standard deviation.

Before undertaking this second step, care was taken to confirm that that the differences between sales volumes estimated through the 2 different methods followed a normal distribution, by using histograms (figures not shown).

- 3) The third step was to estimate, for each outlet, the total volume of antimalarials/RDT sold and explore whether there was an association between total volume sold and the bias (i.e. the mean of the difference, b_1). This is because for the bias to be a meaningful estimate of the level of agreement between the 2 different methods, the

bias should be constant throughout the range of measurements; in other words, we explored whether the mean difference was constant for small and large sales volumes. In the absence of a recognised gold standard method for measuring sales volumes, an outlet's total sales volume was estimated as the average of RC and RA estimates. Formally:

$$\frac{RA_i + RC_i}{2} \quad (c)$$

The association between total volume sold and measurement bias was explored graphically using a scatter plot of the differences against total volume sold and confirmed statistically using a correlation coefficient obtained through the STATA command *baplot* (Jull and Frydenberg, 2010).

- 4) The fourth step was to calculate the interval within which 95% of paired estimates were expected to lie – the interval is referred to as the (upper and lower) limits of agreement between the 2 methods. This interval tells us how far apart measurements by the 2 methods are likely to be for most outlets (Bland and Altman, 1986) Formally:

$$LoA = \overline{RA - RC} \pm 1.96 SD \quad (d)$$

8.3.2.2 Fieldworkers' experiences in conducting the Sales Level Survey

In order to compare the retail audit technique and recall methods for measuring sales volumes, we collected data on interviewers' accounts of collecting sales volume data through each technique. The objective was to explore issues that could not be investigated solely from measuring sales volumes through the 2 different methods, by revealing the implementation process and perceptions of interviewers. Data were collected from notes written up by fieldworkers at the end of each outlet visit, using a large blank space on each questionnaire. In these diaries, fieldworkers were asked to describe and compare their experiences in collecting data across products (antimalarials compared to RDT), and for antimalarials, across dosage forms (tablets compared to non-tablets) and packaging types (loose tablets compared to packed tablets; drugs stocked in non-original packaging). They were also asked to reflect on the overall implementation process, drawing on their observation of shopkeepers' behaviour during the implementation of each method.

Semi-formal group discussions were also organised during the course of the fieldwork to clarify fieldworkers' accounts recorded in the diaries. These discussions provided a forum for fieldworkers to elaborate on particular topics, share arduous experiences, discuss their views and trade funny stories. Group discussions also had the advantage of creating interactions between fieldworkers, which prompted other fieldworkers to remember their own experiences on particular aspects of the implementation process (Green and Thorogood, 2004), through which additional data less salient or not captured in diaries were collected. Group discussions were facilitated by the candidate, with the assistance of a trained research assistant. Discussions were not tape-recorded and written notes were taken by both the candidate and the research assistant. Ethics-wise, fieldworkers' participation as research subjects was explained to each candidate during the recruitment process and consent was received orally from each fieldworker recruited. Group discussions were conducted with each of the 3 fieldworker teams involved in the SLS. A total of 5 group discussions were conducted, each with a team of 4 data collectors lasting an average of 1.5 hours. For the SLS in the wholesale sector, 3 group discussions were organised: the first discussion took place a few days after the start of data collection, the second at the end of SLS1, the third at the end of SLS2. For the SLS in the retail sector, 2 group discussions were organized in mid data collection and at the end of SLS2. Topics discussed during group discussions are presented Appendix 4.

Fieldwork diaries kept in Khmer were translated into English by a trained research assistant and diaries were typed in WORD Microsoft Office. These data were analysed using a simple thematic content approach through which recurrent themes under each of the topics discussed were listed and compared. Notes taken during group discussions by the candidate and her assistant were reviewed, compared and typed by the candidate after each group discussion using WORD Microsoft Office. Notes were categorized as either empirical observational notes from fieldworkers, which were treated as diary data and typed with the diaries' accounts, or as the candidate's personal interpretation of issues explored during the discussions, which were entered into a separate document.

8.3.2.3 Costs of implementing Retail Audit Technique and Recall Methods

Project expenditure records were used for calculating the financial costs of implementing the recall method and the retail audit method. Specifically, we used expenditure records for the SLS implemented at retail outlets for costing the implementation of retail audit technique and recall methods in both retail and wholesale outlets. There were two reasons for doing so. First,

the SLS implemented at wholesale outlets was conducted at the same time as the SCS and documenting specific costs for the SLS component was problematic. Second, we did not expect the costs of the SLS wholesale to be very different than those of the SLS retail: both surveys were conducted over a period of 30 days so the resources required in terms of human resources and communications were expected to be the same; and, whilst retail outlets were located in harder-to-reach areas they were somewhat less scattered so travel costs for the SLS at wholesale outlets were not expected to have been much lower than those of the SLS at retail outlets.

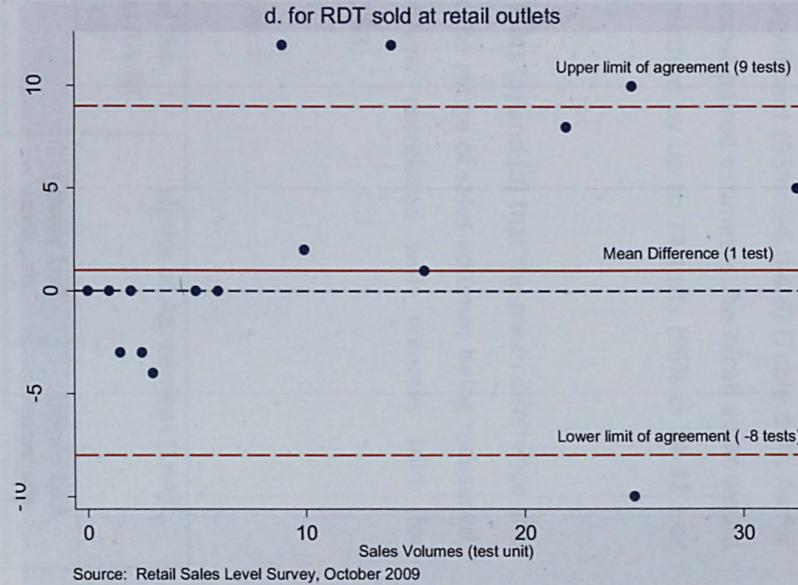
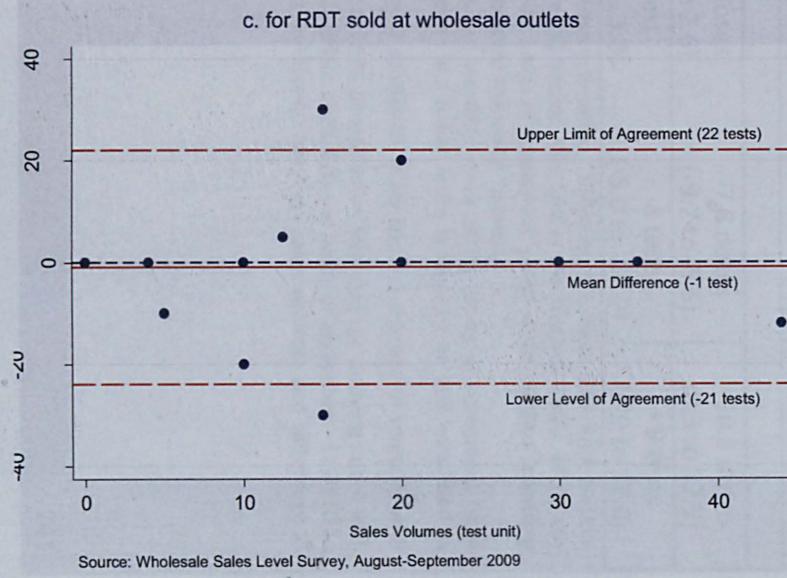
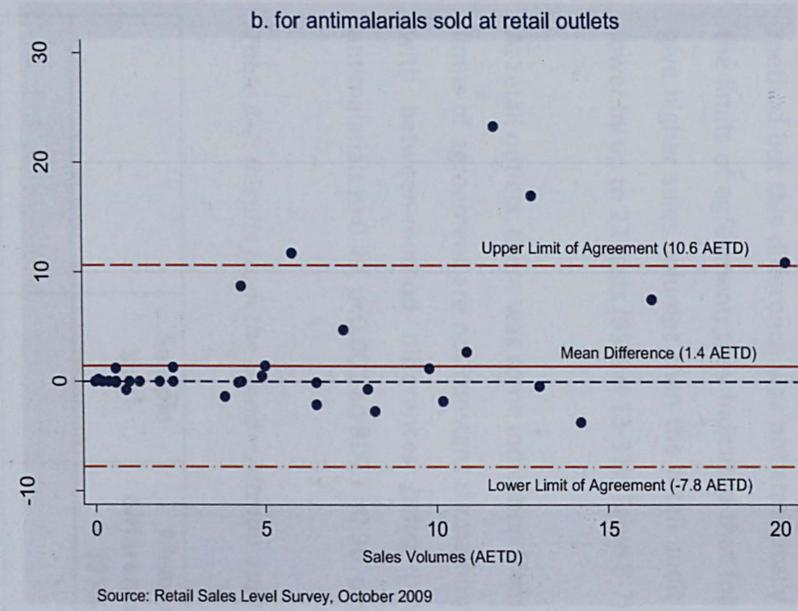
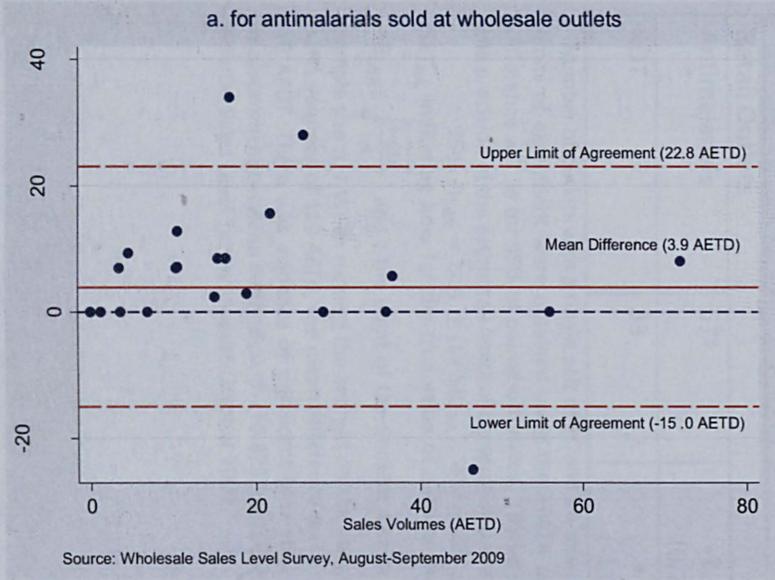
8.3.3 Results

8.3.3.1 Level of agreement between retail audit technique and recall methods

Figure 8-9 presents the scatter plots which were developed for investigating (i) the existence of an association between the size of the measurement (sales volumes) and the measurement bias (mean difference), and (ii) the level of agreement between retail audit technique and recall methods. On each plot, the y-axis shows the between-method differences and the x-axis the corresponding volume being measured at each outlet. The dashed blue line drawn at $y=0$ represents the line of equality between the volumes measured by the two different methods. The mean of the between-method differences (b_1) is represented by the horizontal red line and the limits of agreement between the 2 methods are represented by the 2 horizontal dashed red lines.

Plot (a) for wholesale antimalarial sales shows no evidence of correlation between the between-method differences and the size of the volumes sold. This was confirmed by a coefficient of correlation $r = -0.04$ ($p=0.83$). The mean difference between RA and RC estimates for antimalarials was nearly 4 AETDs indicating that the retail audit method provided on average higher estimates than the recall method and it was statistically significant (95% ci 0.6-7.2) (Table 8-8). The limits of agreement indicated that for 95% of paired estimates the retail audit method would give higher sales volumes than the recall method by up to 23 AETDs (95% ci 16.0 to 28.0) or lower sales volumes by up to 15 AETDs (95%ci -20.4 to -9.0) (Table 8-7).

Figure 8-9: Scatter plots of the between-method differences against volumes of sales measured



Plot (c) for RDT sales volumes at wholesale outlets did not indicate that the between-method differences were correlated to the volumes sold ($r=0.04$, $p=0.86$). The mean difference was 1 test with the recall audit providing, on average, larger sales volumes than the retail audit method but this difference was not statistically significant (95%ci -6.0-4.0) (Table 8-7). As for the limits of agreement, they indicated that for most paired estimates the recall audit would give higher sales volumes than the retail audit method by up to 24 tests (95% ci 14-32) or lower by up to 22 tests (95% ci 13-31) (Table 8-7).

At retail outlets, there was some indication from Plots (b) and (d) that the mean difference and limits of agreement are not constant throughout the range of sales volumes being measured, with between-method differences being positively correlated with volumes sold (for antimalarials $r=0.49$, $p<0.001$ ad RDT $r=0.38$, $p=0.03$).

Table 8-7: Results from the Bland – Altman approach

	Sample size ¹	Mean of the differences RA-RC (95% ci) ²	Limits of Agreement (LoA) ²	
			Lower LoA (95%ci ³)	Upper LoA (95%ci ³)
Wholesale Outlets				
Antimalarials	34	+3.9 doses (0.6 to 7.2)	-15 doses (-20.4 to -9.0)	+22.8 doses (16.0 to 28.0)
RDT	23	-1 test (-6.0 to 4.0)	-24 tests (-32.0 to -14.0)	+22 tests (13.0 to 31.0)
Retail Outlets				
Antimalarials	57†	+1.4 doses (0.2 to 2.6)	-7.8 doses (-9.7 to -5.5)	+10.6 doses (8.3 to 12.5)
RDT	33	+1 test (-1.0 to 3.0)	-8 tests (-5.0 to -10.0)	+ 9 tests (6.0 to 12.0)

¹ Number of outlets with a single pair of RC and RA sales volume estimates. ² 95%ci for the mean difference and the limits of agreement were obtained using the STATA command baplot. The LoA is the interval within which the difference will lie for 95% of paired estimates. ³ 95%ci for the limits of agreement, which were used for assessing the precision of the estimated limits of agreement, were calculated manually. Formally:

$95\% \text{ ci}_{\text{LoA}} = \text{LoA} \pm (t * \text{SE}_{\text{LoA}})$, where SE_{LoA} is the standard error of the limits of agreement, with SE_{LoA} indicating how far the true value of each of the upper and lower limits is likely to be and calculated as

$\text{SE}_{\text{LoA}} = \sqrt{\frac{3 * \text{SD}^2}{n}}$ and t the point of the Student distribution at probability=0.05 and $n-1$ degrees of freedom with

sample size n . † When running the analysis on the sample size of 58 (that is when including the outlying outlet with sales volumes of 119 AEDT, the mean difference was 2 AEDT (95%ci 0.23-4.0) and limits of agreement -12 AEDT to 16 AEDT. There was evidence of significant (and stronger) correlation between sales volumes and difference in measurement between methods with $r=0.823$ ($p<0.000$).

Source: Sales Level Survey, August-October 2009

These results will be discussed in Section 8.3.4. The next section turns to fieldworkers' experiences in implementing retail and recall techniques as well as their perceptions of shopkeepers' reactions to each method, drawing on fieldwork diaries and group discussions with fieldworkers. In addition, availability of written sales records for antimalarials and RDTs at retail and wholesale outlets, as reported by fieldworkers, is also discussed.

8.3.3.2 Fieldworkers' experiences and perceptions

Written sales records. The rare availability of written sales records, notably at retail shops, was reported by most fieldworkers.

"She said that she has not forgotten to record her sales. She said that she just did not keep such records" (Fieldwork diary #3 about keeping written records of sales volumes at a retail outlet)

In addition, as expected, where these records were available, shopkeepers, notably wholesalers who more commonly reported to keep such records, refused to share these data sources.

"They refused to show us their records because they said it was private" (Fieldwork diary #1 about keeping written records of sales volumes at a wholesale outlet)

Recall method. Data collectors found the recall technique to be a more convenient approach for collecting sales volume data, notably at retail outlets where shopkeepers said they rarely had customers for malaria treatment.

"She said it is a small business because her area also has Village Malaria Workers [who] would not take money from malaria patients" (Fieldwork diary #16 about the recall method implemented at a retail outlet)

Data collectors also mentioned that retailers seemed to be more comfortable remembering sales volumes of RDT than antimalarials and that this was because performing a malaria test was a more memorable and discrete event than selling antimalarials.

“He said he always does a test, but can’t remember the tests’ results [...] so he was not sure about how many patients [with malaria] he had, and [...] what and how many tablets he gave [to each patient]” (Fieldwork diary #4 about the recall method implemented at a retail outlet)

However, data collectors often questioned the accuracy of recall of sales volume data collected both at retail and wholesale outlets.

“She said: “it might be like this, [or] it may be like that”. (Fieldwork diary #1 about the recall method implemented at a retail outlet).

“She might have misreported her sales volumes, because I saw 5 empty boxes of antimalarials near her”. (Fieldwork diary #5 about the recall method implemented at a wholesale outlet)

Data collectors indicated that, when shopkeepers could not remember their sales volumes, this was because they often handled other consumer goods alongside antimalarials and/or RDT, including toiletries or groceries, which were their main selling items. Another reason was that more than one person worked at the shop, making it more difficult for respondents to provide accurate estimates. Fieldworkers also said that they perceived wholesalers to be less capable of remembering their sales volumes because they generally handled a wider range of drugs and sold larger volumes.

Retail audit technique. Data collectors reported that counting stocks was relatively easy and quick because of the small range of antimalarials/RDT available at each outlet. They also reported that counting RDT tended to be easier than antimalarials, especially when antimalarials were kept in opened tins. For example, one interviewer explained that in one shop the tin was not transparent, preventing him from using the ruler so that he had to count each tablet left in the tin. Also, at times, interviewers reported they had estimated more pills in the tin at the second than at the first visit although shopkeepers said that no new tin had been opened. Interviewers said that when they collected data on quantities received and disposed shopkeepers remembered generally very easily because the reported quantities were generally small and often null. They also reported that shopkeepers were generally surprised to be asked about disposed quantities because they said that they never throw products away nor send these back to suppliers, expect to PSI for exchange of close to expiry antimalarial drugs. However, data collectors reported important challenges around the implementation of the retail audit technique.

First, they indicated that counting stocks was not always possible: for around 8% of antimalarials stocked both wholesalers and retailers refused to let interviewers count the quantities in stock (Table 8-6).

“They did not allow us to count and they did not want to count for us at all [...] they said they didn’t want to spend time with us [...] they said that it [the survey] was useless and wasting their time” (Fieldwork diary #40 about the retail audit technique implemented at a wholesale outlet).

“She claimed that I asked the same question at first visit. She said that I should write the same amount as at first visit”. (Fieldwork diary #2 about the retail audit technique implemented at a wholesale outlet.)

Second, data collectors reported that in many cases shopkeepers preferred to estimate by memory their stock, rather than have these counted. Fieldworkers added that this situation was more common amongst wholesalers who refused to let interviewers open the cupboards where they kept the drugs. This was corroborated by the SLS quantitative data, which showed that at first visit stocks of antimalarial drugs were counted for around 51% of all antimalarial products surveyed at wholesale outlets compared to 97% at retail outlets (Table 8-8).

Table 8-8: Products for which interviewers effectively counted the quantities in stock as % of products surveyed at first and second visits

At first visit (SLS1)	Wholesale outlets		Retail outlets	
	Number of products surveyed	Percent with stock data “counted”	Number of products surveyed	Percent with stock data “counted”
Antimalarial drugs	113	51.3%	136	97.1%
RDT	41	56.1%	41	78.0%

At second visit (SLS2)	Wholesale outlets		Retail outlets	
	Number of products surveyed	Percent with stock data “counted”	Number of products surveyed	Percent with stock data “counted”
Antimalarial drugs	104	57.7%	143	78.3%
RDT	34	61.7%	42	76.2%

Source: Sales Level Survey, August-October 2009

In some cases, data collectors explained during group discussions that the quantities stocked were estimated by memory due to factors beyond the control of shopkeepers. For example, one wholesaler was said to be refurbishing his shop at first visit so that it was not possible to

proceed to the stock count. In other cases, one wholesaler and one retailer did not stock all drugs at the shop premises but at their home so the stock count could not be performed.

As during the recall technique, data collectors questioned the accuracy of the stock data they had recorded. Data collectors said that in some shops they counted higher quantities at second that at first visit, although no new supplies were reportedly received. During a group discussion, a data collector explained that in one wholesale outlet, the shopkeeper had prepared an order at first visit (so quantities were not counted as 'stocked') but that a few days later the customer had cancelled the order and the shopkeeper had put the drugs back on the shelves but forgot to consider it as a new quantity received. Last but not least, fieldworkers reported being worn out by the implementation of the retail audit method, not because of the process of counting products but actually because of respondents' attitudes.

"She blamed me about what the questions asked" (Fieldworker #1 during a group discussion)

"I could hear that she whispered 'what the hell they come again'" (Fieldworker #1 during a group discussion)

This section demonstrated that the recall method was a convenient method for collecting sales volume data, specifically in a setting where written sales records were not available or not accessibility, and where the number of customers for RDT and antimalarials was reported to be low. However, fieldworkers did question the accuracy of recalled estimates and they perceived shopkeepers selling larger volumes, a wider range of drugs and other consumer goods to have more difficulty remembering their sales volumes for antimalarial drugs and RDTs. As for the retail audit technique, whilst interviewers reported that it was relatively easy and quick to count stocks and collect quantities disposed and received, it was neither always pleasant nor feasible to do so because of respondent's attitudes towards the survey, notably at wholesale outlets. The next section presents the relative costs of implementing the recall and retail audit methods.

8.3.3.3 Costs of implementing retail audit technique and recall methods

Using expenditure records for the SLS implemented at retail outlets, it was estimated that the implementation of the retail audit technique amounted to US\$ 8,369 and that of the recall method for US\$ 4,404 (Table 8-9). It is not surprising that the retail audit method was found to

be more expensive than the recall method given that it requires twice as much human resource time (data collection and supervision) and transportation, as well as additional resources during the planning phase, including fieldworker training and pilot of data collection instruments.

Table 8-9: Costs of implementing retail audit technique and recall methods based on resources used for implementing the 2 methods at retail outlets

Cost categories	Number of units (e.g. people, cars)	Number of Days		Unit-Day Cost (US\$)	Total Costs (US\$)	
		RA method	RC method		RA method	RC method
Personnel						
Fieldworkers working fee	4	30	15	16	1,920	960
Fieldworkers' per diem	4	30	15	20	2,400	1,200
Supervisors working fee	1	15	8	23	345	184
Supervisors' per diem	1	15	8	20	300	160
Training						
Training room	1	3.5	3	100	300	300
Training attendance fee	5	5	5	5	125	125
Pilot of survey tools	5	4	2	16	320	160
Communications	-	-	-	-	279	100
Transportation						
Fieldworkers' Car	1	30	15	-	1,554	777
Other transport modes (boat, motos)			-	-	49	24
Supervisors' Car	1	15	8	-	777	414
TOTAL					8,369	4,404

RA is for retail audit technique; RC is for recall

Source: Retail Sales Level Survey, Project Expenditure Records, October 2009

8.3.4 Conclusion

We compared two methods for measuring private sector sales volumes: the retail audit technique and recall methods, and assessed the potential of using written sales records. Before discussing our results, some limitations regarding the design of this comparative study are to be noted. First, the final samples were relatively small, notably at the wholesale level where only 34 antimalarial and 23 RDT observations were available. A second limitation is that whilst negative retail audit estimates clearly indicated data collection errors, which were excluded from the analysis, positive outliers may also have been errors and may have biased estimates too. Third, recalled sales volumes that were compared to the retail audit estimates were collected at the second visit, which may have contributed to improving their accuracy as shopkeepers who expected a second interview may have paid more attention to

antimalarial/RDT sales. Fourth, our study did not assess the repeatability of the retail audit and recall method, which is an important component in comparative studies for exploring the properties of different methods: replicated measurements of the same variable using the same method are generally conducted in the medical field, when for example comparing 2 devices for measuring blood pressure on a sample of individuals (Bland and Altman, 1986). However, it was not possible during this study to explore the repeatability of our methods because of time and financial constraints. Perhaps, more importantly, repeating the retail audit technique at the same wholesale outlets would have been problematic in terms of respondents' acceptability.

At wholesale outlets, the analysis using mean difference and limits of agreements did not allow us to conclude that the 2 methods 'agreed'. The mean difference in antimalarial sales volume estimates between the 2 methods was significant and large (4 AETDs, 95% ci 0.2-7.2) compared to the median volumes sold at wholesale outlets over a 2-week period (estimated to range between 0.8 and 11.6 AETDs depending on the antimalarial category⁴⁸). In most cases, the mean difference was also well above the 10% threshold used for sample size calculations: for example in one outlet the between-method difference actually represented 200% of the sales volumes being measured! The limits of agreement which provide an indication of the difference between the measurements at individual outlets confirmed that estimates obtained through the 2 different methods would greatly disagree for most measurements. The analysis of RDT sales volumes showed that the 2 methods could, *on average*, be used interchangeably: the mean difference was small and not statistically significant (1 test, 95% ci -6.0 to 4.0). However, sales volume measures varied greatly at individual outlet. For example, in one wholesale outlet, the between-method difference for RDT represented 550% of the sales volumes being measured. This was reflected in the limits of agreement that indicated that for most outlets the 2 methods would disagree by around 23 tests.

With the choice of the method likely to dramatically affect the size of the volumes being measured, there would be important implications if one wishes to measure sales volumes specifically at each outlet, for example in the context of an intervention rewarding individual seller as a function of the volume sold. In a study of the market for malaria treatment, this

⁴⁸ Table 6-9 showed that the median number of AETDs sold the week before the SCS among all wholesalers ranged between 0.4 and 5.8 AETDs across antimalarial categories. Assuming constant weekly sales, it can be estimated that the median volume of AETDs sold over a 2-week period is between 0.8 and 11.6 AETDs depending on the antimalarial category. When all antimalarials were considered, the median volume sold over a 2-week period was 0 (IQR 0.0-6.75) (data not shown).

would also have implications if the objective is to measure market size in terms of volumes/values purchased. If the aim is to calculate the HHI or concentration ratio, the implications are however less clear: if the bias is constant across volumes being measured, there would be no major implications in using a particular method for calculating market shares. However, if the bias is not constant, as was the case at retail outlets, using for example the retail audit technique method would overestimate market concentration if it is assumed that the retail audit technique tends to overestimate to a greater extent large volumes sold than small volumes.

There are several reasons that may explain the between-method differences. At wholesale level, fieldworkers reported that shopkeepers had difficulties remembering antimalarial sales volumes as they generally stocked a wide range of products. It is also possible that wholesalers underestimated their sales volumes during recall for fear of disclosure to competitors or regulatory authorities. Fieldworkers also experienced some challenges when implementing the retail audit method, during which it was not always possible to count the quantities stocked. During the SLS, wholesalers were also asked, as part of the SCS, about their business characteristics and practices and this may have influenced the implementation and outcomes of the SLS, by creating fatigue and/or anxiety amongst both respondents and fieldworkers, leading to data collection errors. Retail audit estimates might have been in some cases contaminated by "recall" bias for stock data, and if wholesalers had underreported their sales volumes through the recall technique they may well have misreported their stocks during the retail audit technique.

At retail outlets, results were more difficult to interpret because bias and limits of agreement were not constant throughout the range of measurements. However, qualitative data collected through fieldworkers' diaries and group discussions indicated that recall and retail audit techniques both worked relatively well at retail outlets. Regarding the recall method, shopkeepers did not report retailers to have had a hard time remembering their sales volumes. However, shopkeepers also said that it was easy for them to count stocks. Assuming that shopkeepers might have had more difficulty recalling larger than smaller quantities sold, the retail audit technique might have provided more accurate measures for larger volumes than the recall method, as reflected by the between-method differences with the retail audit method providing higher estimates than the recall method with increased sales volumes. In this context, the retail audit technique method might give more accurate results, which may justify the additional resources required for implementing this method. However, our results

show that this method is prone to many data collection errors and implementation challenges. Table 8-10 summarises the challenges encountered when using written sales records, recall method and retail audit technique for measuring retail and wholesale sales volumes.

Table 8-10: Problems encountered when measuring sales volumes

Methods	Problems encountered				
	Limited feasibility	Complexity	Time consuming/ Cost	Fear of disclosure	Recall bias/ data collection errors
Review written records ¹	✓			✓	
Recall method				✓	✓
Retail audits	✓	✓	✓	✓	✓

¹it is also possible for written sales records to be incomplete

Whilst our analysis does not provide firm conclusions on which method is more likely to provide more accurate sales estimates, it demonstrates that in Cambodia where sales volumes were small, the recall method appeared to have had key advantages: retailers were perceived to easily remember their sales volumes, wholesalers were perceived to find it less invasive and fieldworkers found it more convenient. The suitability of different methods is however likely to differ across settings (country, market), a situation that adds challenges in conducting research on retail and wholesale markets (e.g. development of study design, training of fieldworkers).

CHAPTER 9 DISCUSSION & RECOMMENDATIONS

9.1 Introduction

This chapter addresses the final objective of this thesis which is to analyse the implications of the interplay between market structure, provider conduct, consumer demand and regulation on the availability, price and quality of malaria treatment and to draw recommendations for public health policy and future research. The chapter starts by reviewing the strengths and weaknesses of the methods used for collecting and analysing the data used in this thesis. Areas where additional data would have benefited the analysis are also identified (Section 9.2). The chapter continues by summarising and discussing the findings presented in Chapters 5 to 7 in light of the theoretical literature on models of markets and competition and the empirical literature on retail markets and private commercial sector distribution chains in developing countries (Section 9.3). The chapter ends by developing recommendations for policy and future research on private commercial markets for antimalarial drugs in Cambodia and more generally in other malaria-endemic countries that engage in nationwide subsidy schemes for Artemisinin Combination Therapy (ACT) (Section 9.4).

9.2 Methodological strengths and weaknesses

In this section, the strengths and weaknesses of the methods used for collecting and analysing the data used in this thesis are reviewed and discussed, and areas where additional data would have benefited the analysis are identified.

9.2.1 Obtaining a representative sample of providers

Our analysis used representative data on retail markets and the private commercial sector distribution chain for malaria treatment serving malaria-endemic areas of Cambodia. Retail data were drawn from the ACTwatch Outlet Survey (OS) - a cross-sectional survey of retail outlets stocking antimalarial drugs identified through a census of all public and private outlets with the potential to do so in a representative sample of malaria-endemic areas. We built on this sample to study wholesalers by focusing on the top 2 suppliers for antimalarial drugs for each retail outlet, and repeated this process until the top of the chain was reached, meaning that our sample of wholesalers surveyed during the Supply Chain Survey (SCS) can also be

considered as representative. The completeness of this bottom-up approach for sampling wholesalers in Cambodia in relation to other approaches previously used in the literature, including official lists or interviews with key informants, was demonstrated in Chapter 8. The scope of the data used in the thesis is wider than that used in other studies, which focused on smaller geographical areas (e.g. districts) (MMV, 2007, Goodman et al., 2004) or particular type(s) of private provider types, notably the most accessible and formal ones (e.g. pharmacies operating in urban areas or drug shops in peri-urban areas) (Russo, 2007, Russo and McPake, 2010), or those operating at the extremities of the distribution chain (e.g. importers or wholesalers supplying retailers as opposed to intermediate wholesalers) (PSI, 2007, Tavrow et al., 2003, Amin and Snow, 2005, Adome et al., 1996). These data offered a full picture of the market for malaria treatment from retailers up to wholesalers operating at the top of the chain and demonstrated the heterogeneity of retail and wholesale markets. Finally, the availability of data representative to all malaria endemic areas offered a reliable sampling frame for qualitative research, through semi-structured interviews (SSIs) with both retailers and wholesalers operating at different levels of the chain.

9.2.2 Obtaining high participation and response rates

We achieved high participation rates, despite the commercially and legally sensitive topics covered with retailers and wholesalers. This reflected attention to emphasising the confidentiality of data collected and anonymity of providers participating in the study. There were however some refusals to answer questions related to licensing, despite these questions being asked towards the end of the interview when interviewees were likely to feel more comfortable. We encountered relatively few refusals from antimalarial retailers and wholesalers on questions regarding their purchase and selling prices, in comparison to other countries in which the same study was implemented, especially at the wholesale level (ACTwatch Group, personal communication). However, during our study and as observed elsewhere wholesalers who imported antimalarial drugs were reluctant to share the price at which they purchased their supplies (ACTwatch Group, personal communication). By contrast among retailers, response rates were high in Cambodia, providing a sample of around 640 price mark-up observations.

It is possible that respondents deliberately misrepresented their behaviour, perhaps by reporting lower selling prices, as they would not want to be seen as making excessive profits, which would have led to an underestimation of the mark-ups. One way for assessing the

validity of mark-up data during our study would be to compare purchase prices reported by providers with selling prices stated by the suppliers they purchased from. However, in a given outlet, OS and SCS did not collect information on which of the top 2 supply sources for antimalarial drugs mentioned a particular product was purchased from, so it was not possible to match directly retail purchase and wholesale selling prices reported by different providers in the chain.

Respondents may also have misreported their stocking behaviour, notably of banned antimalarial drugs. Drug stocks were generally stored at the shop premises in transparent storage cabinet and separate storage rooms were rarely found, except amongst wholesalers who imported antimalarial drugs. However, it is possible that some providers stocked a few boxes of illegal drugs, notably artemisinin monotherapy (AMT) banned at the time of the study, that they could hide under the cabinets where other drugs were displayed. The practice of dispensing cocktail therapies might have also been underestimated as cocktail packages can be prepared at the time of consumer purchase. If these practices were widespread among our respondents, market availability and quality outcome measures may have been biased, with availability of inappropriate or ineffective treatment dispensed underestimated.

Qualitative research through SSIs with retailers and wholesalers provided the opportunity to follow up cases where inventory or purchase price had been refused and where banned products were in stock. As demonstrated throughout the thesis by providers' quotes on particularly controversial issues, this offered a more conducive forum than the OS and SCS for collecting data which were sensitive both commercially and legally. In addition, we did not tape record our interviews, which may have reassured providers and widened the scope and depth of data collected. Several other factors allowed for sensitive topics to be followed up at the time of the interview and in-depth data to be collected on factors influencing provider conduct. First of all, the author worked with the same translator from the start of data collection in April 2009 to the end in November 2009 and the 2 researchers had a strong working relationship. Second, simultaneous translation was used during each of the SSIs that were conducted in Khmer with retailers and wholesalers (total of 33, except two interviews that were conducted in English, one with PSI Cambodia and one with a private commercial wholesaler). Through this approach, the author had the opportunity to "participate" in the interview, by closely following up issues with respondents. Third, being two women aged 30 years old, including one foreigner and one of Khmer origin is perceived by the author to have helped the data collection process, especially in shops where women operated. The latter may

have felt more comfortable sharing their business practices, understanding of the market and challenges with us than with men or more generally with younger surveyors. For example, during several SSIs, we were offered to share respondents' lunches or given coconut rice to take away with us. Finally, all three wholesalers who imported antimalarial drugs at the time of the study were interviewed 2 to 3 times during the course of the research, which provided several opportunities to explain the study objectives and answer providers' questions and concerns, which contributed to building trust between us and the interviewees.

9.2.3 Measuring market structure and provider conduct

Previous studies have demonstrated the utility of the Industrial Organization (IO) literature in providing insights into the functioning of health care markets, notably those for pharmaceutical drugs, including antimalarial drugs in low income countries (Goodman, 2004, Bennett, 1996, Nakamba et al., 2002, Gaynor, 2006). The analytical framework presented in Figure 4-1 therefore built on economic concepts related to market structure, provider conduct and consumer demand and illustrated how their interactions affect market performance. To address the aim of our study, market performance was defined in the public health terms of availability, price and quality of malaria treatment.

The analytical framework provided guidance on the range of data to be collected to study market structure and provider conduct. However, in developing countries there is a lack of routine data on health care markets. Furthermore, the analytical framework did not dictate the choice of measures nor which measurement techniques should be used to study the market. In addition, methods for studying markets in low income countries are under-developed and those available lack adaptation for studying informal providers (Conteh and Hanson, 2003) and distribution chains. The complexity of the functioning of markets and lack of empirical work in this area imply that it is not clear which structure and conduct variables should be used and how best they should be measured, let alone how their determinants should be studied.

Market definition

The analysis of competition first requires the difficult task of defining markets on product and geographic dimensions. Ideally we would have used household data on treatment seeking behaviour (location and type of provider visited and drugs obtained) for defining the product and geographic definition of the retail markets. However, these data were not available at the

time of the PhD research. Instead we used data collected during the OS on the complete range of public and private providers of antimalarial drugs operating in the study areas (our product dimension), and conducted SSIs to assess the completeness of OS data. The conceptual framework did not suggest which approach to use for defining the geographical dimension of the market. The IO literature proposes various approaches so an assessment of the suitability of several geographical boundaries was conducted during SSIs, during which data on provenance of retail customers for malaria treatment and perceptions of antimalarial retail providers themselves of competition they faced from other providers were collected. Through this approach, the retail market was defined as the commune. However, it is possible that retailers overestimated the degree of competition they faced, as has been observed elsewhere (Goodman, 2004, Amin, 2002), and that we overestimated the geographical boundaries of the market. However there was not enough data available at the time of this thesis to conduct such an assessment. In the context of Cambodia where mobile providers represented an important source for antimalarial drugs, and drawing on evidence from SSIs, it is however most likely that a narrower definition of the market boundaries, such as for example the village, could have underestimated the size of retail markets.

At wholesale level, the market definition was broader and variable across areas. For instance, in accessible areas the geographical definition is likely to have been at national level and to include all wholesalers operating in the distribution chain for antimalarial drugs. By contrast, in more remote areas, the geographical definition is likely to have been narrower, at the provincial or district level and to include wholesalers supplying retailers only. This is because wholesalers operating at national level (i.e. importers) were less likely to supply remote outlets directly and therefore to have competed with wholesale outlets based closer to the periphery. In this context and because of overlapping chain levels (e.g. with wholesalers operating at several levels of the chain, especially at lower levels), it was not possible to use a geographical definition for the wholesale markets. Instead, the level(s) at which wholesalers operated was (were) used to analyse competition in the private commercial sector distribution chain.

Market concentration and contestability

Data on antimalarial sales volumes at each retail and wholesale outlet were collected by asking providers to recall the quantities of each drug they sold the week preceding the OS and SCS respectively. As discussed in Chapter 8, the recall method used in the SCS offered several advantages for collecting sale volume data compared to alternative methods.

In retail markets, measures of market concentration included the Herfindahl-Hirschman-Index (HHI) and concentration ratios (CR) where the former could not be calculated. During our analysis, it was difficult to make firm conclusions on the extent to which concentration measures reflected the extent of competition in retail markets for malaria treatment.

First, our market concentration measures include both private and public antimalarial sales volumes and values, with all government outlets within each market treated as one provider on the basis that government providers were not expected to compete with one another. It is possible that this analytical approach distorted market concentration measures that were later used in the analysis of retail price mark-ups, by masking the impact of the relative importance of private sales volumes on private retailers' price mark-ups. This could have been one reason for the inverse relationship between price mark-ups and concentration in remote and accessible markets found in chapter 7. However, based on our findings that government providers competed with private commercial providers as revealed during SSIs, we feel that it was important to include the volumes dispensed at government outlets in the analysis of market concentration as excluding them might have misrepresented the degree of retail competition.

Second, in the context of overlapping chain levels, some private retailers may have operated as wholesalers as suggested during SSIs (Section 6.3.1). Retailers operating as terminal suppliers for drug outlets located in more remote areas have commonly been observed in developing countries (Foster, 1991, MMV, 2007, Adikwu, 1996, Yadav, 2007, Battersby et al., 2003, IOM, 2004, Palafox et al., 2009). During our study, it was not possible to separate out wholesale and retail sales. Including retailers' wholesale sales in the calculation of the HHI for retail markets may have had 2 implications: the first is that it may have overestimated the degree of market concentration, which - as with the inclusion of government sales volumes - could have been one reason for the inverse relationship between price mark-ups and concentration in accessible and remote markets found in Chapter 7. The second implication relates to the overestimation of the size of the market for antimalarials, as some drug flows may have been double counted at both wholesale and retail levels. It is difficult to assess the degree to which this occurred, but it is somewhat reassuring that the order of magnitude of the Cambodia MOH's estimates for the total number of doses required for treating all malaria cases annually was similar to our estimates of what was actually used over a one year period. However, from the available data it is not possible to assess the extent to which those who received antimalarial drugs actually needed to receive these medicines. Finally, it is important

to note here that one cannot make a direct link between sales volumes in adult equivalent treatment doses (AETDs) and patients treated, as in practice many customers will be obtaining drugs for children and/or purchasing incomplete doses, so the number of customers to whom drugs were sold will be considerably higher than the volume of AETDs dispensed.

At wholesale level, it was not possible to use traditional measures for assessing market concentration because of the problems of defining wholesale markets. Instead we used the number of times a supplier was mentioned at the previous level as a proxy measure to assess the relative importance of each wholesaler operating at a given level. The frequency of mentions should however be interpreted with caution as it does not measure the market share of a supplier in the wholesale market but provides instead an indication of the frequency of use of particular suppliers by buyers at the next level.

Concentration measures, including traditional measures such as the HHI and CR, do not incorporate an indication of contestability, which is an important aspect of market structure to be considered during the analysis of market competition. Contestability was assessed using qualitative data on providers' perceptions of ease of entry and exit of the market collected during SSIs. The assessment was therefore prone to the subjectivity of providers. In 2011, another OS was conducted in the same study areas, during which a census of all potential outlets stocking antimalarial drugs was repeated. Future research may therefore use these data to gain further insight into contestability in retail markets by looking at the turnover of retail outlets (i.e. outlets' entry and exit) between different points in time and comparing this to our findings from SSIs.

Provider conduct

The analysis of the nature and intensity of competition in retail markets and in the distribution chain started by using SSI data on providers' perceived variations in the degree of competition across provider types and antimalarial products, and in the extent of product differentiation and non-price competition, by identifying which providers and products were perceived by consumers to be of higher quality and how providers responded to these reported consumer preferences. Providers' pricing behaviour and the extent of price competition and providers' response to regulation were also investigated during SSIs. As discussed above, assessing the intensity of competition through the use of qualitative data is prone to the subjectivity of providers and these methods have overall rarely been used by economists. However, during our study they contributed to the application of our conceptual framework, design of the

quantitative analytical model for studying retail price mark-up determinants and interpretation of these findings (Coast et al., 2004).

Retailers' price setting behaviour and the extent of price competition in retail markets were analysed by following the traditional structure-conduct-performance approach by investigating whether more concentrated markets were associated with the exercise of market power. Limitations of this approach that hypothesizes a causal link between structure and conduct, combined with that of using HHI as the measure of market competition are widely recognised in the IO literature (Tirole, 1988, Church and Ware, 2000). Market concentration as measured by the HHI may be endogenous, that is the result of providers' pricing decision, demand or cost factors (Gaynor and Vogt, 2000, Gaynor, 2006). For example, firms that can produce at a lower cost have the ability of charging lower prices and are therefore likely to have higher market shares than firms with higher costs. Keeping these limitations in mind during our study, retail percent price mark-ups were regressed on market characteristics (including concentration, accessibility and malaria transmission risk), strata, outlet and product characteristics. We chose to analyse percent price mark-ups as our outcome variable rather than price. As previously mentioned, consumer prices are heavily influenced by price decisions of economic actors operating at all levels of the distribution chain, including manufacturers, wholesalers and retailers, so they cannot be considered as a measure of retailers' price setting behaviour alone. Paying close attention to the overall context in which market structure, provider conduct and consumer demand interacted was shown to be key in the analysis of retailers' price setting decisions, as reflected by the important influence of, for example, market accessibility levels on retail price mark-ups. As mentioned above, another OS was conducted in 2011 and it is possible that additional OS will be conducted in the near future. If price mark-up data were to be collected during these surveys, it will provide an opportunity to analyse the effects of variations over time in retail market structure on price mark-ups. For example, a recent study analysed anti-retroviral therapy (ART) price determinants in Brazil over a period of 13 years, exploring the influence of drug transaction characteristics and market competition measures on changes in ART prices from each supplier between consecutive years (Meiners et al., 2011).

9.2.4 Measuring market accessibility and risk of malaria transmission

The Cambodia's MOH categorises malaria-endemic villages by risk categories using data on the distance of each village to the forest. In this thesis, relatively recent data on malaria transmission risk for 2009 were used. Given that markets were defined as communes, a composite index of malaria transmission risk was compiled to estimate risk, with each market assigned the level of risk for the majority of its population. Our measure is therefore an approximate measure of risk in each market.

Market accessibility levels were measured using data on the average time to travel in a 4-wheel drive vehicle from the group of villages covered in each market to the nearest road and from there to the closest main commercial centre. Data on distance of each village to the nearest road were relatively old, dating from 2004. Recent development and improvement of the road network may have led to an underestimation of level of accessibility in some markets. The validity of our approach was however backed up by asking local informants with experience of travelling in Cambodia their impressions of market remoteness, including data collectors who participated in the OS, and also through the author's observations during data collection for the SCS.

9.3 Discussion of findings in light of the theoretical and empirical literatures

This section draws together the evidence presented in the thesis and considers it in the light of the theoretical literature on models of markets and competition and empirical literature on studies of retail markets and private commercial sector distribution chains for malaria treatment in developing countries. The section starts by summarizing key features and outcomes of the retail market for malaria treatment in Cambodia before discussing the factors influencing the relative role of the public and private sector in the supply of malaria treatment, private providers' price setting decisions and malaria treatment quality.

9.3.1 Key features and outcomes of the market for malaria treatment

This section summarizes key features of the retail market for malarial treatment, including total market size, market shares across provider types within and between public and private sectors, availability and price of antimalarials and rapid diagnostic tests for malaria (RDTs), and

issues around the quality of malaria treatment. It draws on both the thesis results, and other literature on malaria treatment in Cambodia, as reviewed in Chapter 3.

We would expect the market for antimalarial drugs in Cambodia to be smaller in volume terms than that of other countries where malaria prevalence is higher, such as those in sub-Saharan Africa. The potential for comparison across countries was however limited as the size of antimalarial drug markets in developing countries has rarely been researched. We estimated that around 500,000 adult equivalent treatment doses (AETD) were dispensed per annum in areas at risk of malaria transmission in Cambodia, which is equivalent to 0.17 doses per capita. As expected this was much lower than was found in a study of 3 rural districts of Tanzania, where the market was estimated at 234,000 AETDs sold annually, equivalent to 1.7 doses per capita (Goodman, 2004). However, in value terms, the difference was not so marked. In our study the value of antimalarials dispensed per annum was estimated at US\$ 1 million, equivalent to US\$ 0.37 per capita, whilst in rural Tanzania the total value was US\$ 109,000, equivalent to US\$ 0.75 per capita (Goodman, 2004). This may have reflected the higher ability and willingness to pay for higher value antimalarials in Cambodia due to higher income levels than in Tanzania, as reflected by the difference in gross domestic product per capita between the two countries at the time of the respective studies (Cambodia US\$ 739 in 2009 vs. Tanzania US\$ 290 in 2004).

Private commercial providers were the most common type of provider visited for treating malaria fever (ACTwatch Group, 2009a) and accounted for 75% of all antimalarial sales volumes, with private providers of clinical services accounting for 44% of the total market. The popularity of the private sector in the provision of malaria treatment has been reported in other recent studies conducted in Cambodia (Ozawa and Walker, 2011, Meesen et al., 2011) and in many other developing countries (Snow et al., 1992, Adome et al., 1996, Goodman, 2004, Molyneux et al., 1999, Rutebemberwa et al., 2009, van der Geest, 1987, Agyepong and Manderson, 1994, Foster, 1991, Foster, 1995, Geissler et al., 2000, Hamel et al., 2001, Krause and Sauerborn, 2000, McCombie, 1996, Ndyomugenyi et al., 1998, Njau et al., 2006, Ruebush et al., 1995, Salako et al., 2001).

However, government providers also played an important role in the supply of malaria treatment, dispensing 25% of all antimalarial AETDs. This importance was also observed in other countries. The latest evidence from the ACTwatch project shows public sector market shares in volume terms of 18-27% in Madagascar, the Democratic Republic of Congo and

Benin, 42% in Uganda and 60% in Zambia (O'Connell et al., in press). One exception was Nigeria, where public sector providers accounted for only 2% of the antimalarial market (O'Connell et al., in press). Within the public sector, health facilities are expected to be the most important source of antimalarial drugs. In Cambodia, their role was relatively marginal as they were responsible for only 9% of the total market. The most important government providers were Village Malaria Workers (VMWs), with two VMWs operating in around half of the villages located within 2 kilometres of the forest (CNM's VMW project manager personal communication), accounting for 16% of all antimalarial volumes dispensed in the study areas.

Antimalarial availability was variable across providers types, with around two-thirds of government-owned outlets, half of pharmacies/clinical pharmacies, one third of mobile providers and less than one tenth of grocery and village shops stocking any antimalarial drug in the malaria-endemic study areas (ACTwatch Group, 2009b). ACT availability was overall low amongst these outlets, notably at private commercial outlets, with availability ranging between 19% and 50% across private provider types stocking (ACTwatch Group, 2009b). In other settings where ACT price subsidy and social-marketing like activities have been implemented, ACT achieved similar market shares, ranging between 38-51% in 3 pilot studies conducted in areas of Angola, Tanzania and Uganda (Sabot et al., 2009, Yamey and Schäferhoff, 2011). By contrast, in settings without price subsidy or informational activities for promoting ACT to providers and consumers, market shares were much smaller, accounting for less than 25% of the total volume of antimalarials distributed across all sectors and countries (O'Connell et al., in press).

Prompt parasitological confirmation of all suspected malaria cases by either microscopy or RDTs is recommended before treatment is started (WHO, 2010b, CNM, 2008). However, during our study availability of blood testing services was lower than that of antimalarial drugs in general. Outside public health facilities, blood testing services were relatively rare as observed in other countries (O'Connell et al., in press). RDTs were more commonly stocked than microscopy services across all sectors, with RDT availability ranging between 9% and 50% across private provider types and being significantly higher at pharmacy/clinical pharmacy, drug shops and mobile providers than at grocery and village shops (ACTwatch Group, 2009b). This was much higher than in other ACTwatch countries, where RDTs were available at less than 20% of private shops (O'Connell et al., in press).

Cost of appropriate management of confirmed *P.f* malaria (RDT+ACT) ranged between

US\$ 1.53 and US\$ 2.35 across private provider types, indicating that cost was likely to have been a major barrier for most Cambodians to access effective treatment. The median price of one AETD of the ACT ASMQ at private commercial retail outlets ranged between US\$ 1.18 and US\$ 1.64 across outlet types. It was 2 to 3 times higher than the RRP of the subsidized ACT (US\$ 0.61) and between 3.5 to 5 times more expensive than one AETD of chloroquine, the non-ACT with the highest sales volume at the time of the OS (ACTwatch Group, 2009b). The median price of RDT ranged between US\$ 0.33 and US\$ 0.71 across private commercial outlets (author's own calculations using OS data). In the public sector, antimalarial drugs, ACT and RDT were generally available free of charge (ACTwatch Group, 2009b).

Issues around the quality of malaria treatment obtained included poor access to parasitological diagnosis, poor adherence to diagnosis test results, inappropriate medicines dispensed and drug quality concerns. As described in Chapter 2, less than half of 1,551 individuals who reported having had malaria-like fever in the 2 weeks preceding the household survey conducted in our study areas said they had received a diagnostic test (ACTwatch Group, 2009a). The majority of those who reported testing positive to malaria (87% of those who received a test) said they received a cocktail medicine that did not contain any antimalarial drug and only 35% received an ACT, of which 21% received it the same day or day after (ACTwatch Group, 2009a). Furthermore, of those who reported testing negative to malaria, 11% said they received an antimalarial drug and 7% an ACT. Finally, of those who did not receive a test or were unsure of the test results, 11% reported receiving an antimalarial drug and 5% an ACT (ACTwatch Group, 2009a).

Whilst ACT accounted for 60% of the market, the subsidized ACT Malarine accounted for less than 40% of antimalarial volumes sold at private commercial outlets. nAMT and AMT were widely available, with nAMT (other than chloroquine) accounting for 13% of all volumes sold in the market, and AMT, whose consumption is argued to fuel multi-drug resistance, for 8%.

Further quality concerns relate to the availability of counterfeits and substandard products, which consumers are unlikely to be able to distinguish from genuine and good quality products at the time of purchase. In Cambodia, these concerns are directed to AMT and nAMT specifically, with some years ago 71% of 133 private drug outlets found to sell either fake or substandard artesunate and 60% fake or substandard mefloquine (Rozendaal, 2001). More recently, in 2006, 27% of 451 antimalarial drug samples collected at 171 private drug outlets operating in four provinces in the MDRSC stratum were counterfeits (Lon et al., 2006)

9.3.2 Factors affecting the relative role of private and public providers

The extensive role of the private commercial sector in the supply of antimalarial drugs reflected the interplay between market structure, provider conduct and consumer demand.

Cambodia's health system was recovering from its entire destruction during the Khmer Rouge regime (1975-1979) followed by many years of economic and political instability (until 1998). Evidence showed that the majority of private shops opened at the end or shortly after this period of instability, when unmet needs and demand for health services and products were likely to be high. At the time of our study, in 2009, retail shops made up 80% of all outlets stocking antimalarial drugs and were 4 times more numerous than government providers, meaning that they were a much more geographically accessible source of antimalarial drugs.

Compared to government providers, private outlets also had the advantage of less frequent stock-outs, being open longer hours, even at night, and in the case of mobile providers, the willingness to travel to patients' homes. Proximity to home and convenience were highly valued by consumers and these attributes led them to prefer private shops over government outlets. This was in tune with evidence from the ACTwatch household survey during which the most important factor influencing Cambodians' treatment seeking behaviour was "easy access" (ACTwatch Group, 2009a).

Government failures in public sector provision of malaria treatment included the opportunity cost of travelling longer distances and waiting times at public health facilities, and the risk that drugs may not be available. In addition, public health facilities had shorter opening hours and the staff members were reported to be much less friendly. However, with an average number of 10-14 VMWs per market where they operated, VMWs were likely to have been a highly convenient source of treatment. In addition, it is possible that they were a more reliable source of antimalarial drugs compared to health facilities, experiencing less frequent stock-outs as they received their supplies from a more integrated distribution chain structure (directly from the MOH instead of the Central Stores-Operational district-Health facility route). With the advantages of proximity and free treatment, VMWs therefore represented an attractive source of treatment.

9.3.3 Factors affecting price setting for antimalarial drugs

Results presented in Chapter 7 show that median percent mark-ups across different antimalarial categories ranged between 16% and 42% at wholesale level and between 15% and 366% at retail level across different antimalarial categories. From the evidence presented in the thesis it is not possible to draw firm conclusions on whether prices were at the competitive level i.e. the extent to which they diverted from marginal cost. However, the available evidence suggested that several factors may have contributed to antimalarial prices set above the competitive level, with the intensity of competition varying across different market segments. This section discusses the conditions that prevailed on the market that may have influenced price setting behaviours, including aspects of market structure, provider conduct and consumer demand.

Market concentration

The number of shopkeepers operating in retail markets was highly variable, ranging between 1 and 32 retailers, indicating the heterogeneity of retail market structures. Market concentration measures calculated using the HHI on antimalarial sales volumes ranged between 0.12 and 1.00 which according to US anti-trust guidelines indicates that market structure ranged from unconcentrated to monopoly. This suggests that retail markets for malarial treatment were located throughout the perfectly-competitive-monopoly spectrum. The median HHI calculated on antimalarial sales volumes was 0.50 (0.34-0.74), which, again, according to US anti-trust guidelines indicates high concentration (U.S. Department of Justice and Federal Trade Commission, 2010). Therefore, monopolistic competition or an oligopoly structure seems to have been an appropriate characterization of most retail markets for malarial treatment.

As expected from a classical economic theory perspective, market concentration and retail mark-ups were positively associated but in moderately accessible markets only. In these markets, an increase of 0.1 in the HHI calculated on antimalarial sales volumes led to percent price mark-ups 14% higher. By contrast, whilst the relationship between market concentration and price mark-ups was significant in less accessible markets, it was negative (although the effects were relatively small and evidence of these effects relatively weak). For example, in remote markets, an increase of 0.1 in the HHI led to price mark-ups 5% lower. These effects of market concentration were significantly larger on ACT ASMQ price mark-ups, with an increase

of 0.1 HHI associated with ASMQ mark-ups 17% higher in moderately accessible markets and with mark-ups nearly 10% lower in remote markets.

As previously mentioned, these results might have reflected the provision of malaria treatment by government providers leading private providers to limit pricing by charging lower mark-ups. During SSIs with private shopkeepers, government providers notably VMWs that had the advantage of proximity were perceived to increase the intensity of competition faced by private retailers, which might have resulted in lower consumer prices in markets where VMWs operated. However, it is also possible that consumers were more sensitive to quality than price, implying that providers might have competed on quality attributes rather than price. In our markets with relatively low concentration, higher mark-ups might have reflected the higher costs of providing better quality of care. There are no theoretical predictions of the effect of competition on quality in markets where prices are determined by firms (Gaynor, 2006) and the potential for discussing our results in light of the empirical literature is very limited. Most of the empirical literature on quality competition in health care markets has focused on hospital markets in high income countries and provides mixed results (Gaynor, 2006) with some evidence suggesting that competition increases quality (Gaynor et al., 2010) whilst other studies found that competition reduces quality (Propper et al., 2004). However, in a study of the market for hospital services in Bangkok, a negative correlation between profits and concentration was found combined with some association between lower concentration and higher quality (Bennett, 1996).

Overall, in our study, the effects of concentration on price mark-ups were relatively small compared to that of other predictors. First, antimalarial price mark-ups were significantly and more largely affected by accessibility and malaria transmission risk levels, with in high and moderate risk areas, lower mark-ups in remote markets (115% and 44% respectively) compared to moderately accessible markets, perhaps reflecting the importance of public sector supply through malaria control interventions targeting these areas. Second, mark-ups were higher in remote markets than in more accessible markets in the MDRF stratum, a result that pointed to the influence of the distribution chain structure on consumer prices. For instance, percent mark-ups on ASMQ were 77% higher in remote markets than in moderately accessible markets and 70.5% higher in remote markets compared to accessible markets. This might have reflected the higher costs of purchasing ASMQ faced by providers operating in these areas as they were significantly less likely to receive supplies from a supplier with delivery services. Evidence showed that the structure of the chain varied by remoteness and

outlet type as observed in other countries (MMV, 2007, Chukwujekwu, 2007). In our study, more remote providers, including mobile providers, grocery stores and village shops were served by a chain made of more intermediaries, as they purchased supplies from local wholesalers. By contrast, more accessible providers were served by wholesalers operating at provincial or national level. As expected under the assumption that each seller adds its own mark-ups, higher consumer prices were observed at mobile providers, grocery stores and village shops compared to pharmacies/clinical pharmacies and drug shops (ACTwatch Group, 2009b).

The distribution chain for antimalarial drugs had a pyramid shape with fewer suppliers at the top of the chain and more numerous suppliers at the bottom, as observed in other countries (Yadav, 2007, Yadav and Conesa, 2008, Tavrow et al., 2003, IOM, 2004, Battersby et al., 2003, IFC, 2008, RBM, 2007, Shretta and Guimier, 2003, CHAI, 2008b, Russo, 2007, Russo and McPake, 2010, Chukwujekwu, 2007, MMV, 2007). With a rapid narrowing of the number of wholesalers operating in the distribution chain, we would expect more intense competition at the bottom of the chain compared to the top. This was partly demonstrated by the analysis of wholesale market concentration using the percentage of all supply source mentions that each unique supplier represented. However the analysis of wholesale price mark-ups at different levels of the chain did not indicate that price percent mark-ups were higher at the level supplying wholesalers than at that supplying retailers. However, in the context of overlapping distribution chain levels, it is not possible to conclude firmly on how price mark-ups compared at different levels of the chain.

In the absence of evidence of vertical integration, antimalarial providers were expected to be free to choose their suppliers, which products to stock and what price to charge. This contrasted with situations observed in several malaria-endemic countries such as for example Benin, Nigeria and Zambia, where the structure of the chain was expected to have had more influence on retailers' decisions (RBM, 2007). In Benin, wholesalers sometimes owned pharmacies, which in some areas served a network of depots operating in less accessible areas, with the latter to be served exclusively from their affiliated pharmacy (Tougher et al., 2009). In Zambia, one vertically integrated business engaged in the import, wholesale and retail of antimalarials (Palafox et al., 2011). In Nigeria, vertical integration was found to be common within the distribution chain, with manufacturers and importers having vertically integrated wholesalers or third-party logistics service providers (Palafox et al., 2009).

However, in Cambodia, the evidence demonstrated that retailers and wholesalers used 1 or 2 supply sources for antimalarial drugs and that they did not generally switch to other suppliers, suggesting that competition might have been limited at all levels.

More specifically at the top of the distribution chain, PSI Cambodia was the only importer of the subsidized ACT and no private commercial wholesalers imported ACT products. Several factors prevented wholesalers from entering the ACT import market. The first is that ASMQ was not available commercially and was co-blistered specifically for Cambodia by one manufacturer. The second is that whilst other manufacturers could decide to pre-pack the product to enter the market, the costs would likely be prohibitive for most wholesalers wishing to import the product in the absence of a price subsidy. Third, the popularity of the subsidized ACT amongst both providers and consumers was reported to be the result of the promotional activities of the social marketing programme, including branding, mass media communications and training of private providers. At the top of the chain, this created entry barriers as large investments in registration processes and advertising activities would be necessary to communicate information about a new antimalarial drug. During SSIs, importers highlighted that the market for malaria treatment was too small for realizing scale economies such that the potential for gaining the minimum market share required to be profitable was very limited. Whilst a monopoly situation prevailed on the market for ACT, PSI Cambodia's objectives were however assumed to be unrelated to profit-maximization, following social responsibility principles to benefit society at large, by assessing the ability and willingness to pay of the target groups (PSI, 2003).

Product differentiation

The thesis findings indicated that product differentiation was quite strong within the market which may have created the potential for exercise of market power in pricing decisions. Providers of clinical services attracted customers through their higher health qualifications and wider range of drugs stocked compared to other outlets. Such product differentiation might have encouraged consumers to perceive that these providers as a more appropriate source of antimalarial drugs than other shops (Meesen et al., 2011). We would therefore expect the intensity of competition between private outlets to be reduced, offering providers of clinical services some discretion in their price setting decisions and the opportunity to charge higher prices mark-ups than other types of providers. This was partly verified by our data, which showed price mark-ups on ASMQ 40% higher at pharmacies/clinical pharmacies than at other

provider types. However it did not translate into higher consumer prices (ACTwatch Group, 2009b) as these providers purchased ACT at a lower price than other provider types.

Antimalarial drugs were far from being homogenous products, including ACT, AMT and nAMT, with the latter available in tablet, injectable or suppository form. The evidence demonstrated the popularity of the socially marketed ACT amongst consumers who were reported to perceive Malarine as a product of high quality. Despite this perceived popularity, the socially marketed product accounted for less than 40% of all antimalarial AETD sold in the market. AMTs were reported to be popular, perhaps because they have been available for a relatively long time in Cambodia and were said to have less side effects than ASMQ. Retail price mark-ups on artesunate were 49% lower than on ASMQ, but with higher purchase prices this translated to absolute price mark-ups 2 to 5 times higher than on ASMQ across outlet types and AMT consumer prices 2 to 3 times higher. Furthermore, whilst price mark-ups on injectable antimalarial drug were not statistically different than on antimalarial tablets, OS data showed that absolute price mark-ups were much higher than those on other antimalarial categories and dosage forms, with AMT absolute price mark-ups 6 to 26 times higher than for ACT tablets and 8 to 37 times higher than on nAMT injections, which translated into higher consumer prices (author's own calculation, see Chapters 2 and 5).

Insights from monopolistic and oligopoly models

As discussed above, the structure of markets in monopolistic competition was relevant to some retail markets where there were many sellers, ease of entry and exit and relatively low concentration. In the short run, private providers would each act as a monopoly and make economic profits (provided that they have profit maximising objectives), with price set above marginal cost because each faces a downward sloping demand curve. In the long run and in the absence of entry barriers, economic profits would be driven to zero. However, with differentiated products, firms would retain some discretion in setting their price.

In oligopoly markets with a sufficiently small number of providers, each one would be expected to take the actions of the competing providers as given when selecting its own actions. Several models of oligopoly behaviours described in Chapter 3 may provide insights into the factors that affecting price setting decisions.

In the standard price leadership model, the market leader sets his price first given the likely supply of other providers at that price, whilst other providers would set their prices following

the leader's choice. With a homogenous product, followers are assumed to be perfect competitors and charge the price set by the leader (Varian, 1999). This was illustrated during a SSI with a mobile provider who argued that he set his own price first to maximize his profits whilst other providers were perfect competitors, as they charged the same price. In markets where government providers might have been the leader, private providers were not expected to be conventional followers, given that diagnosis and antimalarial drugs were dispensed free of charge at public health facilities or by VMWs. Instead, SSIs revealed that private providers set their own price considering the broader costs for consumers of seeking care in the public sector, notably transport costs which were easily estimated (as opposed to opportunity costs for consumers which would be hard to value by private providers). As discussed above, in markets where VMWs operated, it is possible that providers limited their prices in order to retain consumers. At higher levels of the chain, PSI Cambodia was the market leader so we could expect other importers to follow. However, in these market segments with strong product differentiation, followers would have retained some discretion in setting their price, charging higher or lower prices than the market leader.

The kinked demand model may help explain the reasons why the consumer price of the socially marketed ACT might have been above the RRP. Supply shortages have occurred repeatedly since the start of the social marketing programme and have been argued to create opportunities for sellers to charge high mark-ups and set price above the RRP. In the context of strong product differentiation, the demand curve faced by each provider would be more elastic for price increases than for price cuts. Levels of ACT mark-ups may have resisted erosion if providers believed that any price cuts they made might be matched by competitors whilst price increases would not.

A key feature of oligopoly is the tension between cooperation and self-interest: firms have an incentive to cooperate in order to maximize their joint profits but there are incentives that hinder sustained cooperation as each seller pursues its own profit. Models of tacit collusion amongst retailers/wholesalers offered some insights into private shopkeepers' price setting decisions. Most markets had few providers (mean 5, see Section 5-2-6), creating incentives for private providers to collude rather than pursue their own self-interest, and two factors might have contributed to prevent cheating and sustain collusion. First, whilst there was no formal professional association of drug sellers, private providers had the opportunity to meet during the regular training sessions organized by PSI and obtain information on competitors' prices. Second, during data collection, we witnessed that when providers were out of stock of a

particular product they actually borrowed from other shops in order to satisfy an immediate consumer demand. In markets where collusion was effectively sustained, antimalarial prices would be expected to be as high as the monopoly model. Interestingly, during qualitative interviews, all antimalarial retailers and wholesalers refuted collusion, arguing they faced intense price competition, with a couple of retail providers even indicating cutting their prices in order to attract custom.

All these models offered some insights on the nature of interactions that may have taken place. As mentioned before, in view of the heterogeneity of markets for antimalarial drugs, it is not possible to say which models were the most appropriate and different types of interactions may have taken place in different markets.

9.3.4 Factors influencing treatment quality

There are many aspects to good quality treatment for malaria. First, access should be prompt and take place within 24 hours after the onset of fever. Second, providers should have the expertise to treat malaria treatment, and use this expertise in the interest of their patients. Third, malaria infections should be confirmed by testing patient blood. Fourth, blood test results should be adhered to, with ACT dispensed to *P.f*/mixed cases, chloroquine to *P.v* cases and no antimalarial to negatives. Fifth, the appropriate medicine should be available and of good quality.

The data presented in this thesis showed that competition in retail markets did not lead to the optimal provision of quality malaria treatment: accessibility to health-qualified providers stocking antimalarials and ACT in particular was limited, access to parasitological diagnosis was poor, adherence to blood test results was lacking, inappropriate treatments were dispensed and the quality of antimalarial drugs was questionable. The factors that influenced these outcomes are discussed in this section.

Whilst competition in retail markets increased accessibility to antimalarial drugs, there was some indication that accessibility was in reality still quite restricted. Evidence from SSI suggested that private providers clustered in more accessible areas. The literature on spatial product differentiation suggests that firms face different incentives in their location decisions (Hotelling, 1929), with sellers locating close to competitors in an attempt to capture more consumers ("market share effect") or further away if product differentiation is sufficiently

strong (“market power effect”) (Netz and Taylor, 2002). SSIs with shopkeepers indicated that the “market share effect” might have dominated in most markets, with retailers locating where the demand was greatest and clustering in more accessible areas, including around *phsars* or alongside main roads and roundabouts. By contrast, VMWs clearly increased accessibility in villages where they were introduced, and may also have improved quality of care, although the evidence is limited (Yeung et al., 2008). However, at the time of our study, they operated in only around half of villages at high risk of malaria in Cambodia (CNM personal communication) and accounted for only 1% of initial visits for treating malaria fever in the study areas (ACTwatch Group, 2009a).

As noted above, the negative relationship between price mark-ups and concentration observed in some markets suggested that consumers might have been more sensitive to quality than price, implying that providers might have competed on quality attributes rather than price. In some cases consumers were reported to have the ability to assess the true quality of a product after its purchase or through the experience of other consumers, suggesting that malaria treatment might have been an experience or reputation good. However, consumers’ understanding of the quality of malaria treatment based on their own experience or that of others was likely to be imperfect, meaning that malaria treatment was more of a credence good whose technical attributes were not well understood and their true quality never observed. Under such conditions, competition may have focused on easily observable attributes (including proximity, opening hours, range of drugs stocked and friendliness) rather than on less observable technical aspects required for providing high quality of care, implying that the quality of malaria treatment might not have been enhanced in more competitive remote and accessible markets.

This was borne out by several dimensions of treatment quality. First, outside public health facilities, microscopy services were relatively rare, a situation that reflected a mixture of factors. Microscopes were likely to have been too expensive for most private shops and consumer demand expected to be low, as a lab service was perceived by most providers to be a different type of business to that of selling drugs and treating. Microscopes also required skills that private providers voluntarily admitted not having, except when they were government doctors working in the nearby health centre. Whilst RDTs were more commonly available, several factors can be put forward to explain poor access to confirmed diagnosis reported by the OS, reflecting the interplay between the inherent characteristics of the product, provider conduct and consumer demand. At the time of the study, Malachek only

detected *P.f* malaria, a situation which according to data from SSIs created some confusion amongst private providers about what to do with negative cases as it did not rule out *P.v* infections. Partly as a result private providers perceived the socially marketed RDT to be of little help in the management of malaria fevers. SSIs also revealed some confusion amongst providers around whether blood testing was authorized in private shops. However, the low use of diagnostics might also have reflected providers' strategies for increasing convenience for consumers by avoiding waiting for blood tests and/or increasing affordability as the combined cost of RDT and ACT (around US\$ 2.00) was likely to deter most consumers. In view of the differential in RDT and ACT prices (with ACT prices being 1.75 times more expensive than RDT), providers might have had a strong incentive to sell ACT without a blood test rather than sell a blood test with the risk of losing drug sales to those with a negative test. Poor access to diagnosis may also have reflected imperfect information on the part of consumers who perceived the risk of fever being malaria to be higher than it actually was.

Even in situations where parasitological diagnosis was performed, evidence showed that adherence to test results was poor. ACT was found to be dispensed to cases who tested negative for malaria whilst positive *P.f* cases were treated with other antimalarial drugs and/or other medicines, including cocktail therapies (ACTwatch Group, 2009a). The consumption of cocktail therapies was found to be widespread, with antimalarial-based cocktails commonly containing quinine, chloroquine or artesunate, combined with vitamin C and paracetamol. During SSIs, providers reported dispensing cocktails as a means to increase profitability, with cocktails containing antimalarial drugs sold at a median price of US\$ 1.88. As for the use of nAMT, notably chloroquine, which accounted for 20% of the market in volume terms, it may have reflected *P.v* treatment malaria. nAMT consumption might also have reflected its relative affordability compared to ACT, which was around 4.5 times more expensive. However, its consumption for treating confirmed *P.f* malaria or other illnesses would have certainly led to treatment failure. During SSIs, consumers were reported to prefer AMT, notably artesunate tablets, over ASMQ which was said to have unpleasant side effects associated with mefloquine. The use of AMT has however important negative societal externalities as it contributes to the spread of artemisinin resistance.

Poor quality of malaria treatment may have been exacerbated by the use of counterfeit or fake medicines. Whilst our study did not assess the quality of antimalarial drugs, evidence showed that 38.5% of AMT and 31.5% of nAMT were of unknown provenance and it possible that counterfeit or substandard products competed with genuine medicines by taking advantage of

consumers' inability to assess product quality. The problem of "lemons" where better quality products are driven out of the market by cheaper products of low quality (Akerlof, 1970) might have therefore emerged on the market for non-ACT.

Although providers of clinical services were reported to attract consumers through their health qualifications, very few of these private providers had the relevant health qualifications for selling drugs, let alone administering injections. However, in the context of imperfect and asymmetric consumer information, private providers acted as agent for consumers, as indicated by OS data, with most mobile providers, pharmacies/clinical pharmacies and drug shops choosing on behalf of the patient which medicines to dispense. By contrast, the agency role of grocery and village shopkeepers seemed to be more limited, which reflected their lack of expertise. However, some of these outlets reported selling cocktail therapies for treating malaria fever, indicating that they had the potential to induce demand and include unnecessary drugs in cocktail packages.

Several quality failures highlighted the limited capacity of authorities to enforce regulations, including the likely prevalence of counterfeit drugs, AMTs and unlicensed outlets. Availability of AMT in the market at the time of the study indicated the inefficacy of regulatory mechanisms introduced in November 2008 for withdrawing it from the market. There had been limited communication of the ban until the end of March 2009, the date at which the MOH requested AMT manufacturers and wholesalers to collect these drugs from the markets and retailers and to stop displaying and selling AMT through an information announcement letter, which failed to specify the nature of the "strict measure" to be used in case of non-compliance. In this context, incentives for private wholesalers and retailers to stop selling AMT might have been particularly limited. In addition, complying with the ban might have translated to important financial losses for most shopkeepers who, as indicated during SSIs, bear the full inventory risk in the absence of arrangements for them and their suppliers to send stocks back to manufacturers.

At the time of our study, only 8% of retail providers (ACTwatch Group, 2009b) and around 10% of wholesalers reported having a MOH license authorizing the sales of pharmaceutical products, although the majority of antimalarial providers reported they had received the visits of health inspectors in the past year. In 2009, there were only 70 drug outlet inspectors for the whole country and recruitment of inspectors was said to be difficult (DDF, personal communication). At the time of the study, health inspectors had no judiciary power and their

role was limited to the provision of information and advice to drug shopkeepers. Since data collection, however, around half of MOH inspectors obtained judiciary power (personal communication, DDF). In addition, a few months after our study, the MOH announced the closure of around 65% of illegal private drug shops (BMJ, 2010). The implications in terms of the characteristics of the market described in the thesis are unclear. On the basis of the proportions of retail outlets operating without a license in our study area, the majority of antimalarial providers would have been closed down, implying that accessibility of malaria treatment would now be much more restricted in areas where unlicensed providers might have been the only source of treatment. However, the extent of the closures in practice remains unclear. Further insights on the impact of this “crackdown” on the prevalence of unlicensed outlets and AMT will be provided by the next OS.

This section has summarised key features and outcomes of the market for malaria treatment in Cambodia and discussed the findings presented in the thesis in light of the theoretical and empirical literatures, focusing on factors influencing the relative role of public and private providers in the provision of malaria treatment, providers’ price setting decisions and quality of malaria treatment. The next section presents a set of recommendations for policy and future research for improving the key market outcomes of availability, price and quality of malaria treatment.

9.4 Recommendations for policy and future research

In this section, recommendations for policy and future research for improving prompt access to quality malaria treatment are presented, drawing on the results presented in this thesis and on relevant evidence from the empirical literature.

Establishing far reaching distribution networks and improving product stock reliability

With the advantage of proximity and willingness to travel to patients’ home, private providers increased accessibility to malaria treatment. However, their potential for doing so may not have been fully exploited. OS data showed that large proportions of outlets that were expected to stock antimalarials in malaria endemic areas did not. Moreover, not all antimalarial outlets stocked the recommended first line ACT and RDT, including government providers, and as reported in Chapter 2 and during SSIs (Section 6.3.4), stock-outs were frequent. In the private commercial sector, it likely reflected a situation where PSI Cambodia’s distribution network failed to reach the more remote outlets. Evidence from the OS demonstrated that less than 15% of shopkeepers reported PSI Cambodia as one of their top 2

suppliers for antimalarial drugs, implying that, in the context that retailers rarely used more than 2 suppliers, they were not reached by PSI Cambodia distribution network (Section 6.3.4). This was also borne out by evidence collected through SSIs with private commercial retailers. By contrast 65% of wholesalers supplying retailers and 75% of those supplying wholesalers reported PSI as one of their top 2 suppliers for antimalarial drugs, indicating that subsidized ACT and RDT reached to a greater extent consumers living in more accessible areas (in the context that most wholesalers also operated as local retailers). Widening the reach of distribution services for ACT and RDT has therefore the potential to contribute to improve product availability and equity in availability.

Evidence presented in Chapter 7 shows that in some market segments market concentration and retail price mark-ups were significantly and positively associated. Increasing ACT availability through far-reaching distribution networks could therefore contribute to increase retail competition and potentially decrease ACT retail prices. Our results also indicated higher price mark-ups in less accessible markets and at outlets not supplied by a wholesaler who delivers orders. As noted before, this may have reflected higher transport costs faced by these retailers when purchasing their supplies. Finally, the analysis of ACT purchase prices showed that retailers generally purchased ACT at a higher price than wholesalers, and at a price above the RRP, with some indication that retailers operating in more remote market segments (e.g. village shops, mobile providers) purchased ACT at a higher price than those in more accessible areas (e.g. pharmacies/clinical pharmacies). This suggested that mark-ups were added at each level of the chain (ACTwatch Group, 2009b). Widening distribution networks would therefore provide an opportunity for reducing retailers' wholesale costs for ACT and potentially ACT retail price mark-ups and prices.

Expanding the reach of distribution services to remote areas where the road network is poor, notably during the rainy season that coincides with the season of high malaria transmission risk, is however likely to be costly for policy makers. However, it may be possible to build on the distribution networks of other importers of pharmaceutical drugs in general. During qualitative interviews with importers, these suppliers indicated that they will be willing to participate in the distribution of ACT and even suggested expanding their networks for that purpose. Financial and non-financial incentives would be required for engaging with these wholesalers but these could be less costly than expanding the distribution network of one importer only and have the benefits of less risk of stock-outs, provided supplies are available from manufacturers. A variety of incentives were suggested by importers such as a fast track

import process for their own products, an exemption of import permit for each shipment, a decrease of the value added tax rate and/or better access to capital. The potential of introducing these incentives could be explored by Government by engaging with private wholesalers through consultative meetings. There might also be non-financial incentives for importers to distribute socially marketed ACT through the positive externalities associated with the prestige of carrying products benefiting from intense promotional activities (Vickers and Waterson, 1991). These may act as a signal of the high quality of the other products handled by these wholesalers providing them opportunities to increase the sales of their own products. Promotion was reported to be an important cost for importers and increasing promotion of their products that way would not involve additional expenses. Further research into the costs of implementing far-reaching distribution channels is therefore required.

Improving drug stock reliability at public health facilities through enhanced capacity in public sector supply chain management would be crucial to encourage consumers to visit facilities where these commodities were, when available, provided free of charge (ACTwatch Group, 2009b). However, this may not be sufficient for improving access to public health facilities and equity in access because of the limited numbers and sparse distribution of public health facilities. An alternative strategy could be to expand the network of village malaria workers (VMWs). Trained volunteers operating at village level increased convenience in accessing potentially higher quality malaria treatment and were likely to have more reliable antimalarial and RDT stocks because of the relatively integrated nature of their distribution chain compared to public health facilities. In addition, community-based programmes have been associated with improved coverage and equity of health care services in Cambodia (Grundy et al., 2009). However, there is limited evidence on the contribution of VMWs in improving access to quality malaria where they have been introduced (Yeung et al., 2008). An evaluation of the effectiveness of the VMW programme is being conducted in Cambodia and will contribute to address this knowledge gap. However, further research into the programme's cost-effectiveness and sustainability will be required.

A more deep-rooted issue for increasing ACT availability in both public and private sectors lies in the procurement of the combination therapy, artesunate and mefloquine which is co-blistered and packaged in age-specific packs specifically for Cambodia by an overseas based manufacturer. Switching to a co-formulated ACT that is available commercially for Cambodia, such as dihydroartemisinin and piperaquine, could therefore contribute to improve availability, notwithstanding requiring improvements in procurement processes.

Decrease wholesale and retail ACT prices (increase ACT subsidy)

Even with wider far-reaching distribution networks, ACT could still be too expensive for some private providers to purchase. At the time of the study, PSI's selling price to wholesale and retail outlets was nearly half a dollar per adult pack (US\$ 0.42), which was much higher than the wholesale price of nAMT in tablet form, including chloroquine, the most popular monotherapy. In addition, even in cases where ACT might have been sold at the level of the RRP, the cost of one adult equivalent treatment dose was two times higher than that of chloroquine (ACTwatch Group, 2009b). Therefore widening the distribution network is unlikely on its own to improve either availability or uptake of quality malaria treatment.

There may be potential for decreasing PSI's wholesale price, notably through the Affordable Medicine Facility for malaria (AMFm). The AMFm was proposed in 2003 by the Institute of Medicines that suggested ACT be highly subsidized at the manufacturer level and made available to both public and private importers, with the objectives of making ACT available to consumers at a price similar to that of older and less effective drugs (IOM, 2004). In Cambodia, the AMFm would "replace" the social marketing programme, with the objective of having several private commercial wholesalers importing the subsidized ACT and distributing it through their existing distribution network. The introduction of the AMFm has been delayed in Cambodia because the ACTs ASMQ and dihydroartemisinin and piperazine (that will most probably replace ASMQ if the AMFm is launched in the context of multi-drug resistance) have not yet gained the Global Fund's quality assurance qualifications (The Global Fund, 2011).

On the basis of the evidence available in the thesis, existing levels of competition in the distribution chain might not have ensured competitive prices so a higher subsidy may not feed down the point of purchase. The potential for increasing competition should therefore be explored. At the top of the chain, whilst all importers expressed interest in ACT during our SSIs, they were nonetheless worried that volumes were too small and that margins will not cover their promotion and transport costs. They also feared other importers would free-ride on the externalities created by the promotional activities of their sales teams. In this context, they nearly all want to enter into an exclusive distributionship agreement with ACT manufacturer. The AMFm could be designed differently using pooled procurement at national level with promotional activities conducted by the CNM or PSI, who could then outsource distribution to private commercial wholesalers with pre-existing distribution networks (CNM, personal communication). At lower levels of the chain, inducing competition may be possible by lowering entry barriers through better access to capital for shopkeepers willing to enter the

antimalarial wholesale market, providing that minimum quality standards are met. This is likely to require additional strategies explored later in this chapter.

Experiences in using RRP on antimalarial drugs are limited and have proved to have different effects on consumer prices. In Cambodia, since the start of the programme around ten years ago, the subsidized ACT always had a RRP and evidence demonstrated that retail prices were generally above the RRP (Sabot et al., 2008, Yeung et al., 2011). By contrast, in Senegal, private pharmacies purchased the subsidized first-line ACT from public sector medical stores and added an average 35% to the price of an adult dose, which translated into a retail price only 4% higher than the RRP (Sabot et al., 2008, Kone et al., 2007). In two districts of Tanzania, a subsidy scheme was piloted and in one district it was combined with a RRP printed on ACT packs. The subsidy effectively decreased the price of ACT below the price paid by consumers in the control area and below the price of older antimalarials. However, ACT prices were higher in the district with the RRP than in the district without (Sabot et al., 2008), calling for caution in the use of RRP.

During our study, some retailers indicated that when consumers were informed about the RRP, they were constrained to sell the subsidized ACT at that recommended price. This therefore supports the use of RRP, combined with effective communications to consumers (explored in more detail later in this chapter), and points to the second issue of setting the level of the RRP.

Little research has been conducted in Cambodia on the level at which RRP should be set. At the time of our study, the RRP for ACT was US\$ 0.61, based on a study on consumers' willingness to pay conducted some years ago (PSI, 2003). As for RDT, no similar research is known to the author to have been conducted in Cambodia. Several private retailers argued that the RRP was set too low and did not provide sufficient profits. Generating evidence on retailers' (and wholesalers') overhead costs including transport, rent, staff, etc and their relative importance should also be considered in order to investigate the levels of profit perceived to be "sufficient" by private providers. During SSIs, we had the opportunity to collect data on cost categories and their relative importance and private shopkeepers were open to sharing their expenses. One challenge for future studies lies in the identification of incremental costs of running a drug business in the context where shopkeepers generally operated within their home.

Intensify provider training and communications to consumers

As discussed above, quality of malaria treatment is multidimensional and there are not enough data on private providers' practices in this thesis to conduct an assessment of strategies for improving the technical quality of care that they provide. Data in this thesis suggested however that knowledge, practical experience, RDT and ACT availability and price, providers' confidence in malaria diagnostics and ACT and consumer demand influenced providers' practices.

The limited reported use of RDT was partly related to the inherent characteristics of the product, which at the time of this study was sensitive to *P.f* infection only. The recent replacement of the old socially marketed RDT by a test detecting both *P.f* and *P.v* malaria offers an opportunity for promoting the utility of RDT use in managing malaria-like fevers. Practical training on using RDT should be facilitated as those stocking RDT often did not feel comfortable using it, including wholesalers, of whom the majority also served end-users. Training could take the form of workshops or group training sessions, which have already been reported to positively influence wholesalers' and retailers' stocking practices as revealed by SSIs conducted with retailers and wholesalers (Section 6.3.5).

Removing any opportunities for providers to dispense inappropriate therapies will be crucial for improving the quality of malaria treatment. This difficult task could first be addressed by switching from co-blistered artesunate and mefloquine to a co-formulated ACT. Evidence from past studies showed selling artesunate and mefloquine individually by cutting blisters or removing tablets from packaging was a common practice amongst private providers (Yeung et al., 2008), meaning that even if sales of AMT are banned, they remain easily accessible to providers but also consumers who may decide to take artesunate alone to avoid side effects associated with mefloquine. Potential for providing incentives to manufacturers to produce co-blistered ACT and fast-track international prequalification procedures could contribute to the introduction of appropriately formulated ACT. This should be a priority on the international agenda given the negative externalities for the spread of multi-drug resistance in Cambodia and to other malaria-endemic countries.

Even if more private providers are given the opportunity to stock ACT, through wider reach of distribution chains and lower wholesale prices, availability may however remain low. Retail providers operating in the more remote markets may be reluctant to stock ACT if they expect

consumer demand for these products to be low because of the lack of information on what constitutes appropriate quality malaria treatment.

Expanding and intensifying social marketing-like activities, including road shows, radio messages, TV ads etc could improve consumer information on ACT efficacy compared to older antimalarial drugs and the need for confirmed diagnosis to mitigate treatment failure and negative externalities for multi-drug resistance. These activities could also be expanded to non-malarial areas in the context of mobile populations with no or little immunity to malaria who travel to forested areas. A more intense communication campaign about the RRP is also required.

Reviewing regulation and extending its supportive role

In view of findings from previous studies, counterfeit or substandard products might have been available on the market (Newton et al., 2008, Lon et al., 2006, MOH, 2004b, MOH, 2001, Dondorp et al., 2004, Newton et al., 2001). However, as mentioned before we did not assess quality of antimalarial drugs. Further assessment of this is underway at retail level through the collection of drug samples during the OS conducted in 2011. Similar research activities should be conducted at the different levels of the chain.

Finally, reviewing the regulatory framework requires clarity over whether private providers are legitimate outlets for malaria treatment, in particular diagnostic testing, and, within the private sector, which outlets are legitimate to do so. Review of the regulatory framework should be conducted centrally at the MOH in collaboration with provincial and district authorities through which the regulation framework could be communicated to private providers. If review of the regulation framework is to be conducted by local authorities alone, there may be a risk of regulation capture by local authorities which in some areas were witnessed during this research to be involved in provision of health care services in the private sector. At the time of the study, we also witnessed great heterogeneity in involvement of local authorities with private providers in terms of information or education meetings conducted. This showed that a supportive role of regulation is possible and that the potential for extending it should be explored by policy makers.

9.5 Conclusion

In Cambodia, as in many other low-income malaria-endemic countries, management of malaria fever is inadequate, notably in retail shops where the majority of people seek care: diagnosis is often presumptive or adherence to blood test results is poor; ACT is expensive and availability is low; alternative antimalarials that are less effective, albeit not necessarily cheaper, are used; and, ACT is dispensed to people who are not in need of such therapy. This situation has important implications, not only in terms of treatment failures and delays in access to appropriate treatment, but also in terms of the negative societal externalities of drug resistance.

To address these issues, interventions working with shopkeepers are being implemented, with the aim to improve treatment availability, price and quality. Retailers are the last link in a chain of manufacturers and wholesalers and their supply sources have an important influence on their selling practices. Yet, there is limited evidence on the functioning of the market for malaria treatment and how it affects retail treatment outcomes. This is partly due to the methodological challenges of studying healthcare markets in poor countries, where routine data are rarely available and methods under-developed or lacking adaptation (Conteh and Hanson, 2003). The complexity of the functioning of markets and lack of empirical work in this area imply that it is not clear how to improve shopkeepers' selling practices.

In this context, the thesis makes two important contributions to the literature. First, it provides evidence on how market structure, provider conduct, customer demand and regulation affected retail treatment outcomes in Cambodia. Drawing on concepts from the IO literature and previous work from Conteh and Hanson (Goodman, 2004, Conteh and Hanson, 2003), and Goodman (Goodman, 2004), the thesis used a mix-method approach, including cross-sectional quantitative data and semi-structured interviews with retailers and wholesalers. Evidence demonstrated that retail and wholesale competition increased accessibility to malaria treatment in Cambodia's malaria endemic areas, but did not lead to optimal supply of affordable quality treatment. Several market and government failures were evident, including intense product differentiation, imperfect consumer information on treatment quality, high concentration, poor public sector treatment accessibility and ineffective regulation. These provided opportunities to use market power to increase mark-ups on antimalarial drugs, although not in all market segments, highlighting the heterogeneity of retail markets and the influence of distribution chain structure and wholesaler's conduct on the availability, price and

quality of malaria treatment. Second, the thesis provides evidence on the relative contribution of different empirical methods, including relatively novel ones, for studying private drug markets in developing settings, and demonstrates that the suitability of different methods or combination of methods is likely to differ across settings (retail vs. wholesale, countries).

The private commercial sector is likely to remain an important source of malaria treatment and pharmaceutical drugs in Cambodia and in other developing countries. Evidence provided in this thesis is therefore relevant to interventions working with retailers and the wider environment in which they operate to improve access to quality health care in poor countries. Recommendations include widening distribution networks for ACT and RDT; improving product stock reliability; decreasing wholesale and retail product prices; intensifying providers' training; diffusing information to consumers on what constitutes appropriate management of malaria fever; and strengthening regulation and the potential to extend its supportive role.

REFERENCES

- ABUYA, T. O., MUTEMI, W., KARISA, B., OCHOLA, S. A., FEGAN, G. & MARSH, V. 2007. Use of over-the-counter malaria medicines in children and adults in three districts in Kenya: implications for private medicine retailer interventions. *Malar J*, 6, 57.
- ACTWATCH GROUP 2009a. *Household Survey Report, Kingdom of Cambodia*.
- ACTWATCH GROUP 2009b. *Outlet Survey Report, Kingdom of Cambodia*.
- ADIKWU, M. U. 1996. Sales practices of patent medicine sellers in Nigeria. *Health Policy Plan.*, 11, 202-205.
- ADOME, R. O., WHYTE, S. R. & HARDON, A. 1996. *Popular Pills: Community Drug Use in Uganda*, Amsterdam, Het Spinhuis Publishers.
- ADU-SARKODIE, Y., STEINER, M. J., ATTAFAUAH, J. & TWEEDY, K. 2000. Syndromic management of urethral discharge in Ghanaian pharmacies. *Sex Transm Infect*, 76, 439-42.
- AGYEPONG, I. A. & MANDERSON, L. 1994. The diagnosis and management of fever at household level in the Greater Accra Region, Ghana. *Acta Trop*, 58, 317-30.
- AHMED, S. M. & HOSSAIN, M. A. 2007. Knowledge and practice of unqualified and semi-qualified allopathic providers in rural Bangladesh: implications for the HRH problem. *Health Policy*, 84, 332-43.
- AKERLOF, G. 1970. The market for "lemons": qualitative uncertainty and the market mechanism. *Quarterly Journal of Economics*, 84, 488-500.
- ALBA, S., DILLIP, A., HETZEL, M. W., MAYUMANA, I., MSHANA, C., MAKEMBA, A., ALEXANDER, M., OBRIST, B., SCHULZE, A., KESSY, F., MSHINDA, H. & LENGELER, C. 2010a. Improvements in access to malaria treatment in Tanzania following community, retail sector and health facility interventions -- a user perspective. *Malar J*, 9, 163.
- ALBA, S., HETZEL, M. W., GOODMAN, C., DILLIP, A., LIANA, J., MSHINDA, H. & LENGELER, C. 2010b. Improvements in access to malaria treatment in Tanzania after switch to artemisinin combination therapy and the introduction of accredited drug dispensing outlets - a provider perspective. *Malar J*, 9, 164.
- ALTMAN, D. G. & BLAND, J. M. 1983. Measurement in medicine: the analysis of method comparison studies. *The Statistician*, 32, 307-317.
- AMIN, A. A., MARSH, V., NOOR, A. M., OCHOLA, S. A. & SNOW, R. W. 2003. The use of formal and informal curative services in the management of paediatric fevers in four districts in Kenya. *Trop Med Int Health*, 8, 1143-52.
- AMIN, A. A. & SNOW, R. W. 2005. Brands, costs and registration status of antimalarial drugs in the Kenyan retail sector. *Malar J*, 4, 36.

- AMIN, M. A. 2002. *An analysis of private hospital markets in Bangladesh*. PhD Thesis, London School of Hygiene and Tropical Medicine, University of London.
- BAIN, J. 1956. *Barriers to new competition*, Cambridge, Harvard University Press.
- BASCO, L. K. 2004. Molecular epidemiology of malaria in Cameroon. Quality of antimalarial drugs used for self-medication. *Am J Trop Med Hyg*, 70, 245-50.
- BATTERSBY, A., GOODMAN, C., ABONDO, C. & MANDIKE, R. 2003. *Improving the supply, distribution and use of antimalarial drugs by the private sector in Tanzania*, London, Malaria Consortium.
- BAUMOL, W., PANZAR, J. & WILLIG, R. 1982. *Contestable markets and the theory of industry structure*, Harcourt Brace Jovanovitch.
- BENNETT, S. 1996. *Imperfect information and hospital competition in developing countries: a Bangkok case study*. Doctor of Philosophy, London School of Economics and Political Science, University of London.
- BIGDELI, M. & ANNEAR, P. L. 2009. Barriers to access and the purchasing function of health equity funds: lessons from Cambodia. *Bull World Health Organ*, 87, 560-4.
- BLAND, J. M. & ALTMAN, D. G. 1986. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet*, 1, 307-10.
- BLAND, J. M. & ALTMAN, D. G. 2010. Statistical methods for assessing agreement between two methods of clinical measurement. *International Journal of Nursing Studies*, 47, 937-936.
- BMJ. 2010. Cambodia cracks down on illegal drug vendors in bid to counter antimalarial resistance. 340:c2622. Available: <http://www.bmj.com/content/340/bmj.c2622.full>.
- BOJANG, K. A., AKOR, F., CONTEH, L., WEBB, E., BITTAYE, O., CONWAY, D. J., JASSEH, M., WISEMAN, V., MILLIGAN, P. J. & GREENWOOD, B. Two strategies for the delivery of IPTc in an area of seasonal malaria transmission in the Gambia: a randomised controlled trial. *PLoS Med*, 8, e1000409.
- BRIEGER, W. R., SESAY, H. R., ADESINA, H., MOSANYA, M. E., OGUNLADE, P. B., AYODELE, J. O. & ORISASONA, S. A. 2001. Urban malaria treatment behaviour in the context of low levels of malaria transmission in Lagos, Nigeria. *Afr J Med Med Sci*, 30 Suppl, 7-15.
- BUABENG, K. O., DUWIEJUA, M., MATÖWE, L. K., SMITH, F. & ENLUND, H. 2008. Availability and choice of antimalarials at medicine outlets in Ghana: the question of access to effective medicines for malaria control. *Clin Pharmacol Ther*, 84, 613-9.
- CDUS 2002. *Community drug use practices in malaria in Cambodia: a cross-sectional study*, Phnom Penh, Cambodia, European Commission Cambodian Malaria Control Programme, National Centre for Parasitology Entomology and Malaria Control, USAID, Wellcome Trust Mahidol Oxford Tropical Medical Research Programme and WHO,.
- CHAI 2007. *Tanzania Pilot ACT Subsidy: report on preliminary findings*, Government of the United Republic of Tanzania and the Clinton Health Access Initiative,.

- CHAI 2008a. *Review of the private sector anti-malarial market in Tanzania*, New York, Clinton Health Access Initiative,.
- CHAI 2008b. *Tanzania Pilot ACT Subsidy: report on findings*, Government of the United Republic of Tanzania and Clinton Health Access Initiative,.
- CHAI 2008c. *Understanding the private sector anti-malarial market in Zambia*, New York, Clinton Health Access Initiative.
- CHAKRABORTY, S., D'SOUZA, S. A. & NORTHRUP, R. S. 2000. Improving private practitioner care of sick children: testing new approaches in rural Bihar. *Health Policy Plan*, 15, 400-7.
- CHAKRABORTY, S. & FRICK, K. 2002. Factors influencing private health providers' technical quality of care for acute respiratory infections among under-five children in rural West Bengal, India. *Soc Sci Med*, 55, 1579-87.
- CHAMBERLIN, E. 1933. *Theory of monopolistic competition*, Cambridge MA, Harvard University Press.
- CHANDLER, D. 2000. *A history of Cambodia*, Boulder, CO, Westview Press.
- CHUKWUJEKWU, O. 2007. *An Analysis of the Distribution Chain for Malaria-Related Drugs Sold by Retailers in Rural South-Eastern Tanzania*. MSC Public Health Project Report, London School of Hygiene and Tropical Medicine.
- CHURCH, J. & WARE, R. 2000. *Industrial Organization: A Strategic Approach*, Boston, The McGraw-Hill Companies.
- CIA 2009. *The World Factbook 2009*, Washington, DC, Central Intelligence Agency.
- CMBS 2004 *Cambodia National Malaria Baseline Survey 2004*, Phnom Penh, Cambodia, National Institute of Public Health and Malaria Consortium,.
- CMS 2007 *Cambodia Malaria Survey Report*, Phnom Penh, Cambodia, National Institute of Public Health and Malaria Consortium,.
- CNM 2000. *Treatment guidelines for malaria in the Kingdom of Cambodia*, Phnom Penh, National Centre for Parasitology Entomology and Malaria Control Programme.
- CNM 2008. *Treatment guidelines for malaria in the Kingdom of Cambodia*, Phnom Penh, National Centre for Parasitology Entomology and Malaria Control Programme.
- CNM 2009a. *Annual Report 2009*, Phnom Penh, Cambodia, National Centre for Parasitology Entomology & Malaria Control,.
- CNM 2009b. *National malaria control programme. Monitoring and evaluation plan 2009-2014*, Phnom Penh, Cambodia, National Centre for Parasitology Entomology & Malaria Control,.
- COASE, R. H. 1937. The nature of the firm. *Economica*, 6.
- COAST, J., MCDONALD, R. & BAKER, R. 2004. Issues arising from the use of qualitative methods in health economics. *J Health Serv Res Policy*, 9, 171-176.

- COHEN, J. M., SABOT, O., SABOT, K., GORDON, M., GROSS, I., BISHOP, D., ODHIAMBO, M., IPUGE, Y., WARD, L., MWITA, A. & GOODMAN, C. 2010. A pharmacy too far? Equity and spatial distribution of outcomes in the delivery of subsidized artemisinin-based combination therapies through private drug shops. *BMC Health Serv Res*, 10 Suppl 1, S6.
- CONTEH, L. & HANSON, K. 2003. Methods for studying private sector supply of public health products in developing countries: a conceptual framework and review. *Soc Sci Med*, 57, 1147-61.
- DANZON, P. M. & CHAO, L.-W. 2000. Does Regulation Drive out Competition in Pharmaceutical Markets? *Journal of Law and Economics*, 43, 311-357.
- DEMSETZ, H. 1973. Industry Structure, Market Rivalry, and Public Policy. *Journal of Law and Economics*, 16, 1-9.
- DHS 2005 *Demographic and Health Survey 2005*, Phnom Penh, Cambodia, National Institute of Public Health, National Institute of Statistics and ORC Macro.
- DONDORP, A. M., NEWTON, P. N., MAYXAY, M., VAN DAMME, W., SMITHUIS, F. M., YEUNG, S., PETIT, A., LYNAM, A. J., JOHNSON, A., HIEN, T. T., MCGREADY, R., FARRAR, J. J., LOOAREESUWAN, S., DAY, N. P., GREEN, M. D. & WHITE, N. J. 2004. Fake antimalarials in Southeast Asia are a major impediment to malaria control: multinational cross-sectional survey on the prevalence of fake antimalarials. *Trop Med Int Health*, 9, 1241-6.
- DONDORP, A. M., NOSTEN, F., YI, P., DAS, D., PHYO, A. P., TARNING, J., LWIN, K. M., ARIEY, F., HANPITHAKPONG, W., LEE, S. J., RINGWALD, P., SILAMUT, K., IMWONG, M., CHOTIVANICH, K., LIM, P., HERDMAN, T., AN, S. S., YEUNG, S., SINGHASIVANON, P., DAY, N. P., LINDEGARDH, N., SOCHEAT, D. & WHITE, N. J. 2009. Artemisinin resistance in *Plasmodium falciparum* malaria. *N Engl J Med*, 361, 455-67.
- DRANOVE, D. & SATTERTHWAITE, M. 1992. Monopolistic competition when price and quality are imperfectly observable. *RAND Journal of Economics*, 23, 518-534.
- DRANOVE, D. & WHITE, W. D. 1998. Emerging issues in the antitrust definition of healthcare markets. *Health Econ*, 7, 167-70.
- DUBOIS, V., TONGLET, R., HOYOIS, P., SUNBAUNAT, K., ROUSSAUX, J. P. & HAUFF, E. 2004. Household survey of psychiatric morbidity in Cambodia. *Int J Soc Psychiatry*, 50, 174-85.
- EWEN, M. & DEY, D. 2005. *Medicines: too costly and too scarce*, Health Action International Europe Available from www.haiweb.org/medicineprices/2005/PricingbriefingpaperFINAL.doc Accessed 22 August 2008.
- FASSIN, D. 1987. Illicit sales of pharmaceuticals in Africa: sellers and clients in the suburbs of Dakar. *Tropical and Geographical Medicine*, 40, 166-170.
- FOLLAND, S., GOODMAN, A. C. & STANO, M. 2004. *The Economics of Health and Health Care*, Upper Saddle River, New Jersey, Pearson Prentice Hall.

- FOSTER, S. D. 1991. Pricing, distribution, and use of antimalarial drugs. *Bull World Health Organ*, 69, 349-63.
- FOSTER, S. D. 1995. Treatment of malaria outside the formal health services. *J Trop Med Hyg*, 98, 29-34.
- GAYNOR, M. 2006. Competition and Quality in Health Care Markets, Foundations and Trends in Microeconomics.
- GAYNOR, M., MORENO-SERRA, R. & PROPPER, C. 2010. *Death by market power. Reform, competition and patient outcomes in the National Health Service*, Bristol, Centre for Market and Public Organisation. Bristol Institute of Public Affairs.
- GAYNOR, M. & VOGT, W. B. 2000. Antitrust and Competition in Health Care Markets. In: CULYER, A. J. & NEWHOUSE, J. P. (eds.) *Handbook of Health Economics, Volume I*. Elsevier Science B.V.
- GEISSLER, P. W., NOKES, K., PRINCE, R. J., ODHIAMBO, R. A., AAGAARD-HANSEN, J. & OUMA, J. H. 2000. Children and medicines: self-treatment of common illnesses among Luo schoolchildren in western Kenya. *Soc Sci Med*, 50, 1771-83.
- GILBERT, R. 1989. Mobility barriers and the value of incumbency. In: SCHMALENSEE, R. A. W., R.D (ed.) *Handbook of Industrial Organization Volume 1*. Elsevier Science Publishers B.V.
- GOODMAN, C., BRIEGER, W., UNWIN, A., MILLS, A., MEEK, S. & GREER, G. 2007. Medicine sellers and malaria treatment in sub-Saharan Africa: what do they do and how can their practice be improved? *Am J Trop Med Hyg*, 77, 203-18.
- GOODMAN, C., KACHUR, S. P., ABDULLA, S., BLOLAND, P. & MILLS, A. 2009. Concentration and drug prices in the retail market for malaria treatment in rural Tanzania. *Health Econ*, 18, 727-742.
- GOODMAN, C., KACHUR, S. P., ABDULLA, S., MWAGENI, E., NYONI, J., SCHELLENBERG, J. A., MILLS, A. & BLOLAND, P. 2004. Retail supply of malaria-related drugs in rural Tanzania: risks and opportunities. *Trop Med Int Health*, 9, 655-63.
- GOODMAN, C. A. 2004. *An Economic analysis of the retail market for fever and malaria treatment in rural Tanzania*. PhD Thesis, London School of Hygiene and Tropical Medicine, University of London.
- GREEN, J. & THOROGOOD, N. 2004. *Qualitative Methods for Health Research*, London, SAGE Publications.
- GRUNDY, J., KHUT, Q. Y., OUM, S., ANNEAR, P. & KY, V. 2009. Health system strengthening in Cambodia-a case study of health policy response to social transition. *Health Policy*, 92, 107-15.
- HAMEL, M. J., ODHACHA, A., ROBERTS, J. M. & DEMING, M. S. 2001. Malaria control in Bungoma District, Kenya: a survey of home treatment of children with fever, bednet use and attendance at antenatal clinics. *Bull World Health Organ*, 79, 1014-23.

- HETZEL, M. W. 2007. *Access to prompt and effective malaria treatment in the Kilombero Valley, Tanzania*. Doktors der Philosophie, Philosophisch-Naturwissenschaftlichen Fakultät der Universität Basel.
- HOTELLING, H. 1929. Stability in competition. *Economic Journal*, 39.
- IFC 2008. *The Business of Health in Africa: Partnering with the Private Sector to Improve People's Lives*, International Finance Corporation, World Bank Group.
- INTERNATIONAL FINANCE CORPORATION 2008. *The Business of Health in Africa: Partnering with the Private Sector to Improve People's Lives*, World Bank Group.
- IOM 2004. *Saving Lives, Buying Time: Economics of Malaria drugs in an Age of Resistance*, Washington, DC, Institute of Medicine, National Academy Press.
- JULL, S. & FRYDENBERG, M. 2010. *An introduction to STATA for health researchers*, STATA Press.
- KACHUR, S. P., BLACK, C., ABDULLA, S. & GOODMAN, C. 2006. Putting the genie back in the bottle? Availability and presentation of oral artemisinin compounds at retail pharmacies in urban Dar-es-Salaam. *Malar J*, 5, 25.
- KANGWANA, B. B., NJOGU, J., WASUNNA, B., KEDENGE, S. V., MEMUSI, D. N., GOODMAN, C. A., ZUROVAC, D. & SNOW, R. W. 2009. Malaria drug shortages in Kenya: a major failure to provide access to effective treatment. *Am J Trop Med Hyg*, 80, 737-8.
- KANGWANA, B. P., KEDENGE, S. V., NOOR, A. M., ALEGANA, V. A., NYANDIGISI, A. J., PANDIT, J., FEGAN, G. W., TODD, J. E., BROOKER, S., SNOW, R. W. & GOODMAN, C. A. 2011. The Impact of Retail-Sector Delivery of Artemether-Lumefantrine on Malaria Treatment of Children under Five in Kenya: A Cluster Randomized Controlled Trial. *PLoS Med*, 8, e1000437.
- KAUR, H., GOODMAN, C., THOMPSON, E., THOMPSON, K. A., MASANJA, I., KACHUR, S. P. & ABDULLA, S. 2008. A nationwide survey of the quality of antimalarials in retail outlets in Tanzania. *PLoS One*, 3, e3403.
- KESSEL, R. 1958. Price discrimination in medicine. *Journal of Law and Economics*, 1, 20-53.
- KINDERMANS, J. M., VANDENBERGH, D., VREEKE, E., OLLIARO, P. & D'ALTILIA, J. P. 2007. Estimating antimalarial drugs consumption in Africa before the switch to artemisinin-based combination therapies. *Malar J*, 6, 91.
- KIRKWOOD, B. & STERNE, J. 2003. *Medical Statistics*, Oxford, Blackwell Publishing.
- KLOOS, H., CHAMA, T., ABEMO, D., TSADIK, K. G. & BELAY, S. 1986. Utilization of pharmacies and pharmaceutical drugs in Addis Ababa, Ethiopia. *Soc Sci Med*, 22, 653-72.
- KONE, C. G., NDONKY, A., LALOU, R. & LE HESRAN, J.-Y. 2007. ACT subventionees en vente dans les officines privees: experience du Senegal. *Affordable Medicine Facility - Malaria: Technical Proposal to Increase Access to Malaria Medicines. Background paper 7 Summary of Field Research* RBM Secretariat.

- KRAUSE, G. & SAUERBORN, R. 2000. Comprehensive community effectiveness of health care. A study of malaria treatment in children and adults in rural Burkina Faso. *Ann Trop Paediatr*, 20, 273-82.
- LAING, R. 2006. *Price, availability and affordability of medicines: international comparison in 30 countries*, Available from www.dfidhealthrc.org/meta/documents/MeTAresearchmtgannex1RL.ppt Accessed 22 August 2008.
- LANCASTER, K. 1990. The economics of product variety: a survey. *Marketing Science*, 9, 189-206.
- LEVISON, L. 2002. Policy and programming options for reducing the procurement costs of essential medicines in developing countries (unpublished work - Masters paper).
- LEVISON, L. 2006. *Investigating price components: medicine costs between procurement and point of delivery. report on initial field studies.*
- LON, C. T., TSUYUOKA, R., PHANOUVONG, S., NIVANNA, N., SOCHEAT, D., SOKHAN, C., BLUM, N., CHRISTOPHEL, E. M. & SMINE, A. 2006. Counterfeit and substandard antimalarial drugs in Cambodia. *Trans R Soc Trop Med Hyg*, 100, 1019-24.
- MARSH, V. M., MUTEMI, W. M., MUTURI, J., HAALAND, A., WATKINS, W. M., OTIENO, G. & MARSH, K. 1999. Changing home treatment of childhood fevers by training shop keepers in rural Kenya. *Trop Med Int Health*, 4, 383 - 389.
- MARSH, V. M., MUTEMI, W. M., WILLETTS, A., BAYAH, K., WERE, S., ROSS, A. & MARSH, K. 2004. Improving malaria home treatment by training drug retailers in rural Kenya. *Trop Med Int Health*, 9, 451-60.
- MAUDE, R. J., WOODROW, C. J. & WHITE, L. J. 2010. Artemisinin Antimalarials: Preserving the "Magic Bullet". *Drug Dev Res*, 71, 12-19.
- MAYHEW, S., NZAMBI, K., PEPIN, J. & ADJEI, S. 2001. Pharmacists' role in managing sexually transmitted infections: policy issues and options for Ghana. *Health Policy Plan*, 16, 152-60.
- MCCOMBIE, S. C. 1996. Treatment seeking for malaria: a review of recent research. *Soc Sci Med*, 43, 933-45.
- MEESEN, B., BIGDELI, M., CHHENG, K., DECOSTER, K., IR, P., MEN, C. & VAN DAMME, W. 2011. Composition of pluralistic health systems: how much can we learn from household surveys? An exploration in Cambodia. *Health Policy and Planning*, 26, i30-i44.
- MEINERS, C., SAGAON-TEYSSIER, L., HASENCLEVER, L. & MOATTI, J. P. 2011. Modeling HIV/AIDS drug price determinants in Brazil: is generic competition a myth? *PLoS ONE*, 6, e23478.
- META 2007. *Analysis of the public, private and mission sector supply chains for essential drugs in Zambia (first draft)*, London, Medicines Transparency Alliance, DFID Health Resource Center.
- MMV 2007. *Understanding the anti-malarial market: Uganda 2007. An overview of the supply side*, Geneva, Medicines for Malaria Venture.

- MOH 2001. *Study report on counterfeit and substandard drugs in Cambodia*, Phnom Penh, Ministry of Health.
- MOH 2003. *Pharmaceutical Sector Strategic Plan 2005-2010*, Phnom Penh, Ministry of Health.
- MOH 2004a. *Medicine pricing survey report for Uganda*, Kampala, Health Action International and The World Health Organization.
- MOH 2004b. *Second study report on counterfeit and fake drugs in Cambodia*, Phnom Penh, Ministry of Health.
- MOH 2008. *Health Strategic Plan 2008-2015*, Phnom Penh, Ministry of Health.
- MOH 2009. *National Health Statistics Report 2008*, Phnom Penh, Ministry of Health.
- MOLYNEUX, C. S., MUNG'ALA-ODERA, V., HARPHAM, T. & SNOW, R. W. 1999. Maternal responses to childhood fevers: a comparison of rural and urban residents in coastal Kenya. *Trop Med Int Health*, 4, 836-45.
- MORIYA, A., VOGT, W. & GAYNOR, M. 2010. Hospital prices and market structure in the hospital and insurance industries. *Health Economics, Policy and Laws*, 5.
- MYHR, K. 2000. *Comparing prices of essential drugs between four countries in east Africa and with international prices*, Geneva, Médecins Sans Frontières. Available from <http://www.accessmed-msf.org/resources/key-publications/key-publication-detail/article/comparing-prices-of-essential-drugs-between-four-countries-in-east-africa-with-international-prices> Accessed 22 August 2008.
- NAKAMBA, P., HANSON, K. & MCPAKE, B. 2002. Markets for hospital services in Zambia. *Int J Health Plann Manage*, 17, 229-47.
- NAKYANZI J, KITUTI F, ORIA H & KAMBA P 2009. Expiry of medicines in supply outlets in Uganda. *Bull World Health Organ*, 88.
- NDYOMUGYENYI, R., NEEMA, S. & MAGNUSSEN, P. 1998. The use of formal and informal services for antenatal care and malaria treatment in rural Uganda. *Health Policy Plan*, 13, 94-102.
- NELSON, P. 1970. Information and consumer behaviour. *Journal of Political Economy*, 78.
- NELSON, P. 1974. Advertising as information. *Journal of Political Economy*, 82, 729-754.
- NETZ, J. S. & TAYLOR, B. A. 2002. Maximum or minimum differentiation? location patterns of retail outlets. *The Review of Economics and Statistics*, 84.
- NEWSON, R. 2002. Parameters behind "nonparametric" statistics: Kendall's tau, Somers' D and median differences. *The Stata Journal*, 2, 45-64.
- NEWTON, P., PROUX, S., GREEN, M., SMITHUIS, F., ROZENDAAL, J., PRAKONGPAN, S., CHOTIVANICH, K., MAYXAY, M., LOOAREESUWAN, S., FARRAR, J., NOSTEN, F. & WHITE, N. J. 2001. Fake artesunate in southeast Asia. *Lancet*, 357, 1948-50.
- NEWTON, P. N., FERNANDEZ, F. M., PLANCON, A., MILDENHALL, D. C., GREEN, M. D., ZIYONG, L., CHRISTOPHEL, E. M., PHANOUVONG, S., HOWELLS, S., MCINTOSH, E., LAURIN, P.,

- BLUM, N., HAMPTON, C. Y., FAURE, K., NYADONG, L., SOONG, C. W., SANTOSO, B., ZHIGUANG, W., NEWTON, J. & PALMER, K. 2008. A collaborative epidemiological investigation into the criminal fake artesunate trade in South East Asia. *PLoS Med*, 5, e32.
- NIS 2008. *General Population Census of Cambodia 2008: National Report on Final Census Results*, Phnom Penh, Cambodia, National Institute of Statistics and Ministry of Planning.
- NIS 2009. *Nation-wide establishment listing of Cambodia*, Phnom Penh, National Institute of Statistics, Ministry of Planning.
- NJAU, J. D., GOODMAN, C., KACHUR, S. P., PALMER, N., KHATIB, R. A., ABDULLA, S., MILLS, A. & BLOLAND, P. 2006. Fever treatment and household wealth: the challenge posed for rolling out combination therapy for malaria. *Trop Med Int Health*, 11, 299-313.
- NOEDL, H. 2005. Artemisinin resistance: how can we find it? *Trends Parasitol*, 21, 404-5.
- NOLL, R. 1989. Economic perspectives on the politics of regulation. In: WILLIG, R. S. A. R. D. (ed.) *Handbook of Industrial Organization*. Elsevier Science Publishers B.V.
- NSHAKIRA, N., KRISTENSEN, M., SSALI, F. & WHYTE, S. R. 2002. Appropriate treatment of malaria? Use of antimalarial drugs for children's fevers in district medical units, drug shops and homes in eastern Uganda. *Trop Med Int Health*, 7, 309-16.
- O'CONNELL, K. A., GATAKAA, H., POYER, S., NJOGU, J., EVANCE, I., MUNROE, E., SOLOMON, T., GOODMAN, C., HANSON, K., ZINSO, C., AKULAYI, L., RAHARINJATOVO, J., AROGUNDADE, E., BUYUNGO, P., MPASELA, F., SOPOH, M. O., AGBANGO, J. A., RAMAROSANDRATANA, B. F., EZEDINACHI, E., LUGEMWA, M., HAMAENZA, B., CHAPMAN, S., SHEWCHUK, T. & CHAVASSE, D. in press. Got ACTs? Availability, price, market share and provider knowledge of antimalarial medicines in public and private sector outlets in six malaria-endemic countries. *Malar J*.
- OKORO, B. A. & JONES, I. O. 1995. Pattern of drug therapy in home management of diarrhoea in rural communities of Nigeria. *J Diarrhoeal Dis Res*, 13, 151-4.
- ONWUJEKWE, O., UZOCHUKWU, B., EZE, S., OBIKEZE, E., OKOLI, C. & OCHONMA, O. 2008. Improving equity in malaria treatment: relationship of socio-economic status with health seeking as well as with perceptions of ease of using the services of different providers for the treatment of malaria in Nigeria. *Malar J*, 7, 5.
- OZAWA, S. & WALKER, D. G. 2011. Comparison of trust in public vs private health care providers in rural Cambodia. *Health Policy Plan*, 26 Suppl 1, i20-9.
- PALAFOX, B., PATOUILARD, E., TOUGHER, S., GOODMAN, C. & HANSON, K. 2009. *The private commercial sector distribution chain for malaria treatment in Nigeria: findings from a rapid survey*. Available at <http://www.actwatch.info>.
- PALAFOX, B., PATOUILARD, E., TOUGHER, S., GOODMAN, C. & HANSON, K. 2011. *Supply Chain Survey Results. Zambia. August 2011 (draft)*, ACTwatch Group.
- PERRY, M. K. 1989. Vertical Integration: Determinants and Effects. In: SCHMALENSEE, R. & WILLIG, R. D. (eds.) *Handbook of Industrial Organization*. Elsevier Science Publishers.

- POPE, C. & MAYS, N. 1995. Reaching the parts other methods cannot reach: an introduction to qualitative methods in health and health services research. *BMJ*, 311, 42-5.
- PROPPER, C., BURGESS, S. & GREEN, K. 2004. Does competition between hospitals improve the quality of care?: Hospital death rates and the NHS internal market. *Journal of Public Economics*, 88, 1247-1272.
- PSI 2003. *Findings from the Willingness-to-Pay for Malarine Survey*.
- PSI 2007. *Cambodia MAP Study Evaluating the Coverage and Quality of Malaria Prevention and Treatment in Endemic Areas*, Phnom Penh, Population Services International.
- PSI 2008a. *ACTwatch: Outlet and Household survey study designs for Cambodia*, Phnom Penh.
- PSI 2008b. *ACTwatch: Outlet Survey Study Design*.
- PSI 2008c. Stratification and Sampling Methodology for ACTwatch in Cambodia.
- RAJAKARUNA, R. S., WEERASINGHE, M., ALIFRANGIS, M., AMERASINGHE, P. H. & KONRADSEN, F. 2006. The role of private drug vendors as malaria treatment providers in selected malaria endemic areas of Sri Lanka. *J Vector Borne Dis*, 43, 58-65.
- RBM 2007. *Affordable Medicine Facility - Malaria, Technical proposal to increase access to malaria medicines: Background paper 7 Summary of Field Research*, Roll Back Malaria Secretariat.
- ROPER, C., PEARCE, R., NAIR, S., SHARP, B., NOSTEN, F. & ANDERSON, T. 2004. Intercontinental spread of pyrimethamine-resistant malaria. *Science*, 305, 1124.
- ROZENDAAL, J. 2001. Fake antimalarial drugs in Cambodia. *Lancet*, 357, 890.
- RUEBUSH, T. K., KERN, M. K., CAMPBELL, C. C. & OLOO, A. J. 1995. Self-treatment of malaria in a rural area of western Kenya. *Bull World Health Organ*, 73, 229-36.
- RUSSO, G. 2007. *Medicine Prices in Mozambique: a study of determinants and policy options*. Doctor in Public Health, University of London.
- RUSSO, G. & MCPAKE, B. 2010. Medicine prices in urban Mozambique: a public health and economic study of pharmaceutical markets and price determinants in low-income settings. *Health Policy Plan*, 25, 70-84.
- RUTEBEMBERWA, E., NSABAGASANI, X., PARIYO, G., TOMSON, G., PETERSON, S. & KALLANDER, K. 2009. Use of drugs, perceived drug efficacy and preferred providers for febrile children: implications for home management of fever. *Malar J*, 8, 131.
- SABOT, O., YEUNG, S., PAGNONI, F., GORDON, M., PETTY, N., SCHMITS, K. & TALISUNA, A. 2008. Distribution of artemisinin-based combination therapies through private sector channels: lessons from four country case studies.
- SABOT, O. J., MWITA, A., COHEN, J. M., IPUGE, Y., GORDON, M., BISHOP, D., ODHIAMBO, M., WARD, L. & GOODMAN, C. 2009. Piloting the global subsidy: the impact of subsidized artemisinin-based combination therapies distributed through private drug shops in rural Tanzania. *PLoS One*, 4, e6857.

- SACHS, J. & MALANEY, P. 2002. The economic and social burden of malaria. *Nature*, 415, 680-5.
- SALAKO, L. A., BRIEGER, W. R., AFOLABI, B. M., UMEH, R. E., AGOMO, P. U., ASA, S., ADENEYE, A. K., NWANKWO, B. O. & AKINLADE, C. O. 2001. Treatment of childhood fevers and other illnesses in three rural Nigerian communities. *J Trop Pediatr*, 47, 230-8.
- SCHAFFER, J. L. 1999. Multiple imputation: a primer. *Stat Methods Med Res*, 8, 3-15.
- SCHERER, F. M. 2000. The pharmaceutical industry. Chapter 25. In: A.J CULYER AND J.P NEWHOUSE (ed.) *Handbook of Health Economics*. Amsterdam: Elsevier.
- SCHERER, F. M. & ROSS, D. 1990. *Industrial Market Structure and Economic Performance*, Boston, Houghtin Mifflin Company.
- SCHWARTZ, J. B. & BHUSHAN, I. 2004. Improving immunization equity through a public-private partnership in Cambodia. *Bull World Health Organ*, 82, 661-7.
- SHAH, N. M., BRIEGER, W. R. & PETERS, D. H. 2011. Can interventions improve health services from informal private providers in low and middle-income countries?: a comprehensive review of the literature. *Health Policy Plan*, 26, 275-87.
- SHRETTA, R. & GUIMIER, J. M. 2003. *Flow of antimalarial drugs in the public and private sector, affordability and discussions of potential strategies to improve financial access*, Arlington, Management Sciences for Health.
- SMITH, F. 2009. Private local pharmacies in low- and middle-income countries: a review of interventions to enhance their role in public health. *Trop Med Int Health*, 14, 362-72.
- SMITH, L. A., JONES, C., MEEK, S. & WEBSTER, J. 2009. Review: Provider practice and user behavior interventions to improve prompt and effective treatment of malaria: do we know what works? *Am J Trop Med Hyg*, 80, 326-35.
- SNOW, R. W., PESHU, N., FORSTER, D., MWENESI, H. & MARSH, K. 1992. The role of shops in the treatment and prevention of childhood malaria on the coast of Kenya. *Trans R Soc Trop Med Hyg*, 86, 237-9.
- SORENSEN, A. T. 2000. Equilibrium Price Dispersion in Retail Markets for Prescription Drugs. *The Journal of Political Economy*, 108, 833-850.
- SPENGLER, J. J. 1950. Vertical Integration and Antitrust Policy. *The Journal of Political Economy*, 58, 347-352.
- STATA INC. 2003. *Survey Data Reference Manual*, Stata Press.
- STATA CORP. 2009. *Stata Survey Data Reference Manual. Release 11*, College Station, Texas, Stata Press.
- STIGLITZ, J. E. & WALSH, C. E. 2002. *Principles of Microeconomics*, New York, W.W. Norton & Company.
- TAGBO, O. & HENRIETTA, U. O. 2007. Comparison of clinical, microscopic and rapid diagnostic test methods in the diagnosis of Plasmodium falciparum malaria in Enugu, Nigeria. *Niger Postgrad Med J*, 14, 285-9.

- TALISUNA, A., GREWAL, P., RWAKIMARI, J. B., MUKASA, S., JAGOE, G. & BANERJI, J. 2009. Cost is killing patients: subsidising effective antimalarials. *Lancet*, 374, 1224-6.
- TAVROW, P., SHABAHANG, J. & MAKAMA, S. 2003. Vendor-to-vendor education to improve malaria treatment by private drug outlets in Bungoma District, Kenya. *Malar J*, 2, 10.
- TAWFIK 2006. *Mosquitoes, Malaria and Malarine. A qualitative study on malaria drug use in Cambodia*, Arlington, VA, Management Sciences for Health USAID.
- THE GLOBAL FUND 2011. *List of malaria pharmaceutical products classified according to the Global Fund quality assurance policy*, Available at <http://www.theglobalfund.org/en/procurement/quality/pharmaceutical/> Accessed 5 October 2011.
- TIROLE, J. 1988. *The Theory of Industrial Organization*, Massachusetts Institute of Technology
- TOUGHER, S., PATOUILLARD, E., PALAFOX, B., GOODMAN, C. & HANSON, K. 2009. *The private commercial sector distribution chain for malaria treatment in Benin: findings from a rapid survey*. Available at <http://www.actwatch.info>.
- TREN, R. & HESS, K. 2011. Measuring the AMFm. *Lancet*, 377, 810; author reply 810-1.
- TUAN, T., DUNG, V. T., NEU, I. & DIBLEY, M. J. 2005. Comparative quality of private and public health services in rural Vietnam. *Health Policy Plan*, 20, 319-27.
- U.S. DEPARTMENT OF JUSTICE & FEDERAL TRADE COMMISSION 2010. Horizontal Merger Guidelines.
- UN MILLENNIUM PROJECT 2005. *Investing in Development: A Practical Plan to Achieve the Millenium Development Goals*, New York.
- URC-MCC 2009. *Baseline Surveys along the Cambodian - Thai border*, Phnom Penh, USAID.
- VAN DAMME, W., VAN LEEMPUT, L., POR, I., HARDEMAN, W. & MEESEN, B. 2004. Out-of-pocket health expenditure and debt in poor households: evidence from Cambodia. *Trop Med Int Health*, 9, 273-80.
- VAN DER GEEST, S. 1987. Self-care and the informal sale of drugs in south Cameroon. *Soc Sci Med*, 25, 293-305.
- VAN DER GEEST, S. & HARDON, A. 1988. Drugs use: methodological suggestions for field research in developing countries. *Health Policy and Planning*, 3, 152-158.
- VARIAN, H. 1989. Chapter 10. Price discrimination. In: R.SCHMALENSEE AND R.D WILLIG (ed.) *Handbook of Industrial Organization*. Elsevier Science Publishers B.V.
- VARIAN, H. 1999. *Intermediate Microeconomics*, New York, W.W Norton & Company.
- VERDRAGER, J. 1986. Epidemiology of the emergence and spread of drug-resistant falciparum malaria in South-East Asia and Australasia. *J Trop Med Hyg*, 89, 277-89.
- VICKERS, J. & WATERSON, M. 1991. Vertical Relationships: An Introduction. *The Journal of Industrial Economics*, 39, 445-450.

- WAFULA, F. N. & GOODMAN, C. A. 2010. Are interventions for improving the quality of services provided by specialized drug shops effective in sub-Saharan Africa? A systematic review of the literature. *Int J Qual Health Care*, 22, 316-23.
- WANG, R. 2006. Price competition in the Chinese pharmaceutical market. *Journal of Health Care Finance and Economics*, 6.
- WHITTY, C., HOPKINS, H., ANSAH, E., LESLIE, T. & REYBURN, H. 2008a. *Opportunities and threats in targeting antimalarials for the AMFm: the role of diagnostics* Washington, DC, Resources For The Future.
- WHITTY, C. J., CHANDLER, C., ANSAH, E., LESLIE, T. & STAEDKE, S. G. 2008b. Deployment of ACT antimalarials for treatment of malaria: challenges and opportunities. *Malar J*, 7 Suppl 1, S7.
- WHO 2007. *Medicine Prices: a new approach to measurement*, Geneva, World Health Organization.
- WHO 2010a. *Global report on antimalarial drug efficacy and drug resistance: 2000-2010*, Geneva, World Health Organization.
- WHO 2010b. *Guidelines for the treatment of malaria - Second Edition*, Geneva, World Health Organisation.
- WHO 2010c. *World Malaria Report 2010*, Geneva, World Health Organization.
- WHO & HAI 2008. *Measuring medicine prices, availability, affordability and price components Second Edition* [<http://apps.who.int/medicinedocs/index/assoc/s14868e/s14868e.pdf>], World Health Organization and Health Action International.
- WILLIAMS, H. A. & JONES, C. O. 2004. A critical review of behavioral issues related to malaria control in sub-Saharan Africa: what contributions have social scientists made? *Soc Sci Med*, 59, 501-23.
- WILLIAMSON, O. E. 1979. Transaction cost economics: the governance of contractual relations. *Journal of Law and Economics*, 22.
- WORLD BANK. 2010. *Poverty Measures 2010* [Online]. Available: <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/0,,contentMDK:22568112~pagePK:210058~piPK:210062~theSitePK:336992,00.html>, [Accessed 11 Octobre 2010].
- YADAV, P. 2007. *Analysis of the public, private and mission sector supply chains for essential drugs in Zambia*, London, DFID Health Resource Centre.
- YADAV, P. & CONESA, S. 2008. *Uganda antimalarial markets: Preliminary Analysis*, Technical Report for the the Medicines Transparency Alliance.
- YADAV, P. & ONGOLA, M. 2007. Analysis of Complementary Supply Chain Interventions' and 'Estimating Private-Sector Demand for Anti-Malarials in Ghana, Uganda and Zambia Using Household Consumption Expenditures and Willingness-to-Pay Estimates'. *Affordable Medicines Facility – malaria: Technical Proposal to Increase Access to Malaria Medicines. Background Paper 9*.

- YAMEY, G. & SCHÄFERHOFF, M. 2011. Price Subsidy Schemes for Artemisinin-Based Combination Therapies (ACTs): Do They Work? Available at <http://globalhealthsciences.ucsf.edu/pdf/e2pi-price-subsidy-schemes-for-acts4.pdf>.
- YEUNG, S., PATOUIILLARD, E., ALLEN, H. & SOCHEAT, D. 2011. Socially-marketed rapid diagnostic tests and ACT in the private sector: ten years of experience in Cambodia. *Malar J*, 10, 243.
- YEUNG, S., VAN DAMME, W., SOCHEAT, D., WHITE, N. J. & MILLS, A. 2008. Access to artemisinin combination therapy for malaria in remote areas of Cambodia. *Malar J*, 7, 96.
- ZUROVAC, D., NDHLOVU, M., SIPILANYAMBE, N., CHANDA, P., HAMER, D. H., SIMON, J. L. & SNOW, R. W. 2007. Paediatric malaria case-management with artemether-lumefantrine in Zambia: a repeat cross-sectional study. *Malar J*, 6, 31.
- ZUROVAC, D., NJOGU, J., AKHWALE, W., HAMER, D. H. & SNOW, R. W. 2008. Translation of artemether-lumefantrine treatment policy into paediatric clinical practice: an early experience from Kenya. *Trop Med Int Health*, 13, 99-107.
- ZWANZIGER, J., MELNICK, G. & EYRE, K. M. 1994. Hospitals and antitrust: defining markets, setting standards. *J Health Polit Policy Law*, 19, 423-47.

APPENDICES

APPENDIX 1 Methods for reviewing the range of approaches used for studying markets for pharmaceutical drugs in low and middle income countries

The literature search focused on methods used in studies of markets for pharmaceutical drugs in low and middle income countries. Two types of methods for studying markets were searched: the methods for collecting data (e.g. survey, existing databases) on key variables of a market (e.g. structural aspects including range of providers and products, sales volumes, and elements of provider conduct such as price mark-ups) and methods for analyzing these data (e.g. market concentration measures, price-mark-up determinants).

Methods were identified by searching databases indexing social science studies (Table A-1). Searches were conducted using key terms from database thesaurus, where available and by limiting the search to studies published between January 1980 and December 2010 in English or French. Searches were finalised in January 2011.

Table A-1 Database Search Strategy

Databases	Key terms (free terms, unless specified)
Pubmed	Pharmaceutical preparations ^{†*} , Medicine, Pharmaceutical drug
Embase	Commerce ^{†*}
Econlit	Retail, Wholesale, Distribution chain, Supply chain
IBSS	Private sector [†]
JSTOR	Competition, Economics [†] , Sales [±] , Drug Marketing [±]
Business Source Premier	Mark-up, Profit, Margin

[†]Mesh term under PubMed; ^{*}The term pharmaceutical preparations and Commerce were specific to PubMed; Under other databases, medicine and pharmaceutical drug free words were used in place of pharmaceutical preparations; Commerce refers to the interchange of goods or commodities, especially on a large scale, between different countries or between populations within the same country. It includes trade (the buying, selling, or exchanging of commodities, whether wholesale or retail) and business (the purchase and sale of goods to make a profit); Under the other databases, free key words, including retail, wholesale, distribution chain or supply chain were used. For other key terms, Mesh terms were used as free words, except for Economics which was also an indexed term under Econlit and which was used in combination with terms sales and drug marketing in order to refine results and reduce the number of hits; [±] used under Econlit only

Studies were included if they took place in African, Asian and Latin American low and middle income countries. Studies that looked at one or several aspects of pharmaceutical drug markets (in terms of market structure and provider conduct) were included in the review. Bibliographies of identified studies were checked for additional references.

The grey literature on methods for studying antimalarial markets in low and middle income countries was identified during a workshop on survey methods in developing countries. The workshop was organised in 2008 by the Malaria Medicines Venture, a not-for profit public-private partnership. Staff working in various organisations, including, amongst others, the UK Department of International Development, IMS Health, Malaria Consortium, Population Services International, the University of Harvard, the World Bank and the World Health Organization shared their knowledge and experiences in studying pharmaceutical drug markets in developing country settings. Additional unpublished studies were identified during key informant interviews with staff members of the Clinton Foundation and MIT-Zaragoza International Logistics Program involved in antimalarial market surveys.

APPENDIX 2 Methods for reviewing the empirical evidence on private commercial sector distribution chains

The search strategy aimed to identify published, grey and unpublished studies on the retail distribution chain for malaria treatment in low and middle income countries. Published studies were identified by searching web-based databases, using key terms pertaining to market structure and price mark-ups (Table A-2). Grey and unpublished sources were identified by searching the websites of organisations involved in research related to the distribution chain for malaria treatment in low and middle income countries and contacting key informants within these institutions (the William J. Clinton Foundation, Medicines for Malaria Venture, Dalberg Global Development Advisors, Health Action International Europe, MIT-Zaragoza International Logistics Program). Searches were finalised in September 2011.

Table A-2 Database search strategy

Databases	PubMed	EconLit	IBSS
Key words	Private sector†; Commerce†*; Private providers; Retail sector; Supply chain; Distribution chain Antimalarials†; Malariat; Non-prescription drugst; Prescription drugst; Drugs, essential† Price; Pricing; Mark-up(s); Profit margin; Price component Developing countries†; Africa†; Asia, Western†; Asia, South-eastern†; Latin America†	Private sector; Retail sector; Wholesale; Supply chain; Antimalarials; Pharmaceuticals Price; Pricing; Mark-up(s); Profit margin; Price component	

† Mesh term; *The interchange of goods or commodities, especially on a large scale, between different countries or between populations within the same country. It includes trade (the buying, selling, or exchanging of commodities, whether wholesale or retail) and business (the purchase and sale of goods to make a profit) [<http://www.ncbi.nlm.nih.gov/sites/entrez>, accessed 10 March 2008]. PubMed searches were limited to government publications, journal articles and technical reports.

RESEARCH

Open Access

Retail sector distribution chains for malaria treatment in the developing world: a review of the literature

Edith Patouillard^{1*}, Kara G Hanson¹, Catherine A Goodman^{1,2}

Abstract

Background: In many low-income countries, the retail sector plays an important role in the treatment of malaria and is increasingly being considered as a channel for improving medicine availability. Retailers are the last link in a distribution chain and their supply sources are likely to have an important influence on the availability, quality and price of malaria treatment. This article presents the findings of a systematic literature review on the retail sector distribution chain for malaria treatment in low and middle-income countries.

Methods: Publication databases were searched using key terms relevant to the distribution chain serving all types of anti-malarial retailers. Organizations involved in malaria treatment and distribution chain related activities were contacted to identify unpublished studies.

Results: A total of 32 references distributed across 12 developing countries were identified. The distribution chain had a pyramid shape with numerous suppliers at the bottom and fewer at the top. The chain supplying rural and less-formal outlets was made of more levels than that serving urban and more formal outlets. Wholesale markets tended to be relatively concentrated, especially at the top of the chain where few importers accounted for most of the anti-malarial volumes sold. Wholesale price mark-ups varied across chain levels, ranging from 27% to 99% at the top of the chain, 8% at intermediate level (one study only) and 2% to 67% at the level supplying retailers directly. Retail mark-ups tended to be higher, and varied across outlet types, ranging from 3% to 566% in pharmacies, 29% to 669% in drug shops and 100% to 233% in general shops. Information on pricing determinants was very limited.

Conclusions: Evidence on the distribution chain for retail sector malaria treatment was mainly descriptive and lacked representative data on a national scale. These are important limitations in the advent of the Affordable Medicine Facility for Malaria, which aims to increase consumer access to artemisinin-based combination therapy (ACT), through a subsidy introduced at the top of the distribution chain. This review calls for rigorous distribution chain analysis, notably on the factors that influence ACT availability and prices in order to contribute to efforts towards improved access to effective malaria treatment.

Background

In many low- and middle-income countries, the retail sector plays an important role in the provision of malaria treatment [1-14]. For example, it was the first source of care for around 45% of households seeking malaria treatment across four communities in Enugu State, Nigeria [15] and in three rural districts of

Tanzania nearly 40% of all anti-malarial volumes were dispensed within the retail sector [16]. Retail providers tend to operate closer to homes [15,17-19] and offer a more reliable and wider range of drugs than public health providers [2,11,14,18-20], sometimes at lower costs [14,21-23].

The market for anti-malarial drugs includes artemisinin-based combination therapy (ACT), which is the most effective drug regimen and the official first-line treatment in most developing countries, non-artemisinin drugs, some of which were recommended before the

* Correspondence: Edith.Patouillard@lshtm.ac.uk
¹London School of Hygiene and Tropical Medicine, Keppel Street, London, UK



© 2010 Patouillard et al. licensee BioMed Central Ltd. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/2.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ACT era (e.g. chloroquine, amodiaquine, sulphadoxine-pyrimethamine and quinine), and artemisinin monotherapies. These three product types are available under different formulations including tablets, suppositories, suspensions, syrups and liquid injectables. Some are sold under their proprietary names, and referred to as innovator brands when they are products patented by their originators, or branded generics in the case of generic versions of innovator products marketed under a different name. Others are sold as unbranded generics without a proprietary name.

Within the retail market, these products are sold by a wide range of providers whose characteristics vary substantially across settings. Providers can be pharmacies, drug shops, grocery stores, market stalls or itinerant hawkers. In East and West Africa, drug shops that specialize in handling drugs play a major role, such as in Tanzania where they accounted for 88% of retail sector anti-malarial sales volumes [16]. Mobile vendors are common in West Africa, but are rarely found in East and Southern Africa [24]. Outlets staffed by trained pharmacists are rare in all countries [17,25], and concentrated in urban areas, whilst drug shops can be found in both urban and more densely populated rural areas. Finally, general shops that sell drugs alongside household goods are often the only medicine retailers in more remote rural villages.

Pharmacies are generally authorized to stock both prescription-only drugs and over-the-counter (OTC) products, while other outlets can only sell OTC drugs, although in practice some illegally stock prescription-only medicines [24]. Whilst anti-malarial drug availability is relatively high in the retail sector [19,25-30], the range of anti-malarials is generally lower in outlets which are more remote or have less qualified staff [19,25,28,31]. ACT is rarely available outside facilities and pharmacies because of their high price relative to older, less effective alternatives. For example, in six districts of Zambia, ACT accounted for only 7% of all anti-malarials sold in the retail sector [33] and in Tanzania, the old monotherapy sulphadoxine-pyrimethamine (SP) was the most commonly retailed anti-malarial, followed by artemisinin monotherapies [34]. The availability of artemisinin monotherapies is highly variable, but a major cause of concern as their use is likely to contribute to the development of artemisinin resistance [35].

Other concerns around the quality of care provided in the retail sector relate to retailers' lack of qualifications, poor knowledge of drugs and dosages [36-39], and stocking of unregistered [28,31] and sometimes substandard or counterfeit drugs [6,19,40-44]. Although care provided by pharmacies is far from perfect [45,46], most of these concerns are directed to non-pharmacy outlets. Drug shop staff are rarely qualified pharmacists [47],

having at best a basic nursing background [24,26] or sometimes just secondary education [47]. General retailers have even fewer qualifications and some are illiterate [18,20].

These drug retailers are the last link in a chain of suppliers and their practices are likely to be heavily influenced by what happens further up the distribution chain. Retail availability, for instance, will be affected by which products are available from suppliers, the marketing strategies used to promote certain drugs, and the registration of drugs and regulation of providers further up the chain. Retail prices will be influenced by wholesale prices, and the cost of obtaining and storing goods. Retail quality will be determined by how products have been handled and stored higher up the chain. In turn, the behaviour of suppliers in the chain will be influenced by the nature of competition and regulation that they face.

Understanding the distribution chain for anti-malarials is, therefore, crucial in designing interventions to improve retail sector care. This is of particular importance in the light of the implementation of the Affordable Medicines Facility for Malaria (AMFm), which will rely on existing distribution chains to deliver heavily subsidized ACT to consumers. This article aims to support such initiatives by summarizing the current state of knowledge on the retail sector distribution chain for malaria treatment in low- and middle-income countries.

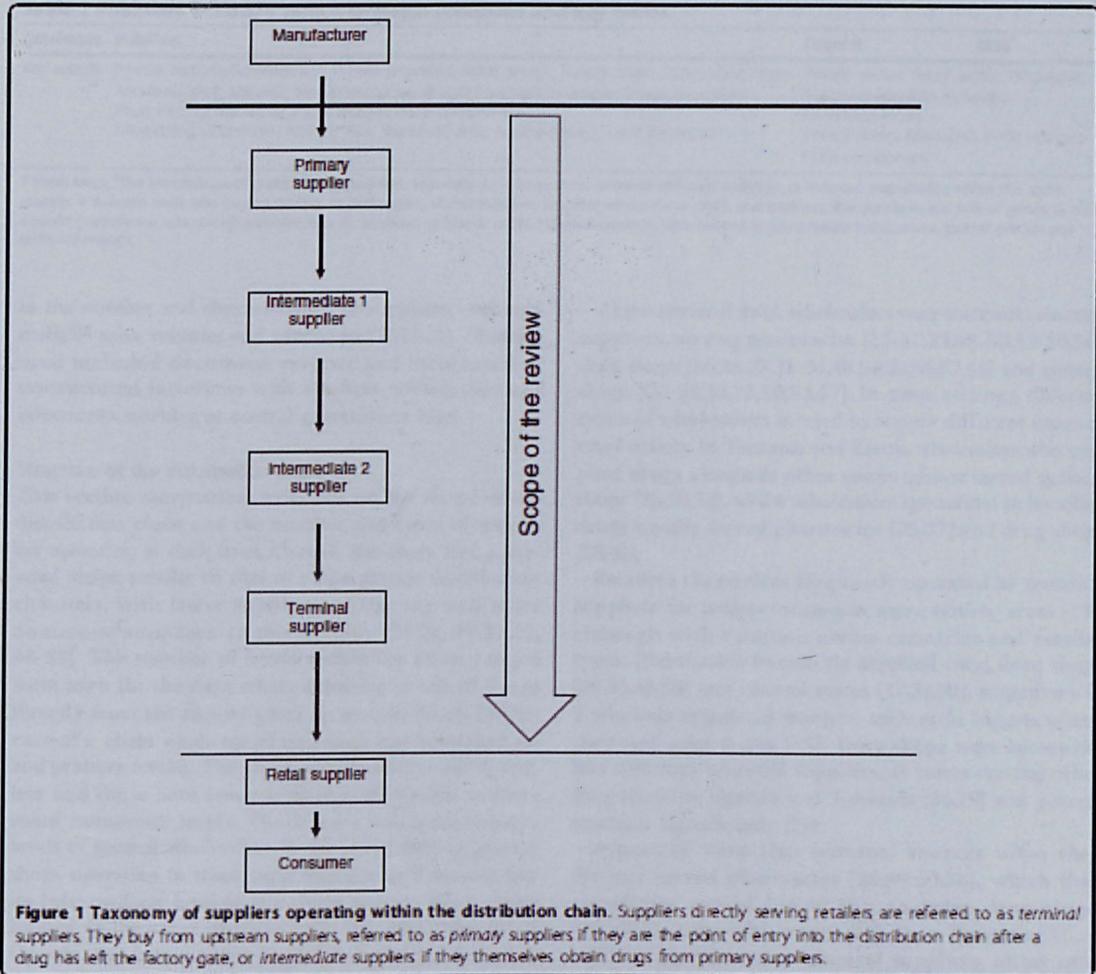
Methods

Scope of the review

The retail sector distribution chain refers to all levels of the in-country distribution chain, in other words to the chain of wholesalers serving the retail sector. The focus is on suppliers who operate from the point where commodities leave the factory gate or port of entry down to those directly supplying retailers. For the purpose of the review, a taxonomy of suppliers was developed (Figure 1). Suppliers who sell directly to retailers are termed *terminal* suppliers. These buy from upstream suppliers, referred to as *primary* suppliers if they are the point of entry into the distribution chain, or *intermediate* suppliers if they themselves obtain drugs from primary suppliers.

Literature search and review strategies

The search strategy aimed to identify published, grey and unpublished studies on the retail sector distribution chain for malaria treatment in low- and middle-income countries. Published studies were identified by searching web-based databases, using key terms pertaining to market structure and price mark-ups (Table 1). Grey and unpublished sources were identified by searching the websites of organizations involved in research related to the distribution chain for malaria treatment in low and



middle income countries and contacting key informants within these institutions (the William J. Clinton Foundation, Medicines for Malaria Venture, Dalberg Global Development Advisors, Health Action International Europe, MIT-Zaragoza International Logistics Program). Searches were finalized in February 2009.

Studies were included if they provided data specifically on anti-malarials for products stocked, volume sold and mark-ups. Studies that looked at the structure of the distribution chain, in terms of supply sources, supplier numbers and characteristics for both anti-malarials and medicines in general were also included on the basis that anti-malarials are expected to follow the same distribution route as other drugs and represent an important share of all drugs distributed in developing countries.

The review focuses on wholesalers but includes two aspects of retailer behaviour relevant to the study of the distribution chain: their sources of supply and the mark-up they add at the retail level. Other aspects of the retail market, such as its structure and operations have been reviewed elsewhere [24]. Studies were excluded if they compared retail prices to international reference prices without any information on price components across distribution chain levels.

Results

Thirty-two references exploring the distribution chain for anti-malarials and pharmaceutical drugs in general were identified. The evidence they provide focuses mainly on supply sources, with limited attention

Table 1 Published literature search strategy: databases and key words

Databases	PubMed	EconLit	IBSS
Key words	Private sector†; Commerce†; Private providers; Retail sector; Supply chain; Distribution chain Anti-malarials; Malaria†; Non-prescription drugs†; Prescription drugs†; Drugs, essential† Price, Pricing; Markup(s); Profit margin; Price component Developing countries†; Africa†; Asia, Western†; Asia, Southeastern†; Latin America†	Private sector; Retail sector; Wholesale; Supply chain; Anti-malarials; Pharmaceuticals	Price; Pricing; Markup(s); Profit margin; Price component

† Mesh term; *The interchange of goods or commodities, especially on a large scale, between different countries or between populations within the same country. It includes trade (the buying, selling, or exchanging of commodities, whether wholesale or retail) and business (the purchase and sale of goods to make a profit) (<http://www.ncbi.nlm.nih.gov/sites/entrez>, accessed 10 March 2008). PubMed searches were limited to government publications, journal articles and technical reports.

to the number and characteristics of suppliers, and anti-malarial sales volumes and mark-ups (Table 2). Methods used included document reviews and structured or unstructured interviews with retailers, wholesalers and informants working at central government level.

Structure of the distribution chain

This section summarizes evidence on the shape of the distribution chain and the number and types of suppliers operating at each level. Overall, the chain had a pyramid shape similar to that of other private distribution channels, with fewer suppliers at the top and more numerous suppliers at the bottom [25,26,29,31,32, 48-55]. The number of levels within the chain ranged from zero (in the case where retailers obtained drugs directly from the factory gate) up to four levels (in the case of a chain made up of terminal, two intermediate and primary levels). The chain serving more remote outlets and those with less qualified staff tended to have more numerous levels. There were two intermediate levels of general wholesalers in the chain serving general shops operating in three rural districts in Tanzania but no intermediate level in the chain serving drug shops located in the same districts [32]. In a rural district of Uganda, two intermediate levels of wholesalers supplied the chain down to general stores and market stalls whilst the chain serving drug shops had a single intermediate level of wholesalers [26].

Data on the total number of suppliers operating at each level of the anti-malarial distribution chain were generally lacking. When available, data mainly concerned registered suppliers of pharmaceutical products in general [25,26,31,48-50,52] and rarely provided information on the total number of suppliers handling anti-malarials [29,32,51,53]. Overall the number of importers operating in a country was reported to range from 1 to 50 [53]. In Burkina Faso, there were 4 private importers and in Uganda 15 importers and 50 wholesalers, with the latter sometimes owned by importers [54]. The type of businesses acting as terminal, intermediate and primary suppliers is described below, although as will become clear, there is considerable overlap between these categories in practice.

At the terminal level, wholesalers were the most common suppliers, serving pharmacies [25-27,33,48-50,52-54,56], drug shops [26,28,29,31-34,48,50,53,54,57,58] and general shops [25-28,32,33,50,53,57]. In some settings, different types of wholesalers tended to supply different types of retail outlets. In Tanzania and Kenya, wholesalers who supplied drugs alongside other commodities served general shops [25,28,32], whilst wholesalers specialized in handling drugs usually served pharmacies [25,27] and drug shops [28,32].

Retailers themselves frequently operated as terminal suppliers for outlets located in more remote areas [13], although with variation across countries and retailer types. Pharmacies frequently supplied rural drug shops [26,31,48,50] and general stores [17,26,50], sometimes in a relatively organized manner, such as in Nigeria where they sent sales teams [17]. Drug shops were somewhat less common terminal suppliers, at times serving other drug shops in Uganda and Tanzania [26,29] and general stores in Uganda only [26].

Importers were also terminal sources when they directly served pharmacies [26,49,50,56], which they sometimes owned [26,49,50], and also drug shops [26,32,50], using sales teams, such as in Tanzania [32].

Public agencies were terminal suppliers, either officially such as in Sri Lanka where the State Pharmaceutical Corporation supplied retail outlets [47] or unofficially in other countries, where government health workers sold public sector drugs to retail shops, such as in Uganda and Cameroon for example [18,19,48].

Terminal suppliers' characteristics were rarely explored. When available, the evidence shows that in Tanzania wholesalers infrequently had any health-related qualifications, although drug specific wholesalers were reported to employ more qualified staff (mainly pharmacy and biochemistry graduates) and to have been in operation for longer than general wholesalers [32].

Information on terminal suppliers' locations shows that overall, remotely located drug shops and general stores obtained their supplies more locally than more accessible retailers. In Zambia, 24% of outlets located in three border districts with DR Congo or Tanzania obtained their drugs from district suppliers and the

Table 2 Overview of the literature

Reference	Distribution chain structure			Anti-malarial products	
	Source of supply	Number of suppliers	Suppliers' characteristics	Volumes sold	Mark-ups
Burkina Faso					
RBM Secretariat, 2007 [77]	X	X	-	-	X
Cambodia					
Institute of Medicine, 2004 [48], Shretta and Guimier, 2003 [55]	X	X	-	-	X
PSI, 2008 [58], Sabot, 2009 [63]	X	-	-	X	X
Rozendaal, 2001 [44]	X	-	-	-	-
Cameroon					
Van der Geest, 1987 ± [19]	X	-	X	-	-
RBM Secretariat, 2007 [54]	X	X	-	-	X
Ghana					
Buabeng et al., 2008 [56]	X	-	-	-	-
Kenya					
Marsh et al., 2004 [57]	X	-	-	-	-
Ministry of Health of the Government of the Republic of Kenya, 2004 [78]	-	-	-	-	X
Myhr, 2000 [61]	-	-	-	-	X
Tavrow, 2003 [25]	X	X	X	-	X
Amin and Snow, 2005 [27]	X	-	-	-	-
Mozambique					
Russo, 2007 ± [49]	X	X	-	-	-
Nigeria					
Adikwu, 1996 ± [17]	X	-	-	-	-
IFC, 2008 ± [52]	X	X	-	-	-
Senegal					
Institute of Medicine, 2004 [48], Shretta and Guimier (2003) [55]	X	X	-	X	X
Kone et al., 2007 [62]	X	-	-	-	X
IFC, 2008 ± [52]	X	X	-	-	-
Sri Lanka					
Rajakaruna et al., 2006 [47]	X	-	-	-	-
Tanzania					
Battersby et al., 2003 [31]	X	X	-	-	X
Goodman, 2004 [20], Chukwujekwu, 2007 [32]	X	X	X	-	X
Clinton Foundation, 2008 [34]	X	-	-	X	X
Government of the Republic of Tanzania and Clinton Foundation, 2008 [29]	X	X	-	X	X
Uganda					
Adome et al., 1996 [18]	X	-	-	-	-
The Republic of Uganda, 2004 [59]	X	-	-	-	X
MMV, 2007 [26]	X	X	-	-	X
Yadav and Conesa, 2008 [51]	-	X	-	-	-
IFC, 2008 ± [52]	X	X	-	-	-
RBM Secretariat, 2007 [54]	X	X	-	-	X

Table 2: Overview of the literature (Continued)

Zambia					
Institute of Medicine, 2004 [48], Shretta and Guimier, 2003 [55]	X	X	-	-	X
Yadav, 2007 ± [50]	X	X	-	X	-
Clinton Foundation, 2008 [33]	X	-	-	-	X
Low/Middle income countries					
Foster, 1991 ± [13]	X	-	-	-	-
Yadav and Ongola, 2007 ± [53]	X	X	-	X	-

± = studies on distribution chain for pharmaceutical drugs in general (other studies are specific to anti-malarials)

same proportion chose to cross borders to buy from Tanzanian or Congolese suppliers [33]. In Tanzania, drug shops generally obtained anti-malarials from drug specific wholesalers or pharmacies located in the capital city, hundreds of kilometres away [28,29,32], whilst those located more than 1,000 kilometres away from the capital city obtained their supplies from more nearby locations [29]. In Uganda and Kenya, general shops usually obtained their supplies from local suppliers [25-27]. In Kenya, the location of general shops' supply sources varied with outlet size, such that large shops where more than one person worked during opening hours obtained their supplies from general wholesalers located inside or outside the district whilst smaller shops where one person worked during opening hours bought more frequently from general wholesalers located within the district [27].

Mobile suppliers, such as sales representatives of drug companies or general distributors, served retailers in many settings, although their popularity and the types of outlets they served varied. In Kenya, mobile vendors commonly supplied both drug and general shops [25,27,57], whilst in Tanzania mobile vendors only served general shops, representing in some districts only 1% of supply sources [28], but in others being a more common source of supply [31]. In Nigeria, sales representatives of large national and international drug companies supplied all types of retail outlets [17]. By contrast, in Uganda and Tanzania, local manufacturers' sales teams supplied the more accessible retailers with more qualified staff [26,32]. Finally, overseas manufacturers directly supplied retailers in Sri Lanka only where 5% of retailers obtained drugs directly from drug companies in India [47].

At intermediate level, studies provided much less information on supply sources. In settings where intermediate-level suppliers were identified [26,32,48,52], they were wholesalers who, as in the case of those operating at terminal level, either handled drugs alongside other commodities or specialized in drugs, hence supplying distinct distribution chains. Information on the location of intermediate suppliers was available only for

Tanzania and Uganda, where they operated in the capital city [26,32] and at regional [32] or district level [26]. In Tanzania, intermediate wholesalers were sometimes agents of upstream suppliers at regional level [32]. Regional wholesalers also, at times, used mobile services providing door-to-door services to their customers [32]. In other settings, there was no information available at this level or no intermediate suppliers operating in the chain serving the studied areas [18,25,27,58]. Finally, as at terminal level, information on suppliers' characteristics was provided by a single study reporting that in Tanzania general suppliers had started their business more recently than drug specific wholesalers and rarely employed staff with health related qualifications [32].

At the top of the chain or primary level, suppliers were importers who were agents of overseas pharmaceutical companies, sometimes contracted to act as their sole supplier for distributing their products locally [26,32,50] or, more rarely, integrated with overseas companies as seen in Mozambique [49]. The literature provided little information on the nature of this agency relationship. In the case of exclusive distributorship agreements between overseas companies and local importers, the latter frequently exchanged products with other importers for which one or the other was the sole supplier [26,31,32,49,50], creating horizontal transactions at the top of the chain. This situation was reported in Zambia where importers tended to have regular customers who would generally purchase the bulk of their supplies from few importers. As importers were generally the sole entry point for a particular drug, they would often exchange products between one another [32,50] rather than send customers to buy from the relevant importer. As a result, no clear differentiation between wholesalers and importers existed in many settings, as these roles were product dependent [50,59]. As at terminal and intermediate levels, suppliers' characteristics were provided only by the study conducted in Tanzania, where drug-specific suppliers employed more staff with health-related qualifications and had been in operation for longer than general suppliers [32].

Finally, illegal distribution channels were reported in several countries, whereby drugs were smuggled from one country to another [19,44,48,56]. For example, drugs smuggled from Nigeria were commonly found on sale in Cameroon or passing through Cameroon to reach Gabon or the Central African Republic [19]. In Senegal, smuggling took the form of sea or air shipments diverted from their initial destination or illegal imports of donations from European countries [48]. Whilst illegal channels were commonly reported, the literature offered very limited information on their structure and actual size [19]. In Zambia, illegal importers were found to serve wholesalers and drug shops directly [48].

This section shows that the distribution chain is far more complicated than as characterized in our taxonomy (Figure 1). Figure 2 represents what happens in reality, as reported in the literature.

Anti-malarial sales volumes and mark-ups

Sales volume estimates are key data for assessing the relative importance of wholesalers within the distribution chain and understanding suppliers' pricing decisions. Data on actual volumes sold across chain levels were found in only six references [29,34,48,53,55,60]. Anti-malarial sales volumes reported by 21 wholesalers operating across six regions of Tanzania ranged from

2,001 and 27,000 doses per month [34]. The rest of the literature indicated relatively concentrated wholesale markets (compared to retail markets), especially at the top of the chain where a few suppliers were responsible for most of the volume sold [33,51,53]. Only one study on the anti-malarial import market in Uganda calculated concentration ratios (the proportion of anti-malarial sales volumes/value accounted for by the *n* largest firms) and the Hirshman-Herfindahl index (HHI) (the sum of squared market shares of each firm in the market). The study found that five importers accounted for nearly 72% of anti-malarial sales with a HHI of just under 1400, indicating moderate market concentration (an index under 1,000 is associated with competitive markets and above 1,800 with monopoly) [51].

More attention has been paid to measuring anti-malarial price mark-ups, especially on first-line treatments for uncomplicated malaria or the most common alternatives at the time of the studies. Methods used included regulatory document reviews, qualitative interviews with key informants including government officials, wholesalers and retailers [48,54,61], sometimes combined with semi-structured or structured interviews with wholesalers, retailers and/or consumers (Table 3). For the purpose of this review, mark-up data were summarized using a specific taxonomy. Primary mark-ups, therefore, refer to the margins that primary suppliers

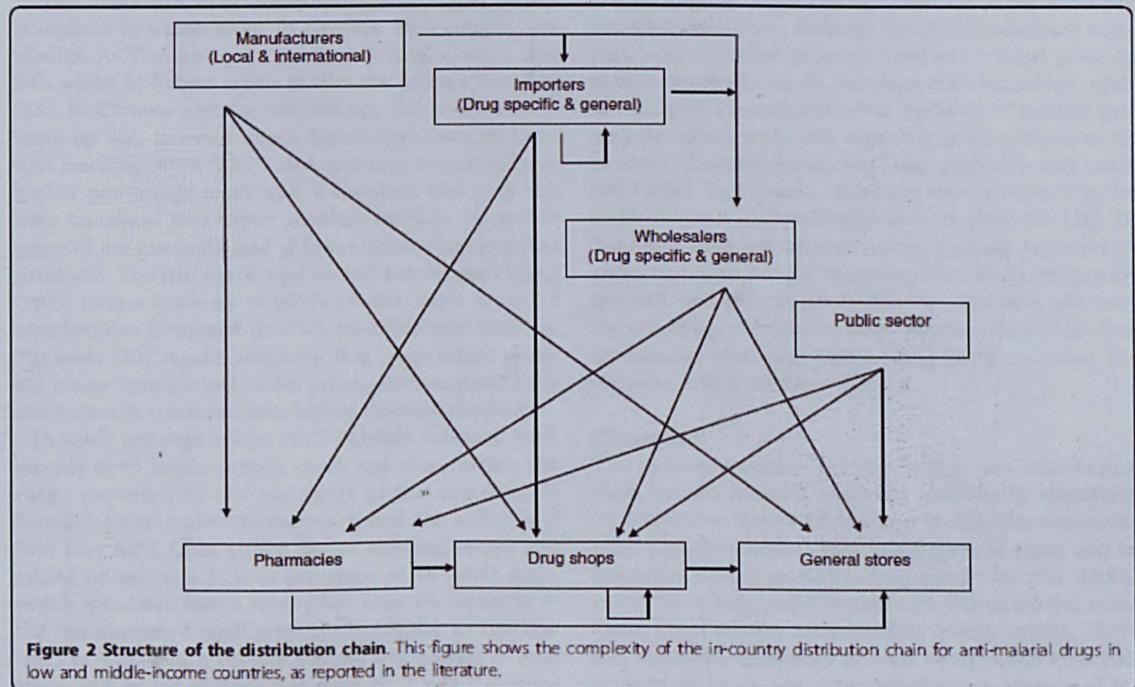


Figure 2 Structure of the distribution chain. This figure shows the complexity of the in-country distribution chain for anti-malarial drugs in low and middle-income countries, as reported in the literature.

(entry point to the distribution chain) add on top of their purchase prices when they serve intermediate or terminal wholesalers. Terminal mark-ups relate to margins added by terminal wholesalers (retailers' direct supply sources) on top of the price at which they obtained the drug, either from primary or intermediate suppliers (Table 3).

Overall, studies reported mark-ups within the distribution chain serving pharmacies or/and drug shops, except one that also provided anti-malarial mark ups within the chain supplying general stores.

Within the distribution chain, mark-ups varied across levels, ranging from 27% to 99% at primary level, 8% at intermediate and 2% to 67% at terminal level (Table 3). In some settings, mark ups varied depending on the structure of the chain [26], with somewhat higher mark-ups at a given level observed in a distribution chain made of fewer levels. For example, in Tanzania, when supplying regional wholesalers, importers added between 27% and 43%, whilst when directly supplying retailers they added between 50% and 67% [29].

In the retail market, price mark-ups on anti-malarials have been relatively more researched. They were sometimes very high and varied greatly across outlet type and location, and anti-malarial type and packaging. There were four key findings. First, mark-ups ranged between 3% and 566% in pharmacies, 29% and 669% in drug shops and 100% and 233% in general shops (Table 3). Second, mark-ups were somewhat higher in rural outlets compared to urban ones. In Zambia, for example, the median ACT mark-up in Lundazi, a rural district was 54% whilst in Kabwe urban district the median was 29% [33]. In Choma, a peri urban district, the median ACT mark-up was, however, much higher than in rural Lundazi reaching 300% [33]. Third, generics tended to have higher percentage mark-ups, a situation that may not have translated into higher absolute margins given that generics are generally sold at lower prices than branded products. Fourth, mark-ups varied across packaging types, with a mark-up of 669% on one loose tablet of amodiaquine compared to 270% on a blistered tablet in Tanzania [20]. Again, assuming that loose tablet prices are lower than packed tablet prices, this may not have automatically translated into higher absolute margins.

In some settings, where ACT subsidy schemes have already been implemented, mark ups were within the range expected by the managers of the schemes. In Senegal, private pharmacies purchased the subsidized first-line ACT from public sector medical stores and added on average 35% to the price of an adult dose, which translated into a retail price only 4% higher than the recommended retail price (RRP) [60,62]. In two districts of Tanzania, a subsidy scheme was piloted in drug shops and in one of these two districts, it was combined

with a RRP printed on ACT packs. ACT availability increased and the subsidy effectively decreased the price of ACT below the price paid by consumers in the control area and below the price of older anti-malarials, leading to a large increase in the proportion of anti-malarial consumers purchasing ACT in the two intervention areas (from 1% to 44.2% one year later) [63]. Surprisingly, ACT prices were higher in the district with the RRP than in the district without, suggesting caution in future use of this approach for controlling ACT retail prices [63]. In Cambodia, a contrasting experience of a subsidy scheme was reported. Cambodia is the first country to have switched its first-line treatment to ACT and implemented a social marketing programme, including a subsidy, packs printed with RRP and mass communication campaigns in its endemic provinces. Market penetration of the subsidized ACT remained relatively low and ACT retailed, on average, at a price 70% higher than the RRP [60].

Overall, relatively little is known about the factors that influence pricing decisions. Only one study was identified which used multivariate statistical methods to analyse price determinants, examining prices in drug and general retail shops selling anti-malarials in rural Tanzania. The study found that higher retail prices were associated with branded and packed products, being sold in general shops (which might have reflected higher prices charged by their terminal supply sources) and higher market concentration [16,20]. The rest of the literature provided descriptive findings. Retail and wholesale margins were reported to be influenced by fixed price or margin regulation or, in the absence of regulation, market competition and consumer demand. Wholesale pricing decisions were also reported to be influenced by product characteristics, business practices and costs [26,32,54]. In Uganda, markups were reported to be lower for anti-malarials with shorter shelf life [26]. In Tanzania, drug wholesalers reported giving discounts to customers who bought drugs in relatively large quantities [32], and general wholesalers to customers who purchased drugs alongside other commodities [32]. One wholesaler also reported adding 6-7% to cover his expenses and 3-4% for profit [32].

Discussion

The existing evidence on the retail sector distribution chain for anti-malarial drugs was reviewed by identifying 32 references across 12 low and middle-income countries. The distribution chain has a pyramid shape and its structure varies greatly across countries and within countries across outlet types, with chains having more levels when serving rural and less formal outlets. There was also some indication of weak competition especially at primary level, where few wholesalers accounted for

Table 3 Mark ups on anti-malarial drugs

Country	Methods (study reference)	Generic name* (drug type or brand)	Product description, (as provided in the literature)	Mark ups across supply chain levels						
				Primary	Intermediate 1	Intermediate 2	Terminal	Retail (location where available)		
								Pharmacies	Drug shops	General shops
Burkina Faso	Document review; KI § Semi-structured interviews with suppliers [54]	CQ	1 dose	-	-	-	-	100%	-	-
		SP	1 dose	-	-	-	-	100%	-	-
		ACT	1 dose	-	-	-	30%	100%	-	-
Cameroon	KII [54]	ACT	1 dose	-	-	-	14%	34%	-	-
Cambodia	Semi-structured interviews with suppliers and retailers [48,55] Structured interviews with suppliers [58]	AS	18 tablets	-	-	-	2%	3%	-	-
		AS+M ± (Malarine®)	Child dose	-	-	-	50%	3%	-	-
		AS+M ± (Malarine®)	Adult dose	-	-	-	-	71% **	-	-
		AS+M ± (Malarine®)	Child dose	-	-	-	-	65% **	-	-
		AS+M2	8 tablets	-	-	-	-	29% **	-	-
		AS+M3	12 tablets	-	-	-	-	15% **	-	-
Kenya	KII and structured survey of retailers [78]	AQ (IB)	9 tablets	40%	-	-	15%	33%	-	-
		SP (IB)	3 tablets	29.5%	-	-	15%	33%	-	-
		SP (G, LPG)	3 tablets	-	-	-	15%	20.3%	-	-
	Semi-structured interviews with retailers [25]	AQ (Malaramed®)	Child dose, syrup	-	-	-	-	86%	-	-
		AQ (Amobin®)	Child dose, syrup	-	-	-	-	22.9%	-	-
		AQ (Malaratab®)	Child dose	-	-	-	-	18.9%	-	-
		SP (Laridox®)	Child dose	-	-	-	-	15.1%	-	-
		SP (Fansidar®)	Child dose	-	-	-	-	13%	-	-
		SP (Falcidin®)	Child dose	-	-	-	-	28%	-	-
		Document review [61]	AMs	-	-	-	-	15%	20%	-
	Senegal	KII [54] KI ; Mystery shopper technique at retail level [62]	ACT	1 pack **	-	-	-	10%	33%	-
AS+AQ ±			Adult dose Child dose	- -	- -	- -	15% -	3-5% 11-22%	- -	- -

Table 3: Mark ups on anti-malarial drugs (Continued)

	Semi-structured interviews with suppliers and retailers [55]	Q (IB, BG)	1 dose (injection)	-	-	-	18%	41%	-
		Q (G)	1 dose (injection)	-	-	-	15%	30%	-
Tanzania	Semi-structured interviews with suppliers and retailers [20,32]	AQ	1 tablet	-	-	-	9%	-	270%-669% (rural)
		AQ	1 tablet	-	-	8%	-	-	-
		Q	1 tablet	-	-	-	26%	-	150%-203% (rural)
	Semi-structured interviews with suppliers and retailers [31]	SP	3 tablets	48%	-	-	13%	-	100-233%
	Semi-structured interviews with suppliers and retailers [29,30]	AL (IB) \pm^1	5<15 kg dose	-	-	-	67% **	-	100-200%
			15<25 kg dose	-	-	-	56% **	-	60%-221%
			25<35 kg dose	-	-	-	52% **	-	47%-230%
			35+ kg dose	-	-	-	50% **	-	39%-233%
		AL (IB) \pm^2	5 <15 kg dose	43%	-	-	-	-	100-200%
			15<25 kg dose	34%	-	-	-	-	60%-221%
			25<35 kg dose	31%	-	-	-	-	47%-230%
			35+ kg dose	27-30% **	-	-	-	-	39%-233%
	Semi-structured interviews with suppliers and retailers [34]	ACT (IB)	n/at	-	-	-	21%	-	54% (rural)
		AMT(IB)	n/at	-	-	-	18%	-	44% (rural)
		SP	n/at	-	-	-	23%	-	110% (rural)
		AQ	n/at	-	-	-	41%	-	96% (rural)
		Quinine	n/at	-	-	-	38%	-	64% (rural)
Uganda	Semi-structured interviews with suppliers and retailers [59]	SP (MSG)	3 tablets	-	-	6%	-	410%	-
		SP (LPG)	3 tablets	27%	-	-	29%	501%	-
	KL; Semi-structured interviews with retailers [54]	All AMs	n/a	40-50%	-	-	7-8%	-	-
		AL (G)	1 dose	-	-	-	-	38%	-
		CQ (G)	1 dose	-	-	-	-	100%	-

Table 3: Mark ups on anti-malarial drugs (Continued)

Semi-structured interviews with suppliers and retailers [26]	DHA+PP (IB)	1 tablet	32%	-	-	14%	-	29% (rural)	-
	DHA+PP (IB)	1 tablet	32%	-	-	21%	22% (rural)	-	-
	SP (IB)	1 tablet	57%	-	-	8%	-	43% (rural)	-
	SP (IB)	1 tablet	57%	-	-	16%	50% (rural)	-	-
	SP (G)	1 tablet	-	-	-	40%	-	198% (rural)	-
	SP (G)	1 tablet	-	-	-	13%	271% (rural)	-	-
	CQ (G)	1 tablet	-	-	-	18%	152% (rural)	-	-
	Artemether (IB)	1 ampoule	99%	-	-	33%	-	50% (rural)	-
	Artemether (IB)	1 ampoule	56%	-	-	16%	28% (rural)	-	-
	SP (G)	1 tablet	-	-	-	25%	-	200% (rural)	-
	CQ (G)	1 tablet	-	-	-	41%	-	92% (rural)	-
	DHA+PP (IB)	1 tablet	36%	-	-	11%	65% (urban)	-	-
	Artemether	1 ampoule	56%	-	-	17%	-	136% (urban)	-
	Artemether	1 ampoule	56%	-	-	17%	82% (urban)	-	-
	SP (IB)	1 tablet	57%	-	-	5%	85% (urban)	-	-
SP (G)	1 tablet	-	-	-	25%	56% (urban)	-	-	
CQ (G)	1 tablet	-	-	-	24%	143% (urban)	-	-	
Zambia	Structured interviews with suppliers [33]	ACT	-	-	-	-	-	60%	-
		SP	-	-	-	-	182%	-	-
		ACT	-	-	-	-	29%, 11%-100%	(urban)	-
		ACT	-	-	-	-	67%, 13%-100%	(peri-urban)	-
		ACT	-	-	-	-	54%, 50-100%	(rural)	-
		SP	-	-	-	-	50%, 15%-327%	(urban)	-
		SP	-	-	-	-	300%, 50%-517%	(peri-urban)	-
	Semi-structured interviews with suppliers and retailers [48,55]	Selected AM	¥	-	-	-	-	50%, 15%-500%	(rural)

* AM = anti-malarials; AMT = artemisinin monotherapies; mg = milligrams; ml = millilitres; AS = Artesunate; M = Mefloquine; AS+M2 = combination for children weighing between 16 kgs to 24 kgs; AS+M3 = combination for children weighing between 25 kgs to 35 kgs; AS+M4 = combination for adults; AQ = Amodiaquine; SP = Sulphadoxine-Pyrimethamine; Q = Quinine; AL = Artemether-Lumefantrine; DHA+PP = Dihydroartemisinin+Piperazine; IB = imported innovator brand, IG = imported generic, B = branded; G = locally produced generic, MSG = most sold generic, LPG = lowest priced generic, BG = branded generic I = imported, LP = locally produced; SC = supply chain; ± = subsidized product; - = level of the chain did not exist or data not available; **Author's own calculations; † mean across all products within drug class. ^{††}primary supplier is the terminal supplier, ^{†††}primary supplier sells to terminal regional supplier. ¥ included AQ (3 tablets), Artemether (not stated), AS (6 tablets), CQ (1000 tablets), DHA (not stated), Halofantrine (6 tablets), Mefloquine (3 tablets), Proguanil (not stated), Q (1000 tablets), AL IB (6 tablets), SP (3 tablets). IFC = International Finance Corporation. Mark-up data were rounded to the nearest whole number. SKII = key informant interviews; Mystery shopper technique = unobtrusive observation of shop attendants by researchers who pose as client seeking care from a provider who is unaware of their identity.

most of the anti-malarial volumes sold. Wholesale mark-ups were lower than retail mark-ups and these varied across chain levels and anti-malarial drug types.

Overall, there was a lack of representative data on a national scale, which made the interpretation of data difficult. Studies tended to focus on the distribution chain serving a single type of outlet, often the more formal type, such as pharmacies generally operating in urbanized settings. Data on the number of wholesalers who operate across levels was restricted to registered businesses and information on their characteristics was generally lacking. Studies were mainly descriptive and provided limited evidence on the influence of the distribution chain on retail anti-malarial availability and prices. Sales volume data across chain levels were non-existent and mark-up data were concentrated at retail and terminal levels, with less information at primary and particularly intermediate levels (one study only). This situation can be explained by the methods that have been used to study key variables, which were often limited to document reviews and interviews with key informants (central government, industry representatives) or retailers. Evidence on stocking and pricing decisions within the distribution chain was therefore lacking, an important knowledge gap for improving consumers' access to affordable quality malaria treatment. High mark-ups and prices are commonly perceived as a sign of high profit, often leading to calls for medicine price reduction [64]. However, without information that disaggregates mark-ups into profits and costs it is unclear if such measures are appropriate.

A strong interest in working with retailers to improve the quality of care they provide has emerged in recent years. Goodman and colleagues identified 16 interventions working with medicine sellers to improve malaria treatment, all including a mix of activities such as training and capacity building, demand generation, quality assurance and creation of an enabling environment [28]. However, only two of the 16 interventions were implemented within the distribution chain, involving training wholesalers and mobile vendors in Kenya and sales representatives in Madagascar. Whilst the evidence available on the outcomes of these initiatives was weak and particularly limited in terms of the sustainability and equity of benefits, it showed some improvements in retailers' knowledge and/or performance [28].

The Affordable Medicine Facility for malaria (AMFm) [65] aims to increase coverage of effective treatment and delay the development of drug resistance, by subsidizing ACT at the top of the distribution chain and implementing supporting interventions such as training, regulatory strengthening and consumer education. The capacity of AMFm to meet its goals has been extensively

debated [66-68], including how the structure of the distribution chain and nature of competition at all levels will affect final prices. Sceptics are concerned that the subsidy will be captured by middle-men within the private commercial supply chain and informal unqualified profit-maximizing retailers. This review indicates that there is insufficient evidence on anti-malarial distribution chains to predict with confidence what the outcome will be, particularly reflecting inadequate information on profit margins and the factors that influence pricing decisions. On the one hand, relatively concentrated markets (few suppliers accounting for large share of sales) were documented at the primary supplier level in Uganda and Zambia, accompanied by frequent exclusive dealership relationships, and within local areas at retail level, indicating the potential for exploitation of market power. On the other hand, early experiences of subsidizing ACT provide valuable lessons, notably the importance of rigorous distribution chain analysis, for example to set the RRP at an appropriate level. Reducing the price of ACT will however not suffice and accompanying interventions need to be identified and tailored to each country context [69]. For example, Rapid Diagnostic Tests (RDTs) have the potential to increase access to accurate diagnosis and appropriate treatment, especially in remote areas where alternative routine microscopy services cannot easily be made available [70-73]. However, the distribution of affordable quality RDTs is also not without challenges [71,74,75] and has been the object of little research to date [76].

Conclusions

Available evidence on the distribution chain for retail sector malaria treatment provides some useful descriptive information, but there is a lack of nationally representative data, and of analysis of the determinants of supplier behaviour. In the advent of the AMFm, a better understanding of the role of the anti-malarial distribution chain on retail outcomes is urgently needed. Retailers are likely to remain an important source of malaria treatment and the knowledge gaps identified here could jeopardize the success of initiatives for improving ACT access. Addressing these uncertainties should be a priority of ongoing and future research.

Acknowledgements

EP is supported by a PhD Capacity Building Studentship from the British Medical Research Council (MRC) (# 201621). CG and KH are members of the Consortium for Research on Equitable Health Systems (CREHS), which is funded by the United Kingdom's Department for International Development (DFID). CG is a member of the KEMRI Wellcome Trust Research Programme which is supported by a grant from the Wellcome Trust (#077032). All authors are members of the ACTwatch project, which is supported by a grant from the Bill and Melinda Gates Foundation.

Author details

¹London School of Hygiene and Tropical Medicine, Keppel Street, London, UK. ²Kenya Medical Research Institute - Wellcome Trust Research Programme, Nairobi, Kenya.

Authors' contributions

EP, CG and KH developed the search strategy. EP conducted the search strategy, reviewed the literature and drafted the manuscript. CG helped to draft the manuscript. CG and KH critically revised the manuscript. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

Received: 25 October 2009

Accepted: 11 February 2010 Published: 11 February 2010

References

- Hamel MJ, Odhacha A, Roberts JM, Deming MS: **Malaria control in Bungoma District, Kenya: a survey of home treatment of children with fever, bednet use and attendance at antenatal clinics.** *Bull World Health Organ* 2001, 79:1014-1023.
- Molyneux CS, Mung'ala-Odera V, Harpham T, Snow RW: **Maternal responses to childhood fevers: a comparison of rural and urban residents in coastal Kenya.** *Trop Med Int Health* 1999, 4:836-845.
- Ndyomugenyi R, Neema S, Magnussen P: **The use of formal and informal services for antenatal care and malaria treatment in rural Uganda.** *Health Policy Plan* 1998, 13:94-102.
- Ruebush TK, Kern MK, Campbell CC, Oloo AJ: **Self-treatment of malaria in a rural area of western Kenya.** *Bull World Health Organ* 1995, 73:229-236.
- Agepong IA, Manderson L: **The diagnosis and management of fever at household level in the Greater Accra Region, Ghana.** *Acta Trop* 1994, 58:317-330.
- Geissler PW, Nokes K, Prince RJ, Odhiambo RA, Aagaard-Hansen J, Ouma JH: **Children and medicines: self-treatment of common illnesses among Luo schoolchildren in western Kenya.** *Soc Sci Med* 2000, 50:1771-1783.
- Krause G, Sauerborn R: **Comprehensive community effectiveness of health care. A study of malaria treatment in children and adults in rural Burkina Faso.** *Ann Trop Paediatr* 2000, 20:273-282.
- McCombie SC: **Treatment seeking for malaria: a review of recent research.** *Soc Sci Med* 1996, 43:933-945.
- Njau JD, Goodman C, Kachur SP, Palmer N, Khatib RA, Abdulla S, Mills A, Bloland P: **Fever treatment and household wealth: the challenge posed for rolling out combination therapy for malaria.** *Trop Med Int Health* 2006, 11:299-313.
- Salako LA, Brieger WR, Afolabi BM, Umeh RE, Agomo PU, Asa S, Adeneye AK, Nwankwo BO, Akinlade CO: **Treatment of childhood fevers and other illnesses in three rural Nigerian communities.** *J Trop Pediatr* 2001, 47:230-238.
- Snow RW: **The role of shops in the treatment and prevention of childhood malaria on the coast of Kenya.** *Trans R Soc Trop Med Hyg* 1992, 86:237-239.
- Foster SD: **Treatment of malaria outside the formal health services.** *J Trop Med Hyg* 1995, 98:29-34.
- Foster SD: **Pricing, distribution, and use of antimalarial drugs.** *Bull World Health Organ* 1991, 69:349-363.
- Rutebemberwa E, Nsabagasani X, Pariyo G, Tomson G, Peterson S, Kallander K: **Use of drugs, perceived drug efficacy and preferred providers for febrile children: implications for home management of fever.** *Malar J* 2009, 8:131.
- Onwujekwe O, Uzochukwu B, Eze S, Obikeze E, Okoli C, Ochonma O: **Improving equity in malaria treatment: relationship of socio-economic status with health seeking as well as with perceptions of ease of using the services of different providers for the treatment of malaria in Nigeria.** *Malar J* 2008, 7:5.
- Goodman C, Kachur SP, Abdulla S, Bloland P, Mills A: **Concentration and drug prices in the retail market for malaria treatment in rural Tanzania.** *Health Econ* 2009, 18:727-742.
- Adikwu MJ: **Sales practices of patent medicine sellers in Nigeria.** *Health Policy Plan* 1996, 11:202-205.
- Adome RO, Whyte SR, Hardon A: **Popular pills: community drug use in Uganda.** Amsterdam: Het Spinhuis Publishers 1996.
- Geest van der S: **Self-care and the informal sale of drugs in south Cameroon.** *Soc Sci Med* 1987, 25:293-305.
- Goodman CA: **An economic analysis of the retail market for fever and malaria treatment in rural Tanzania.** London: University of London 2004.
- Williams HA, Jones CO: **A critical review of behavioral issues related to malaria control in sub-Saharan Africa: what contributions have social scientists made?** *Soc Sci Med* 2004, 59:501-523.
- Amin AA, Marsh V, Noor AM, Ochola SA, Snow RW: **The use of formal and informal curative services in the management of paediatric fevers in four districts in Kenya.** *Trop Med Int Health* 2003, 8:1143-1152.
- Brieger WR, Sesay HR, Adesina H, Mosanya ME, Ogunlade PB, Ayodele JO, Orisasona SA: **Urban malaria treatment behaviour in the context of low levels of malaria transmission in Lagos, Nigeria.** *Afr J Med Med Sci* 2001, 30(Suppl):7-15.
- Goodman C, Brieger W, Unwin A, Mills A, Meek S, Greer G: **Medicine sellers and malaria treatment in sub-Saharan Africa: what do they do and how can their practice be improved?** *Am J Trop Med Hyg* 2007, 77:203-218.
- Tavrow P, Shabahang J, Makama S: **Vendor-to-vendor education to improve malaria treatment by private drug outlets in Bungoma District, Kenya.** *Malar J* 2003, 2:10.
- MMV: **Understanding the anti-malarial market: Uganda 2007. An overview of the supply side.** Geneva: Medicines for Malaria Venture 2007.
- Amin AA, Snow RW: **Brands, costs and registration status of antimalarial drugs in the Kenyan retail sector.** *Malar J* 2005, 4:36.
- Goodman C, Kachur SP, Abdulla S, Mwangeni E, Nyoni J, Schellenberg JA, Mills A, Bloland P: **Retail supply of malaria-related drugs in rural Tanzania: risks and opportunities.** *Trop Med Int Health* 2004, 9:655-663.
- Government of the United Republic of Tanzania and the Clinton Foundation: **Tanzania pilot ACT subsidy: report on findings.** 2008.
- Government of the United Republic of Tanzania and the Clinton Foundation: **Tanzania pilot ACT subsidy: report on preliminary findings.** 2007.
- Battersby A, Goodman C, Abondo C, Mandike R: **Improving the supply, distribution and use of antimalarial drugs by the private sector in Tanzania.** London: Malaria Consortium 2003.
- Chukwujekwu O, Goodman C: **An analysis of the distribution chain for malaria-related drugs sold by retailers in rural South-Eastern Tanzania.** London: London School of Hygiene and Tropical Medicine 2007.
- Clinton Foundation: **Understanding the private sector anti-malarial market in Zambia.** 2008.
- Clinton Foundation: **Review of the private sector anti-malarial market in Tanzania.** 2008.
- Dondorp AM, Nosten F, Yi P, Das D, Phyo AP, Tarning J, Lwin KM, Ariey F, Hantakpong W, Lee SJ, Ringwald P, Silamut K, Imwong M, Chotivanich K, Lim P, Herdman T, An SS, Yeung S, Singhasivanon P, Day NP, Lindegardh N, Socheat D, White NJ: **Artemisinin resistance in *Plasmodium falciparum* malaria.** *N Engl J Med* 2009, 361:455-467.
- Marsh VM, Mutemi WM, Muturi J, Haaland A, Watkins WM, Otieno G, Marsh K: **Changing home treatment of childhood fevers by training shopkeepers in rural Kenya.** *Trop Med Int Health* 1999, 4:383-389.
- Nshakira N, Kristensen M, Ssali F, Whyte SR: **Appropriate treatment of malaria? Use of antimalarial drugs for children's fevers in district medical units, drug shops and homes in eastern Uganda.** *Trop Med Int Health* 2002, 7:309-316.
- Abuya TO, Mutemi W, Karisa B, Ochola SA, Fegan G, Marsh V: **Use of over-the-counter malaria medicines in children and adults in three districts in Kenya: implications for private medicine retailer interventions.** *Malar J* 2007, 6:57.
- Okoro BA, Jones IO: **Pattern of drug therapy in home management of diarrhoea in rural communities of Nigeria.** *J Diarrhoeal Dis Res* 1995, 13:151-154.
- Basco LK: **Molecular epidemiology of malaria in Cameroon. XIX. Quality of antimalarial drugs used for self-medication.** *Am J Trop Med Hyg* 2004, 70:245-250.
- Kaur H, Goodman C, Thompson E, Thompson KA, Masanja I, Kachur SP, Abdulla S: **A nationwide survey of the quality of antimalarials in retail outlets in Tanzania.** *PLoS One* 2008, 3:e3403.
- Dondorp AM, Newton PN, Mayxay M, Van Damme W, Smithuis FM, Yeung S, Petit A, Lynam AJ, Johnson A, Hien TT, McGready R, Farrar JJ,

- Looareesuwan S, Day NP, Green MD, White NJ: **Fake antimalarials in Southeast Asia are a major impediment to malaria control: multinational cross-sectional survey on the prevalence of fake antimalarials.** *Trop Med Int Health* 2004, **9**:1241-1246.
43. Newton P, Proux S, Green M, Smithuis F, Rozendaal J, Prakongpan S, Chotivanich K, Mayxay M, Looareesuwan S, Farrar J, Nosten F, White NJ: **Fake artesunate in southeast Asia.** *Lancet* 2001, **357**:1948-1950.
44. Rozendaal J: **Fake antimalarial drugs in Cambodia.** *Lancet* 2001, **357**:890.
45. Adu-Sarkodie Y, Steiner MJ, Attafuah J, Tweedy K: **Syndromic management of urethral discharge in Ghanaian pharmacies.** *Sex Transm Infect* 2000, **76**:439-442.
46. Mayhew S, Nzambi K, Pepin J, Adjei S: **Pharmacists' role in managing sexually transmitted infections: policy issues and options for Ghana.** *Health Policy Plan* 2001, **16**:152-160.
47. Rajakaruna RS, Weerasinghe M, Alifrangis M, Amerasinghe PH, Konraden F: **The role of private drug vendors as malaria treatment providers in selected malaria endemic areas of Sri Lanka.** *J Vector Borne Dis* 2006, **43**:58-65.
48. Institute of Medicine: *Saving Lives, Buying Time: Economics of Malaria drugs in an Age of Resistance*. Washington, DC: National Academy Press 2004.
49. Russo G: **Medicine prices in Mozambique: a study of determinants and policy options.** London: University of London 2007.
50. Yadav P: **Analysis of the public, private and mission sector supply chains for essential drugs in Zambia - Technical Report.** London: DFID Health Resource Centre 2007.
51. Yadav P, Conesa S: **Uganda antimalarial markets: preliminary analysis.** Technical Report for the Medicines Transparency Alliance 2008.
52. International Finance Corporation: **The business of health in Africa: partnering with the private sector to improve people's lives.** World Bank Group 2008.
53. Yadav P, Ongola M: **Analysis of Complementary Supply Chain Interventions' and 'Estimating Private-Sector Demand for Anti-Malarials in Ghana, Uganda and Zambia Using Household Consumption Expenditures and Willingness-to-Pay Estimates'.** *Affordable Medicines Facility - malaria: Technical Proposal to Increase Access to Malaria Medicines Background Paper 9* 2007.
54. RBM Secretariat: **Technical proposal to increase access to malaria medicines. Background paper 7 Summary of Field Research.** *Affordable Medicine Facility - Malaria* 2007.
55. Shretta R, Guilmer JM: *Flow of antimalarial drugs in the public and private sector, affordability and discussions of potential strategies to improve financial access*. Arlington: Management Sciences for Health 2003.
56. Buebeng KO, Duwiewja M, Matowe LK, Smith F, Enlund H: **Availability and choice of antimalarials at medicine outlets in Ghana: the question of access to effective medicines for malaria control.** *Clin Pharmacol Ther* 2008, **84**:613-619.
57. Marsh VM, Mutemi WM, Willelts A, Bayah K, Were S, Ross A, Marsh K: **Improving malaria home treatment by training drug retailers in rural Kenya.** *Trop Med Int Health* 2004, **9**:451-460.
58. PSI: *Cambodia (2007): MAP study evaluating the coverage and quality of malaria prevention and treatment in endemic areas*. Phnom Penh: Population Services International 2008.
59. The Republic of Uganda: **Medicine pricing survey report.** 2004.
60. Sabot O, Yeung S, Pagnoni F, Gordon M, Petty N, Schmits K, Talisuna A: **Distribution of artemisinin-based combination therapies through private sector channels: lessons from four country case studies.** 2008.
61. Myhr K: **Comparing prices of essential drugs between four countries in east Africa and with international prices.** Nairobi:MSF 2000.
62. Kone CG, Ndonky A, Lalou R, Le Hesran J-Y: **ACT subventionees en vente dans les officines privées: experience du Senegal.** *Affordable Medicine Facility - Malaria: Technical Proposal to Increase Access to Malaria Medicines Background paper 7 Summary of Field Research RBM Secretariat* 2007.
63. Sabot OJ, Mwita A, Cohen JM, Ipuge Y, Gordon M, Bishop D, Odhiambo M, Ward L, Goodman C: **Piloting the global subsidy: the impact of subsidized artemisinin-based combination therapies distributed through private drug shops in rural Tanzania.** *PLoS One* 2009, **4**:e6857.
64. World Health Organization: **Medicine prices: a new approach to measurement.** 2007.
65. RBM Task Force: **Draft Technical Proposal for a Global ACT Subsidy.** 2007.
66. **New malaria drug subsidy fails to ensure patients receive best treatment options - procurement policies must change.** http://www.msf.org/msfinternational/invoker.cfm?objectId=8693ADA5-15C5-F00A-25820B1D3428BA2F&component=toolkit.article&method=full_html.
67. Marriot A: *Blind optimism: Challenging the myths about private health care in poor countries*. Oxford: International 2009.
68. Kamal-Yanni M: **Affordable medicines facility for malaria: reasonable or rash?** *Lancet* 2010, **375**:121.
69. Moon S, Perez Casas C, Kindermans JM, de Smet M, von Schoen-Angerer T: **Focusing on quality patient care in the new global subsidy for malaria medicines.** *PLoS Med* 2009, **6**:e1000106.
70. Bell D, Wongsrichanalai C, Barnwell JW: **Ensuring quality and access for malaria diagnosis: how can it be achieved?** *Nat Rev Microbiol* 2006, **4**: 57-20.
71. Lubell Y, Reyburn H, Mbakiliwa H, Mwangi R, Chonya K, Whitty CJ, Mills A: **The cost-effectiveness of parasitologic diagnosis for malaria-suspected patients in an era of combination therapy.** *Am J Trop Med Hyg* 2007, **77**:128-132.
72. Shillcutt S, Morel C, Goodman C, Coleman P, Bell D, Whitty CJ, Mills A: **Cost-effectiveness of malaria diagnostic methods in sub-Saharan Africa in an era of combination therapy.** *Bull World Health Organ* 2008, **86**:101-110.
73. Perkins MD: **Working without a blindfold: the critical role of diagnostics in malaria control.** *Malar J* 2008, **7**.
74. Roland E, Checchi F, Pinoges L, Balkan S, Guthmann JP, Guerin PJ: **Operational response to malaria epidemics: are rapid diagnostic tests cost-effective?** *Trop Med Int Health* 2006, **11**:398-408.
75. Jorgensen P, Chanthap L, Rebuena A, Tsuyuoka R, Bell D: **Malaria rapid diagnostic tests in tropical climates: the need for a cool chain.** *Am J Trop Med Hyg* 2006, **74**:750-754.
76. Frost LI, Reich MR: **Creating access to health technologies in poor countries.** *Health Aff (Millwood)* 2009, **28**:962-973.
77. RBM Secretariat: **Technical proposal to increase access to malaria medicines: Background Paper 5. Supply chain analysis.** *Affordable Medicine Facility - Malaria* 2007.
78. Ministry of Health of the Government of the Republic of Kenya: **A survey of medicine prices in Kenya.** 2004.

doi:10.1186/1475-2875-9-50

Cite this article as: Patouillard et al.: Retail sector distribution chains for malaria treatment in the developing world: a review of the literature. *Malaria Journal* 2010 **9**:50.

Submit your next manuscript to BioMed Central and take full advantage of:

- Convenient online submission
- Thorough peer review
- No space constraints or color figure charges
- Immediate publication on acceptance
- Inclusion in PubMed, CAS, Scopus and Google Scholar
- Research which is freely available for redistribution

Submit your manuscript at
www.biomedcentral.com/submit



APPENDIX 4 Ethics approvals and data collection tools



ក្រសួងសុខាភិបាល
MINISTRY OF HEALTH
គណៈកម្មាធិការជាតិរៀបចំសិក្សាស្រាវជ្រាវ
សំរាប់ការស្រាវជ្រាវសុខភាពដែលពាក់ព័ន្ធនឹងមនុស្ស
National Ethics Committee for Health Research

លេខ: ០៤១/NECHR

ព្រះរាជាណាចក្រកម្ពុជា
KINGDOM OF CAMBODIA
ជាតិ សាសនា ព្រះមហាក្សត្រ
NATION RELIGION KING

រាជធានីភ្នំពេញ, ថ្ងៃទី ២៥ ខែ ០៣ ឆ្នាំ ២០០៩

Mr. Kara Hanson

Project : ACTwatch Supply Chain Study, Cambodia

Reference : March 20th, 2009 NECHR meeting minute

Dear Mr. Kara Hanson

I am pleased to notify you that your project entitled "ACTwatch Supply Chain Study, Cambodia" has been approved by National Ethic Committee for Health Research (NECHR) in the meeting on March 20th, 2009. This approval is valid for twelve months after the approval date.

The Principal Investigator of the project shall submit following document to the committee's secretariat at the National Institute of Public Health at #2 Kim Il Sung Blvd, Khan Tuol Kok, Phnom Penh. (Tel: 855-23-880345, Fax: 855-23-881949):

- Annual progress report
- Final scientific report
- Patient/participant feedback (if any)
- Analyzing serious adverse events report (if applicable)

The Principal Investigator should be aware that there might be site monitoring visits at any time from NECHR team during the project implementation and should provide full cooperation to the team.

Regards,

Chairman

H.E. Prof ENG HUOT

**LONDON SCHOOL OF HYGIENE
& TROPICAL MEDICINE**

ETHICS COMMITTEE



APPROVAL FORM

Application number: 5466

Name of Principal Investigator Kara Hanson
Department Public Health and Policy
Head of Department Professor Anne Mills

Title: Investigating the Supply Chain for Antimalarials and Rapid Diagnostic Tests for Malaria

This application is approved by the Committee.

Chair of the Ethics Committee *T. W. Meade*

Date 18 February 2009

Approval is dependent on local ethical approval having been received.

Any subsequent changes to the application must be submitted to the Committee via an E2 amendment form.

ACTwatch Combined Supply Chain & Sales Level Surveys Information Sheet

My name is _____ and I work for the London School of Hygiene and Tropical Medicine. In collaboration with PSI Cambodia and with the approval of the National Ethics Committee for Health Research of the Ministry of Health, we are conducting a study called the Supply Chain Study on the availability of antimalarial medicines throughout Cambodia. The results of this study will be used to improve the availability of malaria treatment. I would like to invite you to participate in this study because we believe that your experience in the antimalarial business can contribute much to our understanding.

I would like to ask you a number of questions about:

- The operation of your business
- Your suppliers and your customers
- The range and quantity of antimalarials you stock today. I would also like to ask your permission to visit you again in two weeks time to record the quantity of antimalarial medicines you will have in stock at that time.

Finally we would like to record your geographical coordinates using a GPS machine.

How long will the interview take?

The interview with you should take approximately 1 to 1.5 hour, depending on how many antimalarial medicines you have in stock. When we return in two weeks, the interview is expected to be shorter because we will only collect information on the quantities of antimalarials you will stock.

Are there any disadvantages or advantages involved in taking part?

There are no individual benefits to taking part in this study, but in answering our questions you will help improve our understanding of the antimalarial market, and so potentially benefit all Cambodians. The only disadvantage for you is the time to complete the interview.

Who will have access to the information I give?

We are not here to inspect your business and no information about this specific outlet will be passed on to the regulatory authorities. The information gathered from this study is confidential and will be kept private. We will not share individual information about you with anyone beyond our research team. Instead, the knowledge gained from this research will be shared in summary form, without revealing individuals' identities.

What will happen if I refuse to participate?

Participation in this research is completely voluntary. You are free to decide if you want to take part in this study. If you do agree, you can still change your mind at any time. You can refuse to answer any specific question, or stop the interview at any point. If you chose not to answer a question, stop the interview or not participate there will not be any negative implications for you.

What if I have any questions?

If you have any questions, you can ask them now, during the interview or later. If you wish to ask questions later, you may contact any of the following members of the study team:

Dr Kara Hanson, Reader in Health Economics and Policy, Health Policy Unit, London School of Hygiene and Tropical Medicine, London UK. The email address is Kara.hanson@lshtm.ac.uk

Long Dianna, Strategic Information Director, Population Services International-Cambodia. The telephone number is 016 53 11 35.

Phok Sochea, Malaria Research Manager, Population Services International-Cambodia. The telephone number is 017 562 568.

This study has been reviewed and approved by the Cambodia National Ethics Committee, which is a committee whose task is to make sure that research participants are protected from harm

Certificate of Informed Consent

I have read the information sheet for the above study to interviewee of _____(business name) in a language he/she understands.

He/she was given the opportunity to ask questions and seek clarification.

He/she gives voluntary consent to take part in the study.

Signature of researcher _____ Date _____

Print name of researcher _____

I. Census & Screening Information*Interviewer verifies the information below is correct.*

Business ID	District - Business ID: [][][][]-[][][]	
C1. Today's date (dd/mm/yy)	[][]-[][]-[0][]	
C2. Interviewer's name []	C2a. Interviewer's code [][][]	
C3. Province []	C3a. Province code [][][]	
C4. District []	C4a. District code [][][][]	
C5. Name of business (<i>if no name, record "no name"</i>) []	C5a. Business code [][][]	

My name is _____ and I work for the London School of Hygiene and Tropical Medicine. In collaboration with PSI Cambodia, we are conducting a study called the Supply Chain Study on the availability of antimalarial medicines throughout Cambodia. This study is funded by the Bill & Melinda Gates Foundation and the results will be used to improve the availability of malaria treatment. We are not here to inspect your business and no information about this specific business will be passed on to the regulatory authorities.

SCREENING QUESTIONS

S1. Do you have any antimalarial medicines in stock today? 1 = Yes go to S3 2 = No 9 = Don't know	[]
S2. If no, have you stocked any antimalarials in the past 3 months? 1 = Yes 2 = No 9 = Don't know	[]
S3. Do you have any rapid diagnostic test kits for malaria in stock today? 1 = Yes obtain consent 2 = No 9 = Don't know	[]
S4. If no, have you stocked any RDTs in the last 3 months? 1 = Yes 2 = No 9 = Don't know	[]
IF ANSWERED 'NO' OR 'DON'T KNOW' TO ALL 4 OF THE ABOVE QUESTIONS END INTERVIEW OTHERWISE READ INFORMATION SHEET AND OBTAIN CONSENT.	

C6. Number of Visits

	<i>C6a. Supply Chain Survey [& Sales Level Survey First Interview] COMPLETE FOR ALL BUSINESSES</i>			<i>C6b. Sales Level Survey Second Interview ONLY FOR BUSINESSES PARTICIPATING IN THE SALES LEVEL SURVEY. COMPLETE AT SECOND INTERVIEW</i>	
	Visit 1	Visit 2	Visit 3	Visit 1	Visit 2
Date					
Result	[]	[]	[]	[]	[]
	1 = Completed 2 = Business closed down 3 = Eligible respondent not available 4 = Business not open at the time 5 = Interview interrupted 6 = Refused – go to C7 7 = Other: _____ _____			1 = Completed 2 = Business closed down 3 = Eligible respondent not available 4 = Business not open at the time 5 = Interview interrupted 6 = Refused – go to C7 7 = Other: _____	
	<i>If it will be possible to complete the interview at another time, note this time here, and return then:</i> _____			<i>If it will be possible to complete the interview at another time, note this time here, and return then:</i> _____	
C7. REFUSAL: C7a. If the business refused, why? 1 = Client load 2 = Thinks it's an inspection/nervous about license 3 = Not interested 4 = Refuses to give reason 5 = Other (Describe) _____ []			<i>FOR THOSE BUSINESSES PARTICIPATING IN THE SALES LEVEL SURVEY & AT SECOND INTERVIEW</i> C7b. if the business refuses to <i>participate in second interview</i> of Sales Level Survey, why? 1 = Client load 2 = Thinks it's an inspection/nervous about license 3 = Not interested 4 = Refuses to give reason 5 = Other (Describe) _____ []		
C8a. Any other comments _____					

For businesses that participated in the Sales Level Survey:

After the first interview of the Sales Level Survey, interviewer to comment on:

C8b. Tell us about your experience of collecting Quantity sold in the last week

How did it go?
What happened?
Why?
Were written sales records available?
Did it help or not?

C8c. Tell us about your experience of collecting Quantity in stock

How was stock taking of packed tablets? Why?
How was stock taking of loose tablets? Why?
How was stock taking of RDT? Why?
How was your experiences of collecting tablets and loose tablets compare? Why?
How was your experience of collecting tablets and injectables compare? Why?
How was your experience of collecting drugs and RDT compare? Why?
Were stock cards available? if yes, did it help or not?

After the second interview of the Sales Level Survey, interviewer to comment on:

C8d. Tell us about your experience of collecting Quantity sold since last visit

How did it go? What happened? Why? Were written sales records available? Did it help or not?

C8e. Tell us about your experience of collecting Quantity in stock

How was stock taking of packed tablets? Why?
How was stock taking of loose tablets? Why?
How was stock taking of RDT? Why?

How was your experiences of collecting tablets and loose tablets compare? Why?
How was your experience of collecting tablets and injectables compare? Why?
How was your experience of collecting drugs and RDT compare? Why?
Were stock cards available? if yes, did it help or not?

C8f. your experience of collecting Quantity received since last visit

How did it go?
What happened?
Why?
Were written sales records available?
Did it help or not?

C8g. your experience of collecting Quantity disposed since last visit

How did it go? What happened? Why? Were written sales records available? Did it help or not?

P8. If yes, how many of each the following type of businesses does he/she own?		
Type of Business	Number (write #)	Location 1 = This district 2 = Other district 3 = Both 4 = Other (<i>specify</i>) 7 = Not applicable 8 = Refuses 9 = Don't know
I. Drug Manufacturer	[][][]	[]
II. Drug Importer	[][][]	[]
III. Wholesale pharmacies	[][][]	[]
IV. Retail pharmacies	[][][]	[]
V. Depots A &/or B	[][][]	[]
VI. Drug Stores	[][][]	[]
VII. Clinical Pharmacies	[][][]	[]
VIII. Sun Quality Health Network clinics (SQHN)	[][][]	[]
IX. Other private clinics	[][][]	[]
X. General importer/ wholesaler	[][][]	[]
XI. Grocery stores or village shops	[][][]	[]
XII. Other (<i>specify</i>): (if they own a cabinet it can be entered here)	[][][]	[]
P9. How are antimalarials transported to your customers? 1 = You deliver to them 2 = They collect from you 3 = Both 9 = Don't know		[]
P10. In the last three months, have you given credit to any customers who bought antimalarials in bulk? 1 = Yes 2 = No <i>go to question P12</i> 9 = Don't know <i>go to question P12</i>		[]
P11. If yes, what are your most common terms of credit for these customers? (i.e. how many days)? <i>Enter number of days</i> 999 = Don't know		[][][]
P12. Including the owner and yourself, how many people work here (all staff employed at these premises)? 999 = Don't know		[][][]
P13. Has anybody working in this business (including the owner) completed secondary school? 1 = Yes <i>go to P15</i> 2 = No 9 = Don't know		[]

<p>P14. If no or don't know, has anybody working in this business (including the owner) completed primary school? 1 = Yes 2 = No go to question P17 9 = Don't know go to question P17</p>	[]																		
<p>P15. Does anyone working in this business [including the owner] have any health related qualifications? 1 = Yes 2 = No go to question P17 9 = Don't know go to question P17</p>	[]																		
<p>P16. How many people working in this business [including the owner] have the following types of health qualifications? Read List</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <thead> <tr> <th style="text-align: left; padding: 5px;">Type of Health Qualification</th> <th style="text-align: center; padding: 5px;">Number</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">I. University-level Pharmacist</td> <td style="text-align: center; padding: 5px;">[]</td> </tr> <tr> <td style="padding: 5px;">II. Pharmacy Assistant</td> <td style="text-align: center; padding: 5px;">[]</td> </tr> <tr> <td style="padding: 5px;">III. Medical doctor</td> <td style="text-align: center; padding: 5px;">[]</td> </tr> <tr> <td style="padding: 5px;">IV. Medical assistant</td> <td style="text-align: center; padding: 5px;">[]</td> </tr> <tr> <td style="padding: 5px;">V. Laboratory assistant</td> <td style="text-align: center; padding: 5px;">[]</td> </tr> <tr> <td style="padding: 5px;">VI. Specialist</td> <td style="text-align: center; padding: 5px;">[]</td> </tr> <tr> <td style="padding: 5px;">VII. Nurse / Midwife</td> <td style="text-align: center; padding: 5px;">[]</td> </tr> <tr> <td style="padding: 5px;">VIII. Other (<i>Describe</i>):</td> <td style="text-align: center; padding: 5px;">[]</td> </tr> </tbody> </table>		Type of Health Qualification	Number	I. University-level Pharmacist	[]	II. Pharmacy Assistant	[]	III. Medical doctor	[]	IV. Medical assistant	[]	V. Laboratory assistant	[]	VI. Specialist	[]	VII. Nurse / Midwife	[]	VIII. Other (<i>Describe</i>):	[]
Type of Health Qualification	Number																		
I. University-level Pharmacist	[]																		
II. Pharmacy Assistant	[]																		
III. Medical doctor	[]																		
IV. Medical assistant	[]																		
V. Laboratory assistant	[]																		
VI. Specialist	[]																		
VII. Nurse / Midwife	[]																		
VIII. Other (<i>Describe</i>):	[]																		
<p>P17. In the past 2 years, have the staff that work here participated in any type of in-service training or workshops? Do not include pre-service training 1 = Yes 2 = No go to P19 9 = Don't know go to P19</p>	[]																		
<p>P18. If yes, complete the following table:</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <thead> <tr> <th style="width: 50%; padding: 5px;">Subject of training:</th> <th style="width: 25%; padding: 5px;">Run by: 1 = Government 2 = NGO 3 = Private commercial 7 = Not applicable 8 = Refuses 9 = Don't know</th> <th style="width: 25%; padding: 5px;">Duration: (in days) 99=Don't know</th> </tr> </thead> <tbody> <tr> <td style="height: 40px;"></td> <td style="text-align: center;">[]</td> <td style="text-align: center;">[][]-[]</td> </tr> <tr> <td style="height: 40px;"></td> <td style="text-align: center;">[]</td> <td style="text-align: center;">[][]-[]</td> </tr> <tr> <td style="height: 40px;"></td> <td style="text-align: center;">[]</td> <td style="text-align: center;">[][]-[]</td> </tr> </tbody> </table>		Subject of training:	Run by: 1 = Government 2 = NGO 3 = Private commercial 7 = Not applicable 8 = Refuses 9 = Don't know	Duration: (in days) 99=Don't know		[]	[][]-[]		[]	[][]-[]		[]	[][]-[]						
Subject of training:	Run by: 1 = Government 2 = NGO 3 = Private commercial 7 = Not applicable 8 = Refuses 9 = Don't know	Duration: (in days) 99=Don't know																	
	[]	[][]-[]																	
	[]	[][]-[]																	
	[]	[][]-[]																	

SOURCES OF ANTIMALARIALS

<p>P19. In the last 3 months, from how many suppliers have you purchased antimalarials? 00 = No suppliers in last 3 months go to P37 88 = Refuses 99 = Don't know</p>	<p>[] []</p>
<p>P20. In the past 3 months, what was the name of your top supplier of antimalarials? 1 = Knows name of business (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<p>[]</p>
<p>P21a. Commune or Sangkat (<i>of the top supplier</i>) 1 = Knows commune or Sangkat (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<p>[]</p>
<p>P21b. District or Khan (<i>of the top supplier</i>) 1 = Knows district or khan (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<p>[]</p>
<p>P21c. Provincial town or Phnom Penh City (<i>of the top supplier</i>) 1 = Knows town (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<p>[]</p>
<p>P21d. Province (<i>of the top supplier</i>) 1 = Knows province (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<p>[]</p>
<p>P22. Physical address (Location identifiers) (<i>of the top supplier</i>) 1 = Knows address (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<p>[]</p>
<p>P23. Telephone number (<i>of the top supplier</i>) 1 = Knows telephone number (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<p>[]</p>
<p>P24. Type of supplier. Read list. Single response. 1. Drug Importer 2. Wholesale pharmacy 3. General importer 4. General wholesaler 5. Retail pharmacy 6. Drug Store 7. Grocery/convenience stores/village shops/market stalls 8. Clinical Pharmacy 9. Other private commercial clinic (<i>such as SQHN</i>) 10. NGO/Mission clinic 11. Public Health Facility 12. Other (<i>specify</i>): [_____] 88= Refuses 99 = Don't know</p>	<p>[] []</p>
<p>P25. How do you receive your antimalarials from your top supplier? Read list. One response only. 1 = Supplier delivers to you 2 = You collect from supplier or from port/airport 3 = Both 8 = Refuses 9 = Don't know</p>	<p>[]</p>

<p>P26. Do you buy antimalarials medicines on credit from your top supplier? 1 = Yes 2 = No <i>go to question P28</i> 9 = Don't know <i>go to question P28</i></p>	<input type="checkbox"/>
<p>P27. What are the most common terms of credit from your top supplier? <i>Enter number of days</i> 999 = don't know</p>	<input type="text"/>
<p>P28. Did you have any other suppliers for antimalarials in the past three months? 1 = Yes 2 = No <i>go to question P37</i> 9 = Don't know <i>go to question P37</i></p>	<input type="checkbox"/>
<p>P29. In the last 3 months, what was the name of your second top supplier for antimalarials? 1 = Knows name of business (<i>specify</i>): <input type="text"/> 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P30a. Commune or Sangkat (<i>of the second supplier</i>) 1 = Knows commune or Sangkat (<i>specify</i>): <input type="text"/> 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P30b. District or Khan (<i>of the second supplier</i>) 1 = Knows district or khan (<i>specify</i>): <input type="text"/> 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P30c. Provincial town or Phnom Penh City (<i>of the second supplier</i>) 1 = Knows town (<i>specify</i>): <input type="text"/> 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P30d. Province (<i>of the second supplier</i>) 1 = Knows province (<i>specify</i>): <input type="text"/> 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P31. Physical address or location identifiers (<i>of the second supplier</i>) 1 = Knows address (<i>specify</i>): <input type="text"/> 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P32. Telephone number (<i>of the second supplier</i>) 1 = Knows telephone number (<i>specify</i>): <input type="text"/> 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P33. Type of supplier. <i>Read list. Single response.</i></p> <ol style="list-style-type: none"> 1. Drug Importer 2. Wholesale pharmacy 3. General importer 4. General wholesaler 5. Retail pharmacy 6. Drug Store 7. Grocery/convenience stores/village shops/market stalls 8. Clinical Pharmacy 9. Other private commercial clinic (<i>such as SQHN</i>) 10. NGO/Mission clinic 11. Public Health Facility 12. Other (<i>specify</i>): <input type="text"/> <p>88= Refuses 99 = Don't know</p>	<input type="text"/>

P34. How do you receive your antimalarials from your second top supplier? Read list. One response only. 1 = Supplier delivers to you 2 = You collect from supplier or from port/airport 3 = Both 8 = Refuses 9 = Don't know			<input type="checkbox"/>	
P35. Do you buy antimalarials medicines on credit from your second top supplier? 1 = Yes 2 = No go to question P37 9 = Don't know go to question P37			<input type="checkbox"/>	
P36. What are the common credit terms from your second top supplier? Enter number of days 999 = Don't know			<input type="text"/>	
P37. Do you have a license from the Department of Drug & Food (DDF) or the Provincial Health Department (PHD)?				
Type of License	Has License	Observed	Valid Until (mm/yy)	
	1 = Yes 2 = No 7 = Not applicable 8 = Refuses 9 = Don't know		77/77 = N/A	
I. Pharmacy license	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> / <input type="text"/>	
II. Depot A license	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> / <input type="text"/>	
III. Depot B license	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> / <input type="text"/>	
IV. Import permit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> / <input type="text"/>	
V. Manufacturer license	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> / <input type="text"/>	
VI. Other (<i>describe</i>): <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> / <input type="text"/>	
P38. Do you have a general trading license?				
Type of License	Has License	Observed	Valid until (mm/yy)	
	1 = Yes 2 = No 7 = Not applicable 8 = Refuses 9 = Don't know		77/77 = N/A	
I. Wholesale trading license	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> / <input type="text"/>	
II. Retail trading license	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> / <input type="text"/>	
III. Import license	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> / <input type="text"/>	
IV. Manufacturer license	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> / <input type="text"/>	
V. Other (<i>describe</i>): <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> / <input type="text"/>	
P39. Has an inspector from the DDF/ justice police/provincial health office come to visit you in the last year? 1 = Yes 2 = No go to question P41 9 = Don't know go to question P41				<input type="checkbox"/>
P40. When did they last come? Enter date (MM/YY)			<input type="text"/>	
P41. Can you please show us the full range of antimalarials that you currently have in stock. Do you currently have any of the following: (No responses need to be recorded)				
I. Artemisinin Combinations Therapies i. Artesunate+Mefloquine (<i>e.g. Malarine, A+M1,2,3,4</i>) ii. Dihydroartemisinin+Piperaquine (<i>e.g. Artekin, Duo-Cotexcin</i>) iii. Artemisinin+Primaquine+Piperaquine (<i>e.g. Artequick</i>)		III. Non-artemisinin-based malaria drugs vii. Sulphadoxine-Pyrimethamine (<i>e.g. Malastop</i>) viii. Quinine ix. Mefloquine x. Chloroquine (<i>e.g. Nitaquine</i>) xi. Tetracycline (<i>e.g. Tetraman</i>) xii. Amodiaquine xiii. Proguanil		
II. Other Artemisinin-based malaria drugs iv. Artesunate (<i>e.g. Arquine, Plasmotrim</i>) v. Arternether vi. Dihydroartemisinin (<i>e.g. Cotexcin</i>)		IV. Syrups/suspensions V. Injectibles VI. Granules/powders		

P42. Of these products, which is the antimalarial product that you have sold **the most doses of (treatment courses)** in the **past month**?

Generic name 9 = Don't know	Brand name 6 = No preference 9 = Don't know	Dosage form 1 = Tablet 2 = Suppository 3 = Syrup 4 = Suspension 5 = Liquid injectable 6 = Powder injectable 7 = Granule 8 = Other (<i>describe</i>) 9 = Don't know
Do not write here [][]	Do not write here [][][]	[]

P43. In your opinion for treating uncomplicated malaria in adults, what is the most **effective** antimalarial product of all of those available on the market? **Looking for either generic name or brand name.**

Generic name 9 = Don't know	Brand name 6 = No preference 9 = Don't know	Dosage form 1 = Tablet 2 = Suppository 3 = Syrup 4 = Suspension 5 = Liquid injectable 6 = Powder injectable 7 = Granule 8 = Other (<i>describe</i>) 9 = Don't know
Do not write here [][]	Do not write here [][][]	[]

P44. In your opinion for treating uncomplicated malaria in children under five years of age, what is the most **effective** antimalarial product of all of those available on the market? **Looking for either generic name or brand name.**

Generic name 9 = Don't know	Brand name 6 = No preference 9 = Don't know	Dosage form 1 = Tablet 2 = Suppository 3 = Syrup 4 = Suspension 5 = Liquid injectable 6 = Powder injectable 7 = Granule 8 = Other (<i>describe</i>) 9 = Don't know
Do not write here [][]	Do not write here [][][]	[]

P45. Please name the medicine recommended by the government to treat uncomplicated malaria? **Do not read list. Only one response allowed.**

- 1 = Artesunate + Mefloquine (*A+M and Malarine*)
 2 = Dihydroartemisinin + Piperaquine (*e.g. Artekin, Duo-Cotexcin*)
 3 = Artesunate (*e.g. Arquine, Plasmotrim*)
 4 = SP (*eg Malastop*)
 5 = Tetracycline (*eg Tetra-Man*)
 6 = Chloroquine (*eg Nitaquine*)
 7 = Dihydroartemisinin (*e.g. Cotexcin, Malaratin*)
 8 = Other (**specify**): []
 9 = Don't know

[]

III. Antimalarial Inventory Sheets

Proceed to the drug inventory. Different Drug Inventory sheets will be used to record the antimalarial information based on the dosage form of the medicine. Look at the top of each sheet to record the drug information on the appropriate form:

- If the antimalarial is in the form of tablets or suppositories, use the Tablets & Suppositories Drug Inventory Sheet.
- If the antimalarial is in any form other than tablets or suppositories, use the Non-Tablet Drug Inventory Sheet.

P46. Interviewer: Were any of the antimalarials recorded in the inventory ACTs? 1 = Yes gather samples of all ACT products currently in stock 2 = No go to question P49	[]
P47. In the past 3 months, have you ever been out of stock of all these antimalarials (show all gathered ACTs) at the same time? 1 = Yes 2 = No go to question P49 8 = Refuses go to question P49 9 = Don't know go to question P49	[]
P48. At the time you were out of stock of all of these antimalarials (show all gathered ACTs), did you have any other ACTs in stock? 1 = Yes, specify [_____] 2 = No 8 = Refuses 9 = Don't know	[]

OBSERVATION RECORD

P49. May I see where you store your antimalarials? 1 = Yes 2 = No, not stored on these premises go to P53 8 = Refuses go to P53	[]
P50. Are antimalarials stored in a dry area? 1 = Yes, stored in a dry area 2 = No, not stored in a dry area	[]
P51. Are antimalarials protected from direct sunlight? 1 = Yes, protected from direct sunlight 2 = No, not protected from sunlight	[]
P52. Are antimalarials kept on the floor? 1 = Yes, kept on the floor 2 = No, not kept on the floor	[]

SOURCES OF RDTs

If the business either has RDTs currently in stock OR has carried them in the last 3 months, complete this section; otherwise, proceed to C9

P53. In the last three months, from how many suppliers have you purchased rapid diagnostic tests (RDTs) for malaria? 00 = No suppliers in last 3 months go to RDT Inventory Sheet if has RDTs in stock; otherwise go to C9 88 = Refuses 99 = Don't know	[][]
P54. In the past three months, what was the name of your top supplier of RDTs? 1 = Knows name of business (specify): [_____] 8 = Refuses 9 = Don't know	[]

<p>P55a. Commune or Sangkat (<i>of the top supplier</i>) 1 = Knows commune or Sangkat (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P55b. District or Khan (<i>of the top supplier</i>) 1 = Knows district or khan (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P55c. Provincial town or Phnom Penh City (<i>of the top supplier</i>) 1 = Knows town (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P55d. Province (<i>of the top supplier</i>) 1 = Knows province (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P56. Physical address or location identifiers (<i>of the top supplier</i>) 1 = Knows address (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P57. Telephone number (<i>of the top supplier</i>) 1 = Knows telephone number (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P58. Type of supplier. Read list. Single response. 1. Drug Manufacturer 2. Drug Importer 3. Wholesale pharmacy 4. Retail pharmacy 5. Drug Store 6. General importer/wholesaler 7. Grocery/convenience stores/village shops 8. Clinical Pharmacy 9. Other private commercial clinic (<i>such as SQHN</i>) 10. NGO 11. Public Health Facility 12. Other (<i>specify</i>): [_____] 88= Refuses 99 = Don't know</p>	<input type="checkbox"/> <input type="checkbox"/>
<p>P59. How do you receive your RDTs from your top supplier? Read list. One response only. 1 = Supplier delivers to you 2 = You collect from supplier 3 = Both 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P60. Do you buy RDTs medicines on credit from your top supplier? 1 = Yes 2 = No go to question P62 9 = Don't know go to question P62</p>	<input type="checkbox"/>
<p>P61. What are the common credit terms from your top supplier? Enter number of days 999 = Don't know</p>	<input type="text"/> <input type="text"/> <input type="text"/>
<p>P62. Did you have any other suppliers for RDTs in the past three months? 1 = Yes 2 = No go to RDT Inventory Sheet if has RDTs in stock; otherwise go to C9 9 = Don't know go to RDT Inventory Sheet if has RDTs in stock; otherwise go to C9</p>	<input type="checkbox"/>

<p>P63. In the last 3 months, what was the name of your second top supplier for RDTs? 1 = Knows name of business (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P64a. Commune or Sangkat (<i>of the second supplier</i>) 1 = Knows commune or Sangkat (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P64b. District or Khan (<i>of the second supplier</i>) 1 = Knows district or khan (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P64c. Provincial town or Phnom Penh City (<i>of the second supplier</i>) 1 = Knows town (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P64d. Province (<i>of the second supplier</i>) 1 = Knows province (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P65. Physical address or location identifiers (<i>of the second supplier</i>) 1 = Knows address (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P66. Telephone number (<i>of the second supplier</i>) 1 = Knows telephone number (<i>specify</i>): [_____] 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P67. Type of supplier Read list. Single response. 1. Drug Manufacturer 2. Drug Importer 3. Wholesale pharmacy 4. Retail pharmacy 5. Drug Store 6. General importer/wholesaler 7. Grocery/convenience stores/village shops 8. Clinical Pharmacy 9. Other private commercial clinic (<i>such as SQHN</i>) 10. NGO 11. Public Health Facility 12. Other (<i>specify</i>): [_____] 88= Refuses 99 = Don't know</p>	<input type="checkbox"/> <input type="checkbox"/>
<p>P68. How do you receive your RDTs from your second top supplier? Read list. One response only. 1 = Supplier delivers to you 2 = You collect from supplier 3 = Both 8 = Refuses 9 = Don't know</p>	<input type="checkbox"/>
<p>P69. Do you buy RDTs medicines on credit from your second top supplier? 1 = Yes 2 = No go to RDT Inventory Sheet if has RDTs in stock; otherwise go to C9 9 = Don't know go to RDT Inventory Sheet if has RDTs in stock; otherwise go to C9</p>	<input type="checkbox"/>
<p>P70. What are the most common terms of credit from your second top supplier? Enter number of days 999 = Don't know</p>	<input type="text"/> <input type="text"/> <input type="text"/>

X2. Additional observations by interviewer (if any)

A1. Total number of Tablet & Suppository Inventory <i>Sheets/Tablet & Suppo Inventoried</i>	[] []
A2. Total number of Non- Tablet & Suppository Inventory <i>Sheets/Non-Tab & Suppo Inventoried</i>	[] []
A3. Total number of RDT Inventory <i>Sheets/RDT inventoried</i>	[] []

August 2009

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

September 2009

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

October 2009

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Snowball Census

We are trying to develop a complete list of all businesses that wholesale antimalarials or malaria diagnostic test kits in this District/Khan _____ (name of district or Khan)

Is the information provided in the table below complete? Do you know of other businesses of this kind in this town and which are not listed?

If any additional businesses identified, complete in table below:

<i>Complete at source outlet, and verify when you arrive at new outlet</i>			<i>Complete when you arrive at new outlet</i>		
Name of business	Physical address or location identifiers	Phone number	Engages in AM Wholesale? (Y/N)	Engages in RDT Wholesale? (Y/N)	Type of business (drug / general)
			N/A	N/A	N/A
			N/A	N/A	N/A
			N/A	N/A	N/A
			N/A	N/A	N/A
			N/A	N/A	N/A

Second Interview Sales Level Survey SLS2 (Only for businesses included in the Sales Level Survey)

Interviewer verifies that the information below is correct.

Business ID	District - Business ID: [][]-[][]
C1. Today's date (dd/mm/yy)	[][]-[][]-[0][]
C2. Interviewer's name []	C2a. Interviewer's code [][][]
C3. Province []	C3a. Province code [][][]
C4. District []	C4a. District code [][][]
C5. Name of business (<i>if no name, record "no name"</i>) []	C5a. Business code [][][]

Introduce yourself

Go to C6 to record date & number of visits for conducting the second interview of the Sales Level survey (SLS2)

T3. Time Started	[]:[]:[]
------------------	-------------

If they did not have any malaria drugs or RDT at the time of the first interview, go to P71

If they had malaria drugs or/and RDT at the time of the first interview, complete Questions 11 to 14 of the Inventory Sheet you started filling in 2 weeks ago for the Supply chain Survey and Sales Level Survey (SLS1)

<p>P71. Since my last visit, have you received any other malaria drugs?</p> <p>1=yes Go to Inventory Sheets For New Products in stock at second visit SLS2 2=no 9=don't know</p>	[]
<p>P72. Since my last visit have you received any other RDT?</p> <p>1=yes Go to Inventory Sheets For New Products in stock at second visit SLS2 2=no 9=don't know</p>	[]

Thank you very much for your participation.

Do you have any questions or comments for us?

T4. Time Completed	[]:[]:[]
--------------------	-------------

Return to C6 to record final status of interview. If Business participated in Sales Level Survey, go to C8b. when exiting the premises to record your impressions on completing the interview. END INTERVIEW.

TABLETS / SUPPOSITORIES - SUPPLY CHAIN SURVEY (SCS) Complete for <u>all</u> businesses				SALES LEVEL SURVEY FIRST INTERVIEW (SLS1) Only for businesses participating in SLS. Complete at time of SCS		SALES LEVEL SURVEY SECOND INTERVIEW (SLS2) Only for businesses participating in SLS. Complete at second interview of SLS. For new products in stock at time of second interview (because no inventory sheet exists yet), use Tablet & Suppository Drug Inventory Sheet - SLS2	
Code: District [][][][] Business [][][] Product number [][][]							
1. Generic name _____ _____	2. Strength [][] . [][] mg [][] . [][] mg	3. Dosage form 1 = Tablet 2 = Suppository []	8. Wholesale Selling price <i>Interviewer asks</i> What is the minimum quantity that you wholesale (sell at bulk price)? 8a. [][][][][] packs (as you described in Q6) Or 8b. [][][][][] tablets/ suppositories at a unit price of 8c. [][][][][] Riels	10. Quantity in stock <i>Interviewer counts stocks</i> There are : 10a. [][][][][][] full packs/ tins (as you described in Q6)in stock Or 10b. [][][][][][] tablets /suppositories in stock &/or if there is a half-full tin Height of tin (cm) 10c. [][] . [][] cm	11. Quantity sold wholesale since last visit <i>Interviewer asks</i> This business sold 11a. [][][][][][] full packs / tins (as you described in Q6) since the last visit, Or 11b. [][][][][][] tablets/suppositories since the last visit	13. Quantity disposed since last visit <i>Interviewer asks</i> 13a. [][][][][][] packs /tins have been disposed/ thrown away /sent back to supplier/ given to other owned shop since last visit Or 13b. [][][][][][] tablets /suppositories have been disposed/thrown away since last visit	
Do not write here [][][]	[][][] . [][] mg		8d. [][][][][][] Riels What is the minimum price you charge for bulk purchases? 8d. [][][][][][] Riels How many packs or tablets/ suppositories would your customers have to purchase to receive this price? 8e. [][][][][][] packs (as you described in Q6) Or 8f. [][][][][][] tablets/ suppositories	10d. [][] . [][] cm Height of tablets (cm) 10d. [][] . [][] cm Number of tablets/ suppositories in a new full tin 10e. [][][][][] tablets/ suppositories	12. Quantity in stock today <i>Interviewer counts stocks</i> There are: 12a. [][][][][][] full packs /tins (as you described in Q 6.) Or 12b. [][][][][][][] tablets /suppositories &/or if there is a half-full tin Height of tin (cm) 12c. [][] . [][] cm Height of tablets (cm) 12d. [][] . [][] cm Number of tablets/ suppositories in a new full tin 12e. [][][][][][] tablets/ suppositories	14. Quantity received since last visit <i>Interviewer asks</i> 14a. [][][][][][][] packs/ tins have been received (as you described in Q6) Or 14b. [][][][][][][] tablets/suppositories have been received since last visit	
4. Brand name Do not write here [][][]	5. Country of manufacture Do not write here [][][]	6. Package size There is a total of [][][] tablets/ suppositories in each: 1 = Tin 2 = Pack []	9. Purchase price <i>Interviewer asks</i> For the most recent purchase, you bought a total of 9a. [][][][][][] packs (as you described in Q6) Or 9b. [][][][][][] tablets/suppositories at a unit price of 9c. [][][][][][] Riels	For all questions (except Q1 to Q6), other possible answers: 777777= Not applicable 888888 = Does not vary price 999999 = Don't know 666666=Refuses			
7. Quantity sold wholesale (in bulk) in last week. <i>Interviewer asks</i> This business sold 7a. [][][][][][][] packs (as you described in Q6) Or 7b. [][][][][][][] tablets / suppositories							

Information Sheet for Sales Level Survey (Retail)

My name is _____ and I work for the London School of Hygiene and Tropical Medicine and PSI/Cambodia. With the approval of the National Ethics Committee for Health Research of the Ministry of Health, we are conducting a study called the Supply Chain Study on the availability of antimalarial medicines throughout Cambodia. The results of this study will be used to improve the availability of malaria treatment. I would like to invite you to participate in this study because we believe that your experience in the antimalarial business can contribute much to our understanding.

I would like to ask you permission to collect information on the range and volumes of antimalarial drugs & malaria tests (rapid diagnostic tests) that you have in stock today, and to come back in 2 weeks time to collect this information again.

How long will the interview take?

The interview with you should take between 15 to 60 minutes, depending on how many antimalarial medicines you have in stock.

Are there any disadvantages or advantages involved in taking part?

There are no individual benefits to taking part, but in answering our questions you will help improve our understanding of the antimalarial market, and so potentially benefit all Cambodians. The only disadvantage for you is the time to complete the interview.

Who will have access to the information I give?

We are not here to inspect your business and no information about this specific outlet will be passed on to the regulatory authorities. The information gathered from this study is confidential and will be kept private. We will not share individual information about you with anyone beyond our research team. Instead, the knowledge gained from this research will be shared in summary form, without revealing individuals' identities.

What will happen if I refuse to participate?

Participation in this research is completely voluntary. You are free to decide if you want to take part in this study. If you do agree, you can still change your mind at any time. You can refuse to answer any specific question, or stop the interview at any point. If you chose not to answer a question, stop the interview or not participate there will not be any negative implications for you.

What if I have any questions?

If you have any questions, you can ask them now, during the interview or later. If you wish to ask questions later, you may contact any of the following members of the study team:

Dr Kara Hanson

Reader in Health Economics and Policy, Health Policy Unit, London School of Hygiene and Tropical Medicine, London UK, The email address is Kara.Hanson@lshtm.ac.uk

Long Dianna

Strategic Information Director, Population Services International-Cambodia. The telephone number is 016 53 11 35.

Phok Sochea

Malaria Research Manager, Population Services International-Cambodia. The telephone number is 017 562 568.

This study has been reviewed and approved by the Cambodia National Ethics Committee, which is a committee whose task is to make sure that research participants are protected from harm

Certificate of Informed Consent

I have read the information sheet for the above study to interviewee of _____(business name) in a language he/she understands.

He/she was given the opportunity to ask questions and seek clarification.

He/she gives voluntary consent to take part in the study.

Signature of researcher _____ Date _____

Print name of researcher _____

♣ When you enter the outlet, read the information sheet and obtain consent

FIRST INTERVIEW

♣ 1. Is it possible to do the interview?

1=yes 2=no

1.a. If no, why not

1=closed today 2=closed permanently

3= refused: why? _____

4=other: specify _____

♣ 2a. Date of Interview [_!_] / [_!_] / 2009

(day/month)

2b. Start Time [_!_] H [_!_]

3. I would like to ask about drugs for malaria. Can you please show me the full range of antimalarials that you currently have in stock.

♣ Probe: do you currently have any of the following: (No responses need to be recorded)

<p>I. Artemisinin Combinations Therapies</p> <p>i. Artesunate+Mefloquine (e.g. Malarine, A+M1,2,3,4)</p> <p>ii. Dihydroartemisinin+Piperaquine (e.g. Artekin, Duo-Cotexcin)</p> <p>iii. Artemisinin+Primaquine+Piperaquine (e.g. Artequick)</p>	<p>III. Non-artemisinin-based malaria drugs</p> <p>vii. Sulphadoxine-Pyrimethamine (e.g. Malastop)</p> <p>viii. Quinine</p> <p>xix. Mefloquine</p> <p>x. Chloroquine (e.g. Nitaquine)</p> <p>xi. Tetracycline (e.g. Tetraman, Tetra-Ms)</p> <p>xii. Amodiaquine</p> <p>xiii. Proguanil</p>
<p>II. Other Artemisinin-based malaria drugs</p> <p>iv. Artesunate (e.g. Arquine, Plasmotrim)</p> <p>v. Artemether</p> <p>vi. Dihydroartemisinin (e.g. Cotexcin)</p>	<p>IV. Syrups/suspensions</p> <p>V. Injectibles</p> <p>VI. Granules/powders</p>

♣ If they don't have antimalarials in stock, go to #5

♣ If they have antimalarials in stock, go to #4a &/or #4b to fill in Stock Table Questions

4a. Stock Table for Tablets and Suppositories

♣ If a given drug is available in more than one kind of packaging, fill in a separate line for each kind of packaging.

♣ Product description to be filled in at first visit if product in stock at first visit. Product description to be filled in at second visit if in stock at second visit but not at first visit.

PRODUCT DESCRIPTION			FIRST VISIT	SECOND VISIT		
<p>Code</p> <p>[][] District ID</p> <p>[][] Business ID</p> <p>[][] Product No.</p>	<p>1. Generic name</p> <p>_____</p> <p>_____</p>	<p>2. Strength</p> <p>[][] . [] mg</p> <p>[][] . [] mg</p> <p>[][] . [] mg</p>	<p>7. Quantity in stock today:</p> <p>a. Number of full packs/pot/tin in stock (as described in Q 6.)</p> <p>[][][][] full packs/pots/tins or/and if there is a half-full tin</p> <p>b. Height of tin (cm)</p> <p>[][] . [][] cm</p> <p>c. Height of tablets (cm)</p> <p>[][] . [][] cm</p> <p>d. Number of tablets in a new full tin (9999=don't know)</p> <p>[][][][]</p>	<p>8 ★. Quantity sold since last visit (RECALL) (Record # of packs/ pots/tins described in Q6)</p> <p>[][][][][] packs / pots / tins were sold since last visit, OR</p> <p>[][][][][] tablets/suppositories were sold since last visit</p>	<p>10. Quantity <u>disposed since last visit</u></p> <p>[][][][][][] packs / pots / tins have been disposed/thrown away /sent back to supplier/ confiscated since last visit</p> <p>Or</p> <p>[][][][][][] tablets/suppositories have been disposed/thrown away since last visit</p>	<p>11. Quantity <u>received since last visit</u></p> <p>[][][][][][] packs / pots / tins have been received</p> <p>Or</p> <p>[][][][][][] tablets/suppositories have been received</p>
<p>4. Brand name</p> <p>Do not write here</p> <p>[][]</p>	<p>5. Country of manufacture</p>	<p>3. Dosage form</p> <p>1 = Tablet</p> <p>2 = Suppository</p> <p>[]</p>	<p>6. Package size (Fill in number)</p> <p>There is a total of [][][] tablets/ suppositories in each (select package type):</p> <p>1 = Pot/tin</p> <p>2 = Pack</p> <p>[]</p>	<p>9. Quantity in stock today:</p> <p>a. Number of full packs/pot/tin in stock (as described in Q 6.)</p> <p>[][][][][] packs, pot, tin or/and if there is a half-full tin</p> <p>b. Height of tin (cm)</p> <p>[][] . [][]</p> <p>c. Height of tablets (cm)</p> <p>[][] . [][]</p> <p>d. Number of tablets in a new full tin</p> <p>[][][][]</p>		

4c. Stock Table for Malaria Diagnostic Tests or Rapid Diagnostic Tests

♣ If a given drug is available in more than one kind of packaging, fill in a separate line for each kind of packaging.

♣ Product description to be filled in at first visit if product in stock at first visit. Product description to be filled in at second visit if in stock at second visit but not at first visit.

PRODUCT DESCRIPTION		FIRST VISIT	SECOND VISIT		
Code [][] District [][] Business [][] Product No.	1. Brand Name _____ _____ Do not write here [][]	2. Manufacturer _____ _____ Do not write here [][]	7. Quantity in stock: [][][][] packs of tests (as described in 4) Or [][][][] tests	8 ★ . Amount sold <u>since last visit</u> (RECALL QUESTION) This business sold [][][][][] packs of tests Or [][][][][] tests	10. Quantity <u>disposed since last visit</u> [][][][][] packs of tests have been disposed/thrown away /sent back to supplier/given to other owned shop, confiscated since last visit Or [][][][][] tests disposed/thrown away/returned to suppliers/given to other shop/confiscated since last visit
3. Country of Manufacture Do not write here [][]	4. Package size (Fill in number) Total of [][][][] tests per package		9. Quantity in stock today: [][][][][] packs of tests (as described in 6b) Or [][][][][] tests	11. Quantity <u>received since last visit</u> (regardless if in stock at first visit or not) [][][][][] packs of tests (as described in 6b) Or [][][][][] tests	

SECOND INTERVIEW

7. Is it possible to do the interview?

1=yes 2=no

1.a. If no, why not

1=closed today 2=closed permanently

3= refused: *why?* _____

4=other: *specify* _____

8. Date of Interview [_ | _] / [_ | _] / [_ 2 | _ 0] [_ 0 | _ 9]
(day/month)

If they did not have any malaria drugs at the time of the first interview, go to #10

If they had malaria drugs at the time of the first interview, Fill in Stock Table, Questions 8, 9,10,11

9. since my last visit, have you received any other malaria drugs?

1=yes 2=no 9=don't know

if they did receive any other malaria drugs, list them in Stock Table Product Description (Q1-6), and fill in Q 8-11

10. Many thanks for your cooperation. When we come back we would also like to know the quantity of drugs you have received during this 2-week period. therefore it would be very helpful if you could keep a record of any deliveries, or keep any receipts for drugs during this period.

♣ End Time [_ | _] H [_ | _]

♣ Fill in the Business Code Number at the top of each page of the Questionnaire and Stock Table.

♣ Before moving to the next outlet, take a moment to write down some notes about this interview. Discuss these notes with your partners

Notes on Second Interview

Supply Chain Study Semi-structured Interview Information Sheet

My name is Edith Patouillard and I work for LSHTM. With the approval of the Ministry of Health, we are conducting a study called the Supply Chain Study on the availability of antimalarial medicines throughout Cambodia. We would like to ask you some questions about your antimalarial business. The results of this study will be used to improve the availability of malaria treatment. I would like to invite you to participate in this study because we believe that your experience in the antimalarial business can contribute much to our understanding.

The questions will cover:

- Your suppliers and your customers
- Your decisions about antimalarial stocking and pricing
- The costs you face
- The regulatory system

We will take notes during the interview.

How long will the interview take?

The interview with you should take approximately 1 hour.

Are there any disadvantages or advantages involved in taking part?

There are no individual benefits to taking part, but in answering our questions you will help improve our understanding of the antimalarial market, and so potentially benefit all Cambodians. The only disadvantage for you is the time to complete the interview.

Who will have access to the information I give?

We are not here to inspect your business and no information about this specific outlet will be passed on to the regulatory authorities. The information gathered from this study is confidential and will be kept private. We will not share individual information about you with anyone beyond our research team. Instead, the knowledge gained from this research will be shared in summary form, without revealing individuals' identities.

What will happen if I refuse to participate?

Participation in this research is completely voluntary. You are free to decide if you want to take part in this study. If you do agree, you can still change your mind at any time. You can refuse to answer any specific question, or stop the interview at any point. If you choose not to answer a question, stop the interview or not participate there will no be any negative implications for you.

What if I have any questions?

If you have any questions, you can ask them now, during the interview or later. If you wish to ask questions later, you may contact any of the following members of the study team:

Dr Kara Hanson

Reader in Health Economics and Policy, Health Policy Unit, London School of Hygiene and Tropical Medicine, London UK, The email address is Kara.Hanson@lshtm.ac.uk

Long Dianna

Strategic Information Director, Population Services International-Cambodia. The telephone number is 016 53 11 35.

Phok Sochea

Malaria Research Manager, Population Services International-Cambodia. The telephone number is 017 562 568.

This study has been reviewed and approved by the Cambodia National Ethics Committee, which is a committee whose task is to make sure that research participants are protected from harm

**Supply Chain Study Semi-Structured Interview
Certificate of Consent**

I have read the information sheet for the above study to the interviewee of _____ (business name) in a language he/she understands. He/she was given the opportunity to ask questions and seek clarification.

I believe that he/she gives voluntary consent to take part in the study.

Signature of researcher _____ Date _____
Day/month/year

Print name of researcher _____

Supply Chain Study Semi-structured Interviews

Interview Guide

Interview Details

Interviewer Name:	
Language in which the interview was conducted (translator name if language different than English or French)	
Interview Date (dd/mm/yyyy):	
Start Time (hh:mm):	
Interview Location:	
Information forms provided:	yes or no
Consent obtained	yes or no
End Time (hh:mm):	

1) Introduction

- a) Can you tell me a bit about yourself and your role in this business?
- b) Who are the other key people involved in the business and what are their roles?

2) Relationships with your suppliers

- a) How many suppliers of AM do you have? (SCS) Can you name them? (Phd) For how much of the AM volume that you buy do they account for (Phd)?
- b) How do you decide which suppliers to buy antimalarials from?
- c) Do you ever change suppliers? Why? Why not?
- d) Do you buy direct from manufacturers/importers? If not, what stops you? (trying to get at reasons for multiple links in supply chain)
- e) Do you ever have problems with availability of AM supplies?
- f) Do your suppliers have any rules about:
 - i) the prices you can then resell the products at? (e.g. Recommended Retail Price (RRP)? Do you think RRP's are observed? if not, why not?
 - ii) the products you purchase from them (e.g. product tie-in, bundling, exclusive dealing?)
- g) Do your suppliers distribute AMs to you? If yes, how often do they come? Do you pre-order or are they van sales?
- h) Do suppliers send sales reps to visit your business? What influence does that have on your business?
- i) How do you communicate with them?
- j) Are any of your staff paid for by suppliers higher up the supply chain (embedded sales force based at lower levels of the chain)?
- k) What other ways do your suppliers try to influence the AM products you stock? eg gift, bonuses, credit

3) Products stocked (at retail level, this is asked first)

- a) [Which malaria drugs do you have in stock?(Probe: first-line antimalarial treatment, names of banned AM) – start with this question in pilot test, but usually this info available from quantitative survey].
- b) How do you decide which AM to stock? If they don't stock [name of ACT/the first line treatment drug], why? do you know where to buy it from?
- c) How often do you receive supplies/procure?
- d) Why don't you stock [name of ACT/first-line treatment drug]?
- e) What would make you stock it? (?follow up different pack sizes, shelf life, max price at which they would stock)
- f) how do you deal with expired products?
- g) have you heard about/do you stock the rapid diagnosis test? which one? why? why not?
- h) have you ever received training on RDT? who from?

- i) do you use RDT? why? why not? if so, how does it influence AM/treatment sold ?
- j) do you sell AM without a test?
- k) what do you think about RDT? eg opinion about it i.e. popular, precise etc...

4) Setting prices

- a) How do you decide what prices to charge for AM? eg price in other shops, product availability on the market, bonuses you have received from your supplier?
- b) Do you vary your price of a given drug? What are the reasons for this? (eg order value, different customers?)
- c) What is your average markup? Does it vary by drug class? What is the antimalarial product with the highest mark-up? With the lowest mark-up?

5) Relationships with your customers

- a) Who are your customers for AM Eg individuals, cabinet, retail pharmacies, wholesalers, private hospitals/clinics, type of wholesalers, public hospitals/health centres. and who are your customers for RDT?
- b) Where are you customers located? Eg which provinces? (at retail level only; for wholesalers these data are collected during the SCS)
- c) How do they communicate with you? eg when they order, access to their sales records, manage inventory
- d) Distribution: Do you distribute AMs to your customers ? Why/why not? If yes, can you describe your distribution system? Do you have distribution centres / nodes? (e.g. number and frequency of routes, charging practices, logistics) . How do you decide when to distribute eg as soon as order or wait to have several customers on same route? why?(eg less costly or more profitable) do you distribute above a certain order threshold?
- e) Do you send sales reps to you customers? (why/how often, ...)]
- f) Do you place any types of restrictions (price, products) on your purchasers?
- g) Do you have any other strategies for influencing your own customers' choice of product, or providing them with information? eg bonuses, gift for buying specific products
- h) Do you give credit (at retail level)? for how long? why? why not?
- i) Do you do any repackaging / relabeling of AMs?

6) Competition

- a) Which places do you consider your main competitors for customers for antimalarials (other wholesalers, retailers, health facilities, VMW)? What is it about them that makes them your competitors? *if there are facilities or other shops nearby not mentioned, why are they not considered as competitors?*
- b) How do you try to attract more customers to your business? eg distribute at no cost, credit, bonuses, discount
- c) Why do you think some customers choose other businesses instead of yours?
- d) Are there any ways in which businesses cooperate? e.g. do you borrow products from one another? is there a trade associations? (are you a member? What benefit?) Agreements about what prices to charge? Territory/geographic area to focus business on?
- e) Barriers/contestability
 - i) do you think other people will set up similar businesses in this area in the near future? if no, why not? if yes, do you think they will take away your customers?
 - ii) do businesses like this often go out of business? eg bankrupt. Why?
 - iii) do you think this could happen to your business?
 - iv) are you planning to expand/open new business? why? why not?
 - v) do medicines sellers experience any problems in expanding or opening new businesses? eg competition from existing shops, regulation, access to capital

7) Sources of Information

- a) How do you get general information about AM/RDT?

8) Costs involved in wholesaling and retailing AM

- a) We're trying to understand the main costs of running a pharmacy business: Could you please help us to complete this table:

if does not work, try asking about expenses over the last month

Expense	Riels or \$ per month	Notes
Rent		
Electricity		
Gaz		
Stock		
Water		
Phone		
Employees: Salaried		
Employees: Casual/hourly (including salaries to your family members who work here)		
Salary to yourself		
Stationery		
Freight		
Transport to pick up drugs		
Transport to deliver drugs to customers		
Clearance charges		
Marketing		
Trade/business license (This may be annual)		
Pharmacy/depot/cabinet license		
Other PHO fees		
Insurance		
Security		
Taxes – Corporate		
Taxes – Local		
Taxes other		
Other categories		
Total		

- b) Are there any important categories that we have missed?
- c) do you keep records of these expenses? could we see these records?
- d) **[Check by comparing the total revenue with total cost] So that means that your monthly profit is _____?**
- e) If you were to set up this business again today, what would be the costs of setting up?
 - i) Rent a house/premises such as this one?
 - ii) Furniture and fittings
 - iji) Purchase of initial stock
 - iv) Equipment
 - v) Vehicles
 - vi) Loan cost (interest rate)
- f) How do you finance your inventory? Do you have any problems with this?

9) Sales revenue

- a) What is your gross monthly sales revenue?
 - i) **at terminal/terminal/intermediate**, what is the value of your overall daily sales (before paying any expenses? what is the value of your antimalarial/RDT daily or weekly sales?
 - ii) **at primary level**, what is the value of your annual sales for all products? what is the value of your annual AM/RDT sales?
- b) What share of this is from antimalarial drugs/RDT (if previous questions did not work)?
- c) does this vary during the year/any months during the year for which the quantity of AM you sell varies?

10) Regulations

- a) What are the regulatory requirements for opening this kind of business?

- (to registered, do you need to pay a fee or do you just to be a pharmacist/the name of a pharmacist? if yes, how often do you need to pay this fee/renew the license)
- b) What are your views on the regulatory requirements for this type of business?
 - i) Do you think they are reasonable? If not, why not?
 - ii) How do they influence the way you run the business?
 - c) What are your views on the capacity of the regulators to enforce their regulations?
 - i) Do you feel that most people comply?
 - ii) Do you feel that sanctions are enforced?
 - iii) Have you had any personal experiences of dealing with the regulatory authorities? Can you describe them?
 - d) Would you like to see changes in the regulatory system? What aspects would you like to see changing?
 - e) In places we have come from we have heard stories about drugs from health facilities/the public sector/public central medical store getting into private shops. Have you ever heard stories such as these?
 - f) Have you heard stories about AM that may be fake/counterfeit? What do you know about markets for counterfeits/fakes? what kind of suppliers (walk, moto, vans, always the same people, where do they come from, how often do they come?
 - g) What do you know about the operation of a black/parallel market in this country (=unofficial imports / exports, smuggling)

11) Policy Context

Ask about any policy intervention occurring/that might occur in Cambodia

- a) ban monotherapies – if stocks, what have you done with these products/what are you going to sold with these products? (ie continue selling until finish? send back to supplier? throw way? what has been the impact on your business?
- b) OTC products – the MOH has issued a new regulation which asks businesses like yours to sell some drugs only to customers with a prescription. Have your heard about this? how? (received letter from PHO, other businesses told you? what has been/will be the impact on your business?)
- c) private sector regulation for selling AM

12) Suggestions

- a) What is the biggest risk/challenge you face in the AM business? What could be done to address this? eg bad debt
- b) Is there anything else that you want to tell me about your experience in dealing with antimalarials?
- c) Do you have any questions for us?
- d) For future research, we would like your advice on the following survey approaches for identifying the # of businesses that wholesale AM and RDT:
 - i) do you keep lists of your customers? what kind of list (credit, distribute to,...)? does it include name and address of each customers? what share of AM buy wholesale?
 - ii) another approach we thought of is to conduct interviews with your customers as they exit your premises. Interviewers would collect names and addresses of each of your customers visiting your business to buy AM and RDT for a period of ~ 3 days. What do you think of such approach? why? why not? how do you think your customers will feel/react to such approach?

- 13) **Record other notes and impressions on the interview.** type of structure, range of drug stocked, cleanliness, orderliness, business location, interview location

Supply Chain Study Key Informant Interview Information Sheet

Greetings from the London School of Hygiene & Tropical Medicine and PSI/Cambodia!

With the approval of the Ministry of Health, we are conducting a study called the Supply Chain Study on the availability of antimalarial medicines throughout Cambodia. The results of this study will be used to improve the availability of malaria treatment. I would like to invite you to participate in this study because we believe that your experience in the antimalarial business can contribute much to our understanding.

The questions will cover:

- Your role in the supply chains for antimalarials and RDTs
- The overall antimalarial and RDT supply chains
- Price and availability of antimalarials and RDTs
- The policy and regulatory environment.

We will take notes during the interview.

How long will the interview take?

The interview with you should take approximately 1 hour.

Are there any disadvantages or advantages involved in taking part?

There are no individual benefits to taking part, but in answering our questions you will help improve our understanding of the antimalarial market, and so potentially benefit all Ugandans. The only disadvantage for you is the time to complete the interview.

Who will have access to the information I give?

We would like your permission to identify you by name, or other identifying information like the organization you work for, your business title, and your occupation. We would also like your permission to quote this interview. If you do not wish to be named or quoted, the information gathered from this interview is confidential and will be kept private. We will not share individual information about you with anyone beyond our research team. Instead, the knowledge gained from this interview will be shared in summary form, without revealing individuals' identities. Your decision to be named and quoted is voluntary.

What will happen if I refuse to participate?

Participation in this research is completely voluntary. You are free to decide if you want to take part in this study. If you do agree, you can still change your mind at any time. You can refuse to answer any specific question, or stop the interview at any point. If you choose not to answer a question, stop the interview or not participate there will not be any negative implications for you.

What if I have any questions?

If you have any questions, you can ask them now, during the interview or later. If you wish to ask questions later, you may contact any of the following members of the study team:

Dr Kara Hanson

Reader in Health Economics and Policy, Health Policy Unit, London School of Hygiene and Tropical Medicine, London UK, The email address is Kara.Hanson@lshtm.ac.uk

Long Dianna

Strategic Information Director, Population Services International-Cambodia. The telephone number is 016 53 11 35.

Phok Sochea

Malaria Research Manager, Population Services International-Cambodia. The telephone number is 017 562 568.

This study has been reviewed and approved by the Cambodia National Ethics Committee, which is a committee whose task is to make sure that research participants are protected from harm

**Supply Chain Study Key Informant Interview
Certificate of Consent**

I have read the information sheet for the above study to interviewee of _____ in a language he/she understands. He/she was given the opportunity to ask questions and seek clarification.

He/she gives voluntary consent to take part in the study.

Signature of researcher _____ Date _____

Day/month/year

Print name of researcher _____ Edith Patouillard _____

**Supply Chain Study Key Informant Interviews
Interview Guide**

Key Informant Details

Name:	
Organisation:	
Department/Unit:	
Position:	
Length of time with organization:	
Sector: Public or Private or NGO:	
Type of organization:	
Address:	
Telephone:	
Mobile:	
Email:	

Interview Details

Interviewer Name:	Edith Patouillard
Language in which the interview was conducted (name of translator)	
Interview Date (dd/mm/yyyy):	
Start Time (hh:mm):	
Interview Location:	
Information forms provided:	
Consent obtained	
End Time (hh:mm):	

The Supply Chain for Antimalarials

1. Regarding the interviewee's role in the antimalarial supply chain:

- a. Please tell me about your organization and the role it plays in the supply chain for antimalarials.
- b. Please tell me about yourself, your position in the organization, and your role.

2. Regarding the overall antimalarial supply chain:

- a. What are the main levels of the antimalarial supply chain, and what happens at each level?
- b. Who are the main actors at each level of the supply chain (i.e. businesses, NGOs, procurement agencies, international organizations, and donors)?
- c. What are the roles and main activities of actors at each level of the supply chain?
- d. Roughly how many businesses of each type are there? Where are they located?
- e. At each level of the supply chain, are certain businesses responsible for a major share of the market?
- f. Do lists of importers, wholesalers, distributors and outlets at various levels exist?

3. Regarding the price and availability of antimalarials:

- a. Please name the main antimalarial medications (both generic and brand names) that are available in the country.
If at the Pharmaceutical Regulatory Authority, do you have a list of all antimalarials registered in the country?
- b. As best as you can, please try to estimate the sales volume for each brand, class, preparation, therapeutic category etc. of the antimalarials that you mentioned
- c. As best as you can, please try to estimate the retail price for each brand, class, preparation, therapeutic category etc. of the antimalarials that you mentioned
- d. To the best of your ability and being as specific as you can, please estimate the price mark-ups at each level of the supply chain
- e. Please comment on the availability of the antimalarials that you mentioned before. For example:
 - i. Are some products more readily available compared to others?
 - ii. Are there currently or have there recently been problems with the availability of antimalarials?

The Supply Chain for RDTs

4. Regarding the interviewee's role in the RDT supply chain:

- a. Please tell me your organization and the role it plays in the supply chain for RDTs
- b. Please tell me about your role in the supply chain for RDTs

5. Regarding the overall RDT supply chain

- a. Is the supply chain for RDTs distinct from the supply chain for antimalarials?
- b. What are the main levels of the supply chain, and what happens at each level?
- c. Who are the main actors at each level of the supply chain (ie. businesses, NGOs, procurement agencies, international organizations, and donors)?
- d. What are the roles and main activities of actors at each level of the supply chain?
- e. Roughly how many businesses of each type are there? Where are they located?
- f. At each level of the supply chain, are certain businesses responsible for a major share of the market?
- g. Do lists of importers, wholesalers, distributors and outlets at various levels exist?

6. Regarding the price and availability of RDTs.

- a. Please name the main RDTs that are available in the country?
- b. best as you can, please try to estimate the sales volume for each brand, product type, etc. of RDT that you mentioned.
- c. As best as you can, please try to estimate the retail prices for each of the RDT products that you mentioned
- d. To the best of your ability and being as specific as you can, please estimate the price mark-ups at each level of the supply chain.
- e. Please comment on the availability of RDTs that you mentioned before. For example:
 - i. Are some products more readily available compared to other?
 - ii. Are there currently or have there recently been problems with the availability of RDTs?

Policies and Regulations

7. Issuing of licenses, permits, and registration for importers, wholesalers, distributors, and outlets

- a. Are there different categories of licenses for importers, wholesalers, distributors and outlets?
- b. What are the conditions, requirements and processes of licensing/permits/registration? What is the fee structure for licenses/permits/registrations?
- c. How many licenses, permits or registrations were granted this year?
- d. In your opinion, how easy or difficult is it for potential new importers, wholesalers or distributors to enter the markets?
- e. Is there a probationary period for new entrants?
- f. How often must licenses, permits and registrations be renewed? How much does renewal cost?
- g. Please comment on the implementation of these regulations for importers, wholesalers, distributors, and outlets. For example,
 - i. Is it common for businesses to operate without the appropriate license?
 - ii. Why do some businesses choose to operate without the appropriate license?
 - iii. What would you change about licensing and registration arrangements or processes?

8. Regulations

- a. What are the main documents regulating the supply chain for antimalarials?
- b. Please describe the main policies and regulations that dictate the activities of actors at each level of the supply chain for antimalarials.
- c. Please describe the main policies and regulations that dictate the activities of actors at each level of the supply chain for RDTs
- d. Are there any regulations about how the drugs are kept or dispensed, or the types of packaging allowed?
- e. Are there other regulations for businesses related to their operation (ex. staffing, building, etc)?
- f. How is compliance with regulations of antimalarial markets enforced and monitored?
 - i. What type of inspections are conducted at each level of the supply chain?
 - ii. How often are inspections conducted? (in theory and in practice...)
- g. What are some of the findings from recent inspections?
- h. Please comment on the effectiveness of these regulations. For example:
 - i. Is it common to find businesses flouting these regulations?
 - ii. Have there ever been problems such as fake drugs, smuggled drugs, or drugs leaking from public health facilities?
 - iii. What changes to regulations would you like to see?

9. Taxes and Tariffs

- a. Please describe the main taxes that must be paid by actors at each level of the supply chain for antimalarials
- b. Does the tax status of antimalarials differ from other drugs? How?
- c. Please describe the main taxes that must be paid by actors at each level of the supply chain for RDTs.
- d. How are the tax rates set?
- e. How are these taxes paid?
- f. What records of goods bought and/or income must be kept for taxation purposes
- g. What are the costs (official and unofficial) of obtaining clearance for antimalarials?
- h. Please comment on the implementation of taxes and tariffs?
 - i. Are there any problems with taxes not being paid?
 - ii. What impact do taxes have on the supply chain for antimalarials?
 - iii. What would you change about these taxes?

10. Guidelines for treating malaria

- a. What are the most up-to-date guidelines for the treatment of malaria?
- b. Have the most up-to-date guidelines been implemented?
- c. Do you have any opinions on the current national guidelines for the treatment of malaria (either for adults or children, uncomplicated or complicated etc.)? For example:
 - i. Can you comment on the relevance of current national guidelines?
 - ii. How well are they disseminated amongst providers of treatment?
 - iii. Do they impact the prescribing habits or otherwise affect demand for antimalarials?

11. Other key factors affecting antimalarial and RDT availability and price

- a. Please comment on the amount of competition within the antimalarial and RDT market at all levels of the supply chain?
- b. Are there any interventions/pilots that could affect the antimalarial or RDT markets?
- c. Are there any other important factors that affect antimalarial and RDT availability and price in the country?

End Time (hh:mm):

Topic guide for group discussions with data collectors undertaken for the comparative analysis of recall and retail audit methods for measuring wholesale and retail sales volumes

Start with ice-breaking session: funny story from the field?

Areas of discussion:

- 1) Willingness and availability of respondents to participate in SLS1 and SLS2
- 2) Availability of written sales records at first and second visits of the Dales Level SurveySalesLS1 and SLS2
- 3) For the recall method, can you describe your experience in collecting:
 - a. Sales volumes data for antimalarials? How did it compare with RDT?
 - b. Sales volumes data for antimalarials in tablet form? How did it compare to non-tablet?
 - c. Sales volumes data for packs of antimalarials? How did compare to loose tablets or/and tablet in non-original packaging?
- 4) For the retail audit method, can you describe your experience in collecting
 - a. Stock data for antimalarials (E.g. was it possible to count the stocks? If not, why? How did it compare with RDT?
 - b. Stock data for antimalarials in tablet form? How did it compare to non-tablet?
 - c. Stock data for packs of antimalarials? How did compare to loose tablets or/and tablet in non-original packaging?
 - d. Repeat questions a. to c. for data on quantities disposed and quantities received
 - e. How was your experience in collecting a-d at SLS2?
- 5) Did you experience any challenge in implementing the recall method? The retail audit method? What has been your biggest challenge?
- 6) How would you describe the attitudes of shopkeepers towards each method?
- 7) Do you have any other comments?
- 8) Do you have questions?

APPENDIX 5 Calculating antimalarial adult equivalent treatment dose

Active ingredient	Dose(mg) used for calculating 1 AETD*	Active ingredient used for AETD calculation in combination therapy	Notes and data source
Arteether	1050mg		WHO Use of Antimalarials, 2001
Artemether	960mg		WHO Use of Antimalarials, 2001
Artemisinin-Piperaquine-Primaquine	576mg	Artemisinin	Tangpukdee, N. et al. 2008. Efficacy of <i>Artequick</i> versus ACT artesunate and mefloquine in the treatment of acute uncomplicated <i>falciparum</i> malaria in Thailand. The Southeast Asian Journal of Tropical Medicine and Public Health. 39(1): 1-8 http://imsear.hellis.org/handle/123456789/33676
Artesunate	960mg		WHO Use of Antimalarials, 2001
Artesunate-Mefloquine	600mg	Artesunate	Manufacturer Guidelines (<i>Artequin Adult – Mepha</i>)
Chloroquine	1500mg		WHO Model Formulary, 2008
Dihydroartemisinin	480mg		Manufacturer Guidelines (<i>Cotecxin – Holleypharm; MALUether – Euromedi</i>)
Dihydroartemisinin-Piperaquine	360mg	Dihydroartemisinin	Manufacturer Guidelines (<i>Duo-cotecxin – Holleypharm</i>)
Mefloquine	1000mg		WHO Use of Antimalarials, 2001
Primaquine	45mg		This dose is for the gametocytocidal treatment of <i>P. Falciparum</i> . WHO Model Formulary, 2008
Quinine	12600mg		This dose is for quinine sulphate, a salt, as quinine strengths are normally reported for salts. The total dose for quinine base based on 24mg/kg is 10080mg for a 60kg adult. WHO Model Formulary, 2008
Sulfadoxine-Pyrimethamine	1500mg	Sulfadoxine	WHO Model Formulary, 2008

AETD is for adult equivalent treatment dose for a 60kg adult

Source: Adapted from PSI for the ACTwatch project, 2010

APPENDIX 6

Weights used in the analysis of ACTwatch Outlet Survey data

District	Sub-district	Strata	Strata Population	Sub-District Population	District Population	Total PHFs in District (Sample frame)	Number PHFs ¹ visited	Weightfor PHF	Weight for non-PHF
Anlong Veaeang	Anlong Veaeang	MDR S/C	1,463,025	19,883	26,482	2	28	0.50	0.66
Thpong	Anluong Chrey	MDR S/C	1,463,025	10,217	38,920	4	15	0.34	1.29
Krakor	Ansa Chambak	MDR S/C	1,463,025	7,115	53,312	6	6	0.25	1.85
Rovieng	Chhnuon	MDR S/C	1,463,025	5,355	31,138	4	21	0.42	2.46
Choam Khsant	Choam Ksant	MDR S/C	1,463,025	11,379	18,674	2	14	0.71	1.16
Kampot	Kampong Kraeng	MDR S/C	1,463,025	17,280	100,245	7	15	0.13	0.76
Prasat Bakong	Kantreang	MDR S/C	1,463,025	16,140	42,881	4	4	0.31	0.82
Chhuk	Koh Sla	MDR S/C	1,463,025	13,789	25,880	16	25	0.51	0.96
Sala Krau	Psar Prum	MDR S/C	1,463,025	6,074	28,269	1	5	0.47	2.17
Kralanh	Saen Sokh	MDR S/C	1,463,025	17,472	51,318	5	7	0.26	0.75
Srae Ambel	Srae Ambel	MDR S/C	1,463,025	23,009	34,090	2	5	0.39	0.57
Chum Kiri	Srae Chaeng	MDR S/C	1,463,025	16,293	46,080	4	34	0.29	0.81
Smach Mean Chey	Stueng Veaeang	MDR S/C	1,463,025	9,449	30,059	3	3	0.44	1.39
Svay Chek	Svay Chek	MDR S/C	1,463,025	12,814	12,814	5	17	1.03	1.03
Phnum Kravanh	Ta Sah	MDR S/C	1,463,025	19,779	58,127	4	19	0.23	0.67
Kampong Seila	Takavit	MDR S/C	1,463,025	13,307	13,307	1	4	0.99	0.99
Tbaeng Mean chey	Tbaeng Mean chey	MDR S/C	1,463,025	23,814	23,814	3	14	0.55	0.55
Kamrieng	Trang	MDR S/C	1,463,025	16,973	32,480	3	4	0.41	0.78
Varin	Varin	MDR S/C	1,463,025	10,552	10,552	2	23	1.25	1.25
Memot	Choam Triek	MDR Free	1,519,546	15,945	123,903	10	12	0.12	0.86
Sesan	Kampun	MDR Free	1,519,546	6,906	12,970	11	6	1.18	1.98
Sameakki Mean Chey	Krang Lvea	MDR Free	1,519,546	18,571	30,635	4	4	0.50	0.74
Santuk	L'ak	MDR Free	1,519,546	9,886	17,586	7	6	0.87	1.38
Sambour	Ou Krieng	MDR Free	1,519,546	14,463	34,620	26	19	0.44	0.95
Ou Reang	Ou Reang	MDR Free	1,519,546	1,826	4,159	6	8	3.68	7.49
Tboung Khmum	Roka Po Pram	MDR Free	1,519,546	16,629	58,150	15	19	0.26	0.82
Prasat Sambour	Sambour	MDR Free	1,519,546	12,579	54,810	3	3	0.28	1.09
Mittakpheap	Sangkat Muoy	MDR Free	1,519,546	32,439	67,775	3	3	0.23	0.42
Kiri Vong	Saom	MDR Free	1,519,546	16,692	16,692	9	10	0.92	0.82
Sameakki Mean Chey	Svay Chuk	MDR Free	1,519,546	12,064	30,635	4	4	0.50	1.13
Chamkar Leu	Ta Prok	MDR Free	1,519,546	6,256	38,529	11	11	0.40	2.19
Thala Barivat	Thala Borivath	MDR Free	1,519,546	12,883	12,883	17	21	1.19	1.06
Kracheh	Thma Kreae	MDR Free	1,519,546	12,377	91,031	17	21	0.17	1.11
Prey Chhor	Thma Pun	MDR Free	1,519,546	12,479	27,528	12	74	0.56	1.10
Tram Kak	Tram Kak	MDR Free	1,519,546	13,642	68,188	13	11	0.22	1.00
Prey Chhor	Trapeang Preah	MDR Free	1,519,546	15,049	27,528	12	74	0.56	0.91
Stoung	Trea	MDR Free	1,519,546	11,146	11,146	9	8	1.37	1.23
Dambae	Tuek Chrov	MDR Free	1,519,546	16,021	53,373	3	6	0.29	0.85

¹PHF is Public Health Facility. Source: PSI, personal communication. Adapted by the author.

APPENDIX 7 Factors for scaling-up monthly sales volumes to the whole year

Month	Number of cases treated in 2009 in the public sector†	Scale-up factor ±
January	6,000	0.67
February	4,000	0.44
March	3,900	0.43
April	4,200	0.47
May	7,000	0.78
June (month of data collection)	9,000	1.00
July	9,500	1.06
August	9,400	1.04
September	9,500	1.06
October	8,000	0.89
November	8,000	0.89
Dec	7,500	0.83
Total	86,000	

†source CNM Annual Progress report, 2009

± $\frac{\text{Number of cases treated in a given month in 2009}}{\text{Number of cases treated during the study month (June 2009)}}$

APPENDIX 8 Procurement costs of antimalarials in the public sector

Active Ingredient	Unit	Unit Procurement Cost ¹	AETD Procurement Cost ³
Artesunate and Mefloquine	Blister Tablets 600mg ²	\$3.60	\$4.14
Dihydroartemisinin+Piperaquine	Blister Tablets 320mg ²	\$2.10	\$2.42
Artesunate	Tablet 50mg	\$0.10	\$2.21
Artesunate	Suppository 50mg	\$0.34	\$7.51
Artemether	Ampoule 80mg	\$0.30	\$6.62
Mefloquine	Tablet 250mg	\$0.45	\$2.07
Chloroquine	Tablet 150mg	\$0.01	\$0.12
Quinine	Tablet 300mg	\$0.45	\$21.74

¹Unit Procurement costs of Chloroquine, Mefloquine, Artesunate and Dihydroartemisinin+Piperaquine were collected from the Central Medical Stores records and the CNM in September 2009 and 2010; ² Strength of artemisinin derivative; ³ AETD is for adult equivalent treatment dose. The cost of one AETD was calculated using information on number of units required for 1 AETD and unit procurement costs, inflated by 15% to account for additional costs whilst in-country (e.g. transport and storage).

APPENDIX 9
Chain Study

Sample of 20 sub-districts sampled for the ACTwatch Supply

Stratum with suspected/confirmed Multi-drug resistance (MDR)	Stratum without Multi-drug resistance (MDR)
Sub-district name	Sub district name
Anlong Chrey	L'ak
Ansa Chambak	Svay Chuk
Chhnuon	Saom
Choam Ksant	Ou Krieng
Psar Prum	Trea
Sen Sok	Thala Barivat
Stueng Veaeng	Tram Kak
Takavit (Kampong Seila)	Sambour
Trang	Ta Prok
Varin	Tham Pun

APPENDIX 10 Coding scheme for qualitative data analysis

MARKET STRUCTURE	MARKET DEFINITION	RANGE OF SELLERS & BUYERS
		RANGE OF PRODUCTS
	MARKET CONCENTRATION	
	HORIZONTAL INTEGRATION	
	DISTRIBUTION CHAIN STRUCTURE	
	BARRIERS TO ENTRY	SIZE OF THE MARKET
	REGULATORY FACTORS	
	LACK OF EXPERIENCE	
	LACK OF CAPITAL	
	EXITING THE MARKET	
PROVIDER CONDUCT	PRODUCT DIFFERENTIATION BETWEEN OUTLETS	CUSTOMER DEMAND/ PREFERENCES
		LOCATION
		DRUG AVAILABILITY
		EXPERTISE & REPUTATION
		PERCEIVED DRUG QUALITY
		PERSONAL RELATIONSHIPS
		BLOOD TESTING SERVICES
		PRODUCT PROMOTION
		CREDIT FACILITIES
		DELIVERY SERVICES
	PRICE COMPETITION	
VERTICAL RESTRAINTS	VOLUMES	
	RECOMMENDED RETAIL PRICE	
	PRODUCT BUNDLING	
REGULATION	PUBLIC PRIVATE LINKS	
	OUTLET LICENSES	
	HEALTH QUALIFICATIONS	
	DRUG REGISTRATION	
	INSPECTIONS	
	CLAPDOWN ON UNLICENSED BUSINESSES	
	BAN ON AMT	
	BAN ON PRIVATE SECTOR SALES	
	STOCKING PROHIBITED PRODUCTS	
	EXPIRED PRODUCTS	
	FAKE AND SUBSTANDARD DRUGS	
	DRUG LEAKAGES IN THE DISTRIBUTION CHAIN	
	KNOWLEDGE OF DRUG REGULATION	
	SUGGESTIONS	
INTERVENTIONS (NON-REGULATORY)	PROVISION OF INFORMATION	
	TRAINING OF PRIVATE PROVIDERS	
	SUGGESTIONS	
REFLEXIVITY		

APPENDIX 11 HHI on antimalarial sales values and volumes by market

Stratum	Commune Name	HHI on antimalarial sales values ¹	HHI on antimalarial sales volumes ¹
MDR Free	ANLONG CHREI	1.00	1.00
	BOENG LVEA	0.26	0.27
	CHANG KRANG	0.32	0.30
	DAK DAM	1.00	1.00
	KAMPONG THMA	0.12	0.12
	KAMPUN	1.00	1.00
	KANG CHAM	0.54	0.56
	KAOH SNAENG	0.66	0.38
	KBAL DOMREI	0.19	0.16
	KBAL RO MEAS	1.00	1.00
	KRANG LVEA	0.36	0.21
	KRAYA	0.20	0.28
	OU KRIENG	0.22	0.17
	PEAM		
	PHLUK		
	ROKAPOPRAM	0.29	0.26
	ROLUOS MEANCHEY	0.54	0.69
	RUNG	1.00	1.00
	SAM KUOY	1.00	1.00
	SAMANG	1.00	1.00
	SAMBOK	0.18	0.28
	SAMBOUR		
	SANGKAT MUOY		
	SAOM	0.62	0.51
	SDOU		
	SEN MONOROM	0.64	0.64
	SRAE CHIS	0.63	0.46
	SRAE KOR		
	SRAE RUESSEI	1.00	1.00
	SVAY CHUK	0.37	0.37
	TA LAT		
	TAPROK	0.68	0.46
	THALABARIVAT	0.26	0.38
TMA KRAE	0.29	0.31	
TMA PUN	0.52	0.60	
TRAMKAK	0.32	0.32	
TRAMUNG	0.40	0.43	
TRAPEANG PREAH			
TREA			
TUEK CHROV	0.33	0.43	
MDR Suspected or Confirmed	ANLONG VEAENG	0.13	0.15
	ANSA CHAMBAK	0.71	0.59
	BAK CHENHCHIEN	0.22	0.19
	BOENG REANG	0.58	0.30
	CHAMKAR LUONG	0.96	0.83
	CHHEAN MUKH	0.69	0.68
	CHI KHA KROAM	0.50	0.50
	CHI KHA LEU	0.43	0.43
	CHOAM KHSANT	0.18	0.21
	DANG PEANG	0.50	0.49
	DANG TONG	1.00	1.00
	KAMPONG KRAENG	0.64	0.54
	KAMPONG SEILA	0.19	0.20
	KANTREANG	1.00	1.00
	KROUNCH KOR	1.00	1.00
	LUMTONG	0.49	0.74

Stratum	Commune Name	HHI on antimalarial sales values ¹	HHI on antimalarial sales volumes ¹
	LVEA KRANG	0.72	0.62
	MEAKPRANG		
	OU BAK ROTEH	0.26	0.29
	OU DA	0.38	0.60
	PAL HAL	0.12	0.24
	PHTEAH RUNG	0.28	0.25
	POU	0.36	0.36
	PRAMBEI MOM	0.32	0.34
	PREAH KHLAENG	0.35	0.40
	PRING THUM	0.50	0.50
	RATHANAK	0.30	0.28
	RIEB ROY	0.48	0.45
	ROLUOS		
	RUOS ROAN	0.62	0.73
	SAEN SOKH	0.68	0.68
	SNAYANH CHET	1.00	1.00
	SRAE AMBEL	0.30	0.28
	SRAE CHAENG	0.58	0.58
	SRAE KNONG	0.72	0.83
	STEUNG KAEV	0.58	0.60
	STUENG KACH	0.20	0.36
	STUENG VEAENG		
	SVAY CHEK		
	TA KAEN	0.52	0.56
	TA SAEN	0.28	0.25
	THLAT	0.38	0.42
	TRANG	0.29	0.34
	TRAPEANG PLANG	0.26	0.28
	TRAPEANG TAV		
	TUEK KRAHAM	0.61	0.49
	VARIN	0.55	0.51

¹ A blank cell refers to the case where the HHI could not be calculated because of total sales volumes during the week preceding the survey being null in the corresponding market

APPENDIX 12 Correlations between predictor variables

	HHI_VOL	HHI_VAL	STRATUM	ACCESS	RISK	DOSE FORM	OUTLET TYPE	GENERIC TYPE	SUPPLIER DELIVERS	OUTLET LENGTH OPERATION	BRAND	SALES VOLUMES
HHIVOL	1.00											
HHIVAL	0.89*	1.00										
STRATUM	0.13*	0.06	1.00									
ACCESS	-0.25*	-0.20*	0.11*	1.00								
RISK	-0.04	-0.01	0.25*	-0.01	1.00							
DOSE FORM	-0.05	-0.04	-0.05	0.01	0.06	1.00						
OUTLET TYPE	0.13*	0.12*	-0.26*	-0.17*	-0.12*	0.04	1.00					
GENERIC TYPE	-0.05	-0.05	-0.08-	-0.01	-0.17*	-0.14*	0.14*	1.00				
SUPPLIERS DELIVERS	-0.09	-0.09*	0.23*	0.12*	0.25*	0.03	-0.45*	-0.18	1.00			
OUTLET LENGTH OPERATION	-0.09*	-0.05	-0.03	0.13*	-0.03	0.03	0.02	0.01	-0.01	1.00		
BRAND	-0.01	-0.03	0.13*	0.04*	0.11*	-0.24*	-0.13*	-0.16	0.08*	-0.02	1.00	
SALES VOLUMES	-0.07	-0.10*	0.09*	0.04	-0.05	-0.10	-0.15	0.05	0.14*	0.06	-0.03	1.00

*indicates $P \leq 0.05$

APPENDIX 13 Calculation of interaction coefficients

Table A.13.1 Effects of strata on retail percent price mark-ups across market accessibility levels (All AM, HHI value)

Effects in MDRSC stratum compared to baseline MDRF stratum

Effect of strata across different strata	Coefficient	P-value
ACCESSIBILITY_LOW	0.716	<0.001
ACCESSIBILITY_MODERATE	0.716	<0.001
ACCESSIBILITY_ACCESSIBLE	0.072	0.672

Table A.13.2 Effect of strata on retail percent price mark-ups across market accessibility levels (ASMQ only, HHI volume)

Effects in MDRSC stratum compared to baseline MDRF stratum

Effect of strata across different accessibility levels	Coefficient	P-value
ACCESSIBILITY_LOW	-0.535	0.001
ACCESSIBILITY_MODERATE	-0.535	0.001
ACCESSIBILITY_ACCESSIBLE	0.258	0.186

Table A.13.3 Effect of an increase in market concentration on retail percent mark-ups across market accessibility levels (ASMQ, HHI volume)

Effect of a change in HHI across different strata	Coefficient	P-value
ACCESSIBILITY_LOW	-0.980	0.002
ACCESSIBILITY_MODERATE	1.765	<0.001
ACCESSIBILITY_ACCESSIBLE	-0.057	0.900

Table A.13.4 Effect of strata on retail percent price mark-ups across market accessibility levels (ASMQ only, HHI value)

Effects in MDRSC stratum compared to baseline MDRF stratum

Effect of accessibility across different strata	Coefficient	P-value
ACCESSIBILITY_LOW	-0.723	<0.001
ACCESSIBILITY_MODERATE	-0.723	<0.001
ACCESSIBILITY_ACCESSIBLE	0.246	0.197

Points 1) to 5) describe the model with interactions and calculations of coefficients.

1) How are retail mark-ups affected by market concentration in markets at different levels of accessibility?

- The model is:

$$Y_i = B_0 + B_1 * HHI + B_2 * HHI * ACCESS_MODERATE + B_3 * HHI * ACCESSIBILITY_HIGH + B_4 * ACCESSIBILITY_MODERATE + B_5 * ACCESSIBILITY_HIGH$$

- The coefficients representing the predicted retail mark-ups Y_i are:

	HHI
ACCESSIBILITY_LOW (omitted)	$B_0 + B_1$
ACCESSIBILITY_MODERATE	$B_0 + B_1 + B_2 + B_4$
ACCESSIBILITY_HIGH	$B_0 + B_1 + B_3 + B_5$

- The effect of an increase in HHI on Y_i in moderately accessible markets compared to remote markets is $B_0 + B_1 + B_2 + B_4 - B_0 - B_1 = B_2 + B_4$
- The effect of an increase in HHI on Y_i in accessible markets compared to remote markets is $B_0 + B_1 + B_3 + B_5 - B_0 - B_1 = B_3 + B_5$

2) How are retail mark-ups affected by accessibility across strata?

- The model is:

$$Y_i = B_0 + B_1 \text{ ACCESSIBILITY_MODERATE} + B_2 \text{ ACCESSIBILITY_HIGH} + B_3 \text{ Stratum MDRSC} + B_4 \text{ ACCESSIBILITY_MODERATE} * \text{STRATUM_MDRSC} + B_5 \text{ ACCESSIBILITY_HIGH} * \text{STRATUM_MDRSC}$$

- The coefficients representing the predicted retail mark-ups Y_i are:

	Stratum MDRF (omitted)	Stratum MDRSC
ACCESSIBILITY_LOW (omitted)	B0	B0+B3
ACCESSIBILITY_MODERATE	B0+B1	B0+B3+B1+B4
ACCESSIBILITY_HIGH	B0+B2	B0+B3+B2+B5

- In the MDRF stratum, compared to remote markets (baseline), the effect of being sold in moderately accessible markets on retail mark-ups is $B_0 + B_1 - B_0 = B_1$
- In the MDRF stratum, compared to remote markets (baseline), the effect of being sold in an accessible market is $B_0 + B_2 - B_0 = B_2$
- In the MDRSC stratum, compared to remote markets (baseline), the effect of being sold in moderately accessible markets on retail mark-ups is $B_0 + B_3 + B_1 + B_4 - B_0 - B_3 = B_1 + B_4$
- In the MDRSC stratum, compared to remote markets (baseline), the effect of being sold in moderately accessible markets on retail mark-ups is $B_0 + B_3 + B_2 + B_5 - B_0 - B_3 = B_2 + B_5$

3) How are retail mark-ups affected by strata across markets at different levels of accessibility? As for 2) above,

- The model is:

$$Y_i = B_0 + B_1 \text{ ACCESSIBILITY_MODERATE} + B_2 \text{ ACCESSIBILITY_HIGH} + B_3 \text{ Stratum MDRSC} + B_4 \text{ ACCESSIBILITY_MODERATE} * \text{STRATUM_MDRSC} + B_5 \text{ ACCESSIBILITY_HIGH} * \text{STRATUM_MDRSC}$$

- The coefficients representing the predicted retail mark-ups Y_i are:

	Stratum MDRF (omitted)	Stratum MDRSC
ACCESSIBILITY_LOW (omitted)	B0	B0+B3
ACCESSIBILITY_MODERATE	B0+B1	B0+B3+B1+B4
ACCESSIBILITY_HIGH	B0+B2	B0+B3+B2+B5

- In remote markets, the effect of being sold in MDRSC stratum compared to MDRF is $B_0+B_3-B_0=B_3$
- In moderately accessible markets, the effect of being sold in MDRSC stratum compared to MDRF is $B_0+B_3+B_1+B_4-B_0-B_1=B_3+B_4$

4) How are retail mark-ups affected by accessibility across markets at different levels of malaria transmission risks?

- The model is:

$$Y_i = B_0 + B_1 \text{ moderate access} + B_2 \text{ high access} + B_3 \text{ moderate risk} + B_4 \text{ low risk} + B_5 \text{ moderate risk} * \text{moderate access} + B_6 \text{ moderate risk} * \text{high access} + B_7 \text{ low risk} * \text{moderate access} + B_8 \text{ low risk} * \text{high access.}$$

- The coefficients representing the predicted retail mark-ups Y_i are:

	ACCESSIBILITY_LOW (omitted)	ACCESSIBILITY_MODERATE	ACCESSIBILITY_HIGH
RISK_HIGH (omitted)	B0	B0 + B1	B0 + B2
RISK_MODERATE	B0 + B3	B0 + B1 + B3 + B5	B0 + B2 + B3 + B6
RISK_LOW	B0 + B4	B0 + B1 + B4 + B7	B0 + B2 + B4 + B8

- In market at high risk of malaria transmission, the effect of being sold in a moderately accessible market rather than in a remote market is $B_0+B_1-B_0=B_1$
- In market at high risk of malaria transmission, the effect of being sold in an accessible market rather than in a remote market is $B_0+B_2-B_0=B_2$

- In markets at moderate risk of malaria transmission, the effect of being sold in a moderately accessible market rather than in a remote market is $B_0+B_1+B_3+B_5-B_0-B_3=B_1+B_5$
- In markets at moderate risk of malaria transmission, the effect of being sold in an accessible market rather than in a remote market is $B_0 + B_2 + B_3 + B_6 - B_0 - B_3=B_2+B_6$
- In markets at low risk of malaria transmission, the effect of being sold in a moderately accessible market rather than in a remote market is $B_0 + B_1 + B_4 + B_7 - B_0 + B_4=B_1+B_7$
- In markets at low risk of malaria transmission, the effect of being sold in an accessible market rather than in a remote market is $B_0+B_2+B_4+B_8-B_0-B_4=B_2+B_8$

5) How are mark-ups affected by malaria transmission risk across markets at different levels of accessibility?

As for 4) above,

- The model is:

$Y_i = B_0 + B_1$ moderate access + B_2 high access + B_3 moderate risk + B_4 low risk + B_5 moderate risk * moderate access + B_6 moderate risk * high access + B_7 low risk * moderate access + B_8 low risk * high access.

- The coefficients representing the predicted retail mark-ups Y_i are:

	ACCESSIBILITY_ LOW (omitted)	ACCESSIBILITY_ MODERATE	ACCESSIBILITY_ HIGH
RISK_HIGH (omitted)	B_0	$B_0 + B_1$	$B_0 + B_2$
RISK_MODERATE	$B_0 + B_3$	$B_0 + B_1 + B_3 + B_5$	$B_0 + B_2 + B_3 + B_6$
RISK_LOW	$B_0 + B_4$	$B_0 + B_1 + B_4 + B_7$	$B_0 + B_2 + B_4 + B_8$

- In remote markets, the effect of being sold in a market at moderate risk compared to market at high risk is $B_0+B_3-B_0=B_3$
- In remote markets, the effect of being sold in a market at low risk compared to market at high risk is $B_0+B_4-B_0=B_4$
- In moderately accessible markets, the effect of being sold in a market at moderate risk compared to market at high risk is $B_0 + B_1 + B_3 + B_5 - B_0 - B_1=B_3+B_5$
- In moderately accessible markets, the effect of being sold in a market at low risk compared to market at high risk is $B_0 + B_1 + B_4 + B_7 - B_0 - B_1=B_4+B_7$
- In accessible markets, the effect of being sold in a market at moderate risk compared to market at high risk is $B_0 + B_2 + B_3 + B_6 - B_0 - B_2=B_3+B_6$
- In accessible markets, the effect of being sold in a market at low risk compared to market at high risk is $B_0 + B_2 + B_4 + B_8 - B_0 - B_2=B_4+B_8$

APPENDIX 14 Identifying antimalarial wholesalers through two different methods

Methods	Bottom up	Snowball census
Provinces •district	Number of antimalarial wholesalers identified	Number of additional antimalarial wholesalers identified
Phnom Penh		
•Chamkar Morn	5	n/c ²
Kampong Cham		
•Chamkar Leu	3	n/a ³
•Prey Chhor	1	n/a
Kratie		
•Kracheh Khan	7	1
•Sambo	3	8
•Smach Meanchey	1	3
Battambang		
•Battambang	4	n/c
•Kamrieng	3	n/c
Pailin		
•Pailin	6	n/c
Steung Treng		
•Thalabarivat	1	2
•Steung Treng	6	2
Siem Reap		
•Siem Reap	3	0
•Varin	2	2
•Puok	1	1
•Kralanh,	1	2
•Angkor Chum	1	2
Pursat		
•Sampov Meas	1	n/c
Takeo		
•Tramkak	2	1
Bantey Meanchey		
•Serey Sophorn	4	n/c
Kampong Thom		
•Stoung	2	4
•Baray	1	1
•Sambo	3	0
•Stung Sen	9	0
Preah Vihear		
•Tbaeng Meanchey	3	0
•Rovieng	3	2
•Choam Ksant	6	2
Kampong Speu		
•Phnum Srouch	1	6
•Oudong	2	3
•Cbar Morn	2	3
Kampot		
•Chhuk	1	4
•Angkor Chey	1	1
Kampong Chhnang		
•Sameakki Meanchey	1	0
•Kampong Tralach	1	0

¹ collected from the Ministry of Health provincial department; ² n/c for districts in which snowball census was refused by wholesalers; ³ n/a for districts in which the snowball census was not conducted because of logistic difficulties during fieldwork.

APPENDIX 15 Performance ranking of four methods for identifying and sampling antimalarial wholesalers

Methods	Dimensions	Score	Rationale for score
Official lists	Shape of the AM chain	1	No information.
	Total AM WS in the chain serving the study areas	1	No information on outlet that WS nor on outlet stocking AM
	Number of AM WS operating in a particular area	1	No information on antimalarial wholesalers. Some information about drug outlets, but likely to be inaccurate.
	AM WS Level of operation	2	Possible to deduct rough estimates on number of wholesalers importing antimalarials.
	AM WS name & location	2	Location and name available for drug outlet in general only and lists likely to be outdated.
	Informal AM WS	1	Rarely captures informal providers.
	Affordability	4	Cheap.
	Speed	4	Quick. Best approach.
Key Informant Interviews	Shape of the AM chain	2	Some information on overall shape but simplistic representation.
	Total AM WS in the chain serving the study areas	1	No information.
	Number of AM WS operating in a particular area	1	No information.
	AM WS Level of operation	1	No information.
	AM WS name & location	1	No information.
	Informal AM WS	1	Unlikely for authorities to openly identify informal providers.
	Affordability	4	Cheap. May be combined with collection of official lists. Best approach.
	Speed	3	Quick, although requires more time than just collecting lists.
Bottom-up Approach	Shape of the AM chain	4	Detailed information. Best approach.
	Total AM WS in the chain serving the study areas	4	Provided providers use no more than 2 supply sources.
	Number of AM WS operating in a particular area	1	No information.
	AM WS Level of operation	4	Best approach. Identifies wholesalers operating at more than one level.
	AM WS name & location	3	Some identified, but not all.
	Informal AM WS	4	Providers willingly disclosed their antimalarial supply sources.
	Affordability	1	Expensive: training, pilot, fieldwork. Requires structured or recently updated list of antimalarial wholesalers.
	Speed	2	Time consuming if antimalarial wholesalers are located far apart.
Snowball Census	Shape of the AM chain	1	No information.
	Total AM WS in the chain serving the study areas	1	No information.
	Number of AM WS operating in a particular area	3	Best approach but prone to refusals.
	AM WS Level of operation	1	No information.
	AM WS name & location	4	Detailed information. Best approach.
	Informal AM WS	3	Less good than bottom up as perceived as denunciation and prone to refusals.
	Affordability	2	Expensive: training, pilot, fieldwork (census-like), but small incremental cost when combined with bottom-up method.
	Speed	1	Time consuming if undertaken as standalone (census-like)

AM is for antimalarial, WS is for wholesaler

APPENDIX 16 Sample of antimalarial wholesalers for comparing two different methods for measuring sales volumes

Provinces	District	Number of antimalarial wholesale outlets sampled
Kampong Thom	Baray	8
	Prasat Sambo	4
	Santuk	1
	Steung Sen	12
	Stoung	3
Preah Vihear	Rovieng	4
	Tbaeng Mean Chey	5
	Choam Ksant	4
Siem Reap	Siem Reap	1
	Kralanh	2
	Angkor Chum	1
	Puok	1
	Varin	3
Banteay Mean Chey	Serey Sophorn	4
Battambang	Battambang	5
	Kamrieng	3
Kampong Cham	Chamkar Leu	1
Pailin	Pailin	5
Pursat	Pursat	1
All areas		68

APPENDIX 17 Sample of antimalarial retailers for comparing two different methods for measuring sales volumes

Provinces	Sub-district	Number of antimalarial retail outlets sampled
Kampot	Kaoh Sla	18
	Srae Chaeng	9
	Kampong Kraeng	12
Koh Kong	Stueng Veang	6
	Srae Ambel	35
	Kampong Seila	27
All areas		107