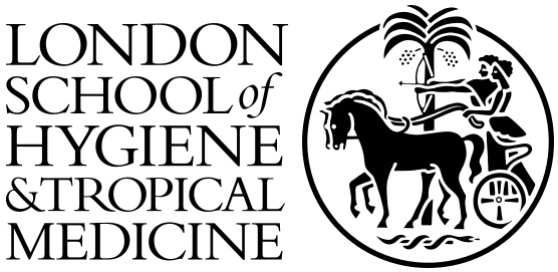

Integrated Community Case Management And Community-Based Health Planning And Services In Ghana: Assessment Of The National Implementation For The Prevention And Management Of Malaria, Diarrhoea And Suspected Pneumonia

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Thesis Submitted In Accordance With The Requirements For The Degree Of

Doctor Of Public Health Of The

University Of London

September 2017

Department Of Disease Control

Faculty Of Infectious And Tropical Diseases

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Funded By The National Malaria Control Programme, Ghana

Statement of own work

I, Blanca Escribano Ferrer, confirm that the work presented in the thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis. I acknowledge the work of Clement T Narh and Solomon A. Narh Bana in co-ordinating the fieldwork for the household surveys, the findings of which are presented in Chapter 4, 5 and 6.

Signed:……. Date: 22th September, 2017

Blanca Escribano Ferrer

Abstract

Background: Ghana has developed two main community-based strategies that aim to increase access to quality treatment for malaria, diarrhoea and suspected pneumonia, and to improve household and family practices: Home-based Care (HBC) and Community-based Health Planning and Services (CHPS). After two and eight years of HBC implementation in the Volta and the Northern Regions respectively, and more than 10 years of CHPS implementation in both regions, there was the need to assess the performance of these strategies in delivering care and preventive messages for children under-five with fever, diarrhoea or cough. **Objectives:** To assess (i) the curative component in terms of utilization, appropriate treatment given and client satisfaction; (ii) the preventive component in terms of carers' disease knowledge and health behaviour and (iii) to determine the cost per case appropriately diagnosed and treated under the HBC and CHPS. **Methods**: A household survey was conducted in the Volta and Northern Regions. The study population were carers of children under- five who had a fever, diarrhoea and/or cough in the last 2 weeks previous to the survey. In addition, a cost analysis was conducted. **Results**: HBC utilization was 17.3% and 1.0% in the Volta and Northern Regions respectively, while CHPS utilization was 11.8% and 31.3%, respectively. HBC in the Volta Region was successful in reaching the poorest, contributing to health equity. Less than 50% of malaria, diarrhoea and suspected pneumonia cases received appropriate treatment in both regions and under both strategies. Health education messages from community-based agents (CBAs) in the Northern Region were associated with the identification of at least two signs of severe malaria (adjusted Odds Ratio (OR) 1.8, 95%CI 1.0, 3.3, p=0.04), two practices that can cause diarrhoea (adjusted OR 4.7, 95%CI 1.4, 15.5, p=0.02) and two signs of severe pneumonia (adjusted OR 7.7, 95%CI2.2, 26.5, p=0.01)-the later also associated with prompt treatment ($p<0.5$). In addition, HBC was associated with prompt care seeking behaviour in the Volta Region and CHPS with prompt care seeking behaviour in the Northern Region. The cost per case appropriately diagnosed and treated was lower under the HBC than under CHPS in the Volta Region. HBC unit costs from the societal perspective were higher in the Northern Region than in the Volta Region and than CHPS due to a high number of CBAs and low preventive and curative activities. However, household costs under the HBC strategy were lower than under CHPS in both regions, reducing the burden of health care cost for families. **Conclusions**: Several actions should be undertaken to improve HBC and CHPS performance ensuring the availability of drugs and CBAs (particularly in the Northern Region). The contribution of HBC to health equity, reduced household costs, disease knowledge and healthy behaviours may justify the inclusion of HBC (preventive and curative services) in the National Health Insurance Scheme benefit package.

Acknowledgements

I would like to thank my great supervisor at the LSHTM Jayne Webster for her continue support, her dedication, her good comments and suggestions and for her patience in helping me to look at details and to be precise. Thanks very much Jayne!

I also want to thank my great supervisor in Ghana, Margaret Gyapong. Without her support, and the one of Dodowa Health Research Centre it would have been very difficult to conduct this research in Ghana. Thanks very much Margaret and I wish you the best for your research team. They are fantastic!

Many thanks as well to my advisor Jane Bruce who helped me with statistics. She was an expert in making difficult things appear easy. Many thanks to my advisor Kristian Hansen who helped me with the cost-effectiveness analysis, which was something new to me. And thanks for continuing your support even after moving from London to Denmark!

Thanks very much to Clement T Narh and Solomon A. Narh Bana from Dodowa Health Research Centre. They were great field coordinators and they gave me enormous support to conduct the household surveys. Many thanks as well to the data entry clerks, the field workers and field supervisors. Without their work experience it would have been impossible to obtain good quality data. Finally, thanks to all carers of children under- five that were interviewed. None of them rejected to participate in the study and they generously gave us their time.

I would also like to express my thanks to the National Malaria Control Programme who financed the field work and helped me with the programme information I needed. I want to particularly name Naa-Korkor Allotey and Roland Glover. There are also a number of colleagues and friends who supported me in different ways. I want to mention Patricio Marquez (World Bank), Kalipso Chalkidou (NICE), Lander Van Omen (Netherlands Embassy in Ghana), Alec Minors (LSHTM) and Paul Psychas (USAID) who helped me with information, discussions and motivation over the last few years, which have indirectly contributed to the thesis. To my examiners Eve Worral and Anja Terlouw, both from the Liverpool School of Tropical Medicine, who helped me to improve my thesis with their comments (which arrived two days before I started a new job!).

Finally, many, many thanks to my close friends and family. They kept supporting me during these four years, encouraging me since the beginning to the end. My parents, my sister Carmita and family, Jose and Mayte, Elvira and family, Carlos and family and Elena and family, my mother in low Angeles Anoll and Pilar Anoll. My friends Carlos de Ahumadas, Pablo y Nuria, Javi Alonso, Laura Buñesch, Ana de Mendoza, Sandra Pardo, Maria Ripol, Daniela Riusdili and Torto Sodja. I

love you!!! Special thanks to my sister Elena. Elenita, eres una campeona! Thanks to my children Marco, Angela and Eduardo for understanding and supporting my decision of doing this DrPH. And of course, thanks to the best husband of the world, who always believed that doing a DrPH was a great idea and always tried to encourage me when I felt tired. Juvi, mil gracias por todo. Te quiero.

Integrating statement

While working in Dodowa Health Research Centre (Ghana) being the scientific officer at the Institute of Infectious Disease of Poverty, I was in contact with many MSc and PhD students. This experience made me feel a strong need in continuing learning and improving my skills. Because of my excellent previous experience with the LSHTM doing my MSc in Epidemiology several years ago, I started to explore the research programmes at the LSHTM, where I discovered the DrPH programme. Based on my background, having worked in different countries in international cooperation and lately in a research centre, and with a desire to keep on working in a public health organisation, I believed that the DrPH programme fit better with my profile than the PhD programme.

The DrPH programme started with two compulsory modules: Evidence based Public Health Policy and Planning and Understanding Leadership, Management and Organizations. With the first module I learnt the importance of systematic reviews and how to conduct them; the relationship between research and policy/practice; the importance of research to inform evidence based policies, understanding that there are other factors that influence policy making such as values, experiences, resources or pressure groups; that researchers and policy makers are different communities with different interests, and the importance of bringing them together in order to researchers understand and focus their research on real health problems and policy makers to be willing to use research results. However, without a well performing organization to implement policies, even if they are sound and evidence based, nothing will change. Therefore, I learn different methodologies to analyse an organisation and I conducted a strategic analysis of the National Health Insurance Scheme in Ghana. I understood the importance of the management and leadership to implement a policy and to improve the health of a population. That both, good managers and leaders are important, but organizations which are over managed but under led lose any sense of spirit or purpose, while poorly managed organizations with strong charismatic leaders may soar temporary to crash shortly thereafter. I also learnt more about my personality through a residential workshop with my classmates. This was a great experience that helped me to develop my Personal Development Plan reflecting on where I am, where do I want to be and which actions do I need to undertake to attain my goal.

These compulsory modules ended with the Organizational and Policy Analysis exercise. I chose to evaluate the impact of Dodowa Health Research Centre (Ghana) on national health policies. This exercise helped me to explore different methodologies to assess the impact of research; to learn about the process of how research is generally conceived, implemented, disseminated and perceived by stakeholders in Ghana as well as identifying factors that influence the use of research for policy

making. Finally, I suggested how these findings could be considered in the Dodowa Health Research Centre strategic planning to reach its goals.

The last component of the DrPH programme was the thesis. Living in Ghana, enjoying working with infectious diseases and believing that evaluation is a necessary tool to understand where we are, to improve performance and reach goals as well as being accountable, I wanted to evaluate a malaria intervention in Ghana. Understanding the importance of research for policy making, and the barriers for translating research into policy (which I learnt during my OPA), I started a collaboration with policy makers since research conception to identify research needs. Home- based care in Ghana was gaining interests and funds, moving from malaria home- based care to integrated community case management. However, programme managers were not sure about the success of this strategy based on the routine data and were interested in deepen explore its impact. Therefore, I decided to assess the home- based care strategy, including in the study another community strategy implemented in Ghana called Community-based Health Planning and Services. After several years of national implementation, what was the performance of these strategies in delivering preventive messages and care for children under-five with fever, diarrhoea or cough? There were several studies that have looked at HBC in Ghana. However, most of these studies focused in a few districts, looked particularly at the curative component of malaria HBC and were conducted in a more "controlled" context or under research study conditions rather than in a real-life programme context. Therefore, my objectives were to assess the programme implementation of the curative component- in terms of utilization, appropriate treatment given and client satisfaction-, the preventive component- in terms of cares' disease knowledge and health behaviour- and the cost analysis of HBC and CHPS for the management of malaria, diarrhoea and pneumonia in children under-five years of age. The National Malaria Control Programme of Ghana believed this study was pertinent and decided to finance the field work. This thesis presents the introduction, the review of the evidence, the objectives, methodology, results, discussion and conclusions of this assessment.

After almost five years engaged in the thesis and the DrPH programme, I can say that I learnt and improved several personal and technical skills. Being persistent and positive was critical to finish the DrPH programme, particularly when difficult moments arrive. I learned that it was not enough to do good work- it was necessary to do perfect work, trying for our best. Being specific, sending clear messages was another critical aspect that I learnt and I am still learning. I felt the importance of understanding that every piece of research must fit in a context and must respond to a research need. I improved my technical skills in epidemiology, statistical analysis and economic evaluations. I learnt that research doesn't end with analysis and results. How we look at results, its interpretation and its significance at different levels- organizational, policy, local, regional, national or global- closes the circle and makes the difference between a good and a perfect piece of work. Finally, the

DrPH programme helped me to become a leader in Public Health that understands policy context, how to engage with stakeholders, encourage teams, communicate results, ensure high technical quality and standard of work and knows its own limitations, being able to seek advice and to learn from any opportunity.

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Acronyms

ACT	Artemisinin Combination Therapy
ARI	Acute Respiratory Infection
CBAs	Community-based Agents
CHPS	Community-based Health Planning Services
CD	Clinical Diagnosis
CDD	Community Drug Distributors
CHWs	Community Health Workers
CQ	Chloroquine
DALYs	Disability Adjusted Life Years
DHRC	Dodowa Health Research Centre
DHS	Demographic Health Survey
DrPH	Doctorate of Public Health
EPI	Expanded Programme on Immunization
FGD	Focus Group Discussion
GFATM	Global Fund for Aids, Tuberculosis and Malaria
GHS	Ghana Health Service
HBC	Home-based Care
HH	Household
HTA	Health Technology Assessment
iCCM	Integrated Community Case Management
IMCI	Integrated Management of Childhood Illness
LQAS	Lot Quality Assurance Sampling
MICS	Multiple Indicator Cluster Survey
NHIS	National Health Insurance Scheme
NMCP	National Malaria Control Programme
NGO	Non-Governmental Organization
ORS	Oral Rehydration Salts
PPS	Probability Proportional to Size
PCA	Principal Components Analysis
QALYs	Quality adjusted life Years
RBM	Roll Back Malaria
RDT	Rapid Diagnostic Test
SES	Socio Economic Status
SOP	Standard Operating Procedures

SP	Sulphadoxine-Pyrimethamine
UHC	Universal Health Coverage
UNICEF	United Nations Children's Fund
WHO	World Health Organization

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Chapter 1. Introduction

1.1. Malaria control and elimination and home-based care

The World Health Organization (WHO) recommends a combination of measures for malaria control and elimination. Those measures include (i) preventive vector control, mainly through universal coverage of long lasting insecticidal nets (LLIN) and indoor residual spraying (IRS); (ii) preventive chemotherapy particularly to pregnant women and infants; (iii) universal prompt diagnosis and appropriate treatment of malaria and (iv) strong malaria surveillance (1, 2). WHO set the target to eliminate malaria from at least 35 countries by 2030 (2).

Seeking care and seeking care promptly is critical to reduce mortality due to malaria. Access to antimalarials within 24 hours of the onset of malaria symptoms is vital to prevent progression to severe malaria or death. The Roll Back Malaria (RBM) partnership recommends that 100% of those suffering from malaria should have prompt access to affordable and appropriate treatment within 24 hours of onset of symptoms (3, 4).

Data from 18 nationally representative surveys conducted between 2013 and 2015 in sub-Saharan Africa where the mortality burden from malaria is greatest, showed that an average of about 51% of febrile children sought care at any time from onset of symptoms in formal facilities (public or private), 13% in informal private facilities (pharmacies, kiosks and traditional healers) and 36% did not seek care, with variations among countries (5). Factors such as distance from home, poverty, financial constraints (direct and indirect cost), demands of domestic life, perceived poor quality of services, drug stock outs, and health workers' behaviour have led to self-treatment of fever cases and the risk of inadequacy and/or bad quality of treatment.

There are three key strategies that seek to improve physical access to quality treatment which are: extension and improvement in the quality of formal health care system, improvement in the informal private sector (mainly drug shops), and the home-based care (HBC) of fevers (6). These 3 strategies are not mutually exclusive and should be complementary considering the different country specific characteristics.

1.1.1. Extension and improvement in the quality of formal health care systems

The extension and improvement in the quality of formal health care systems, reducing or removing all out-of- pocket payments may improve the use of formal health services (6). Distance from health facility, quality of care and cost of services are recognised barriers for the use of health services (7-15). The Alma -Ata Conference called for the need to increase geographical access to health services (16). The 2008 World Health Report also stated the importance of building health infrastructure to achieve universal health coverage (17). With the aim of accomplishing this need, health planers often set the target of 5km distance, or a 1 hour walking travel time equivalent, from households to a public health facility (18-20). Low quality of care not only may decrease the use of services but also can explain unsatisfactory health outcomes. Quality of care is gaining interest in the last decades as geographic access to health care is not enough to save lives (21). A patient must be correctly assessed, classified and treated to reduce morbidity and mortality. The integrated management of childhood illness (IMCI) strategy aims to improve the quality of care given at facility level through improving case management skills of health-care staff and improving overall health systems among other things (section 1.3). Out-of- pocket spending for health care prevents people from using health services or from continuing treatment because they cannot afford to pay. Each year, approximately 150 million people experience financial catastrophe, meaning they are obliged to spend on health care more than 40% of their income, and the global gap between those who can access needed health services without fear of financial hardship and those who cannot is widening (22, 23). Recognising the benefits of removing user fees for access to health services, a global coalition on Universal Health Coverage (UHC) was launched in December 2014 (22) to accelerate reforms that ensure everyone, everywhere, can access quality health services without being forced into poverty. The UHC has 3 main objectives (i) equity in access to health services - those who need the services should get them, not only those who can pay for them; (ii) ensure quality of health services to improve health and (iii) financial-risk protection - ensuring that the cost of using care does not put people at risk of financial hardship (24).

1.1.2. Improvement in the informal private sector

The elimination of user fees is helping but not solving the problem of inequitable access to treatment (6). Transport costs and opportunity costs may also prevent people from seeking care in the formal health system, especially during the rainy season. Instead, drug shops are visited to seek care, although the cost of the drug might be higher than in a public health facility (which often are subsidized) and the drugs prescribed, the doses and the duration of the treatment is often not correct (6, 25-27). Different interventions have been put in place to improve the management of fevers (and also diarrhoea and suspected pneumonia) in the drug shops. The Affordable Medicines Facility for

Malaria (AMFm) pilot project conducted between July 2010- December 2012 in Cambodia, Ghana, Kenya, Madagascar, Niger, Nigeria, Tanzania, and Uganda aimed to increase affordability, accessibility, and use of artemisinin combination therapies (ACT) and eliminate the ineffective medicines sold in shops and pharmacies (28). An independent evaluation showed that the AMFm initiative had not fully achieved the aim of ACT affordability nor the elimination of ineffective antimalarials from the market. However, of the 8 pilots, 5 were successful in increasing availability through an increase of at least 20% of outlets stocking ACTs, 5 pilots were successful in reducing by 3 times the median price of ACT relative to the most popular antimalarial that is not an ACT in private for-profit outlets, and 4 pilots increased by 10% the ACT market share (29, 30). Lessons learned from Phase 1 were incorporated into the Global Fund core grant management and financial processes and the AMFm was subsequently renamed the Private Sector Co-payment Mechanism (28). The introduction of rapid diagnostic test (RDT) in drug shops and the training of drug sellers have showed positive effects in increasing appropriate treatment (26, 31-34).

1.1.3. Home-based Care of fevers

WHO and RBM states that in settings with limited access to health facilities, diagnosis and treatment should be provided at community level through community case management of malaria, recommending the introduction of RDT and rectal artesunate for referral when possible (1, 4, 35). The HBC strategy recognizes the importance of, and seeks to improve the effectiveness of, self-medication practices. This strategy involves presumptively, or with parasitological confirmation, treating febrile children with pre-packaged antimalarial drugs distributed by members of the community and thus has the potential to reduce inequities in access to quality drugs. Challenges of HBC are an inevitable increase in overuse of antimalarials and a possible impact of this on increased risk of resistance to these antimalarials when parasitological confirmation is not done or drugs are taken incorrectly.

Financial sustainability needs to be addressed when HBC aims to be implemented on a large-scale (6). Surprisingly, there is not much evidence on different experiences and approaches to HBC financing. WHO identified five approaches to the financing of long-term home-based care, which means to ensure that an individual who is not fully capable of long-term self-care can maintain the best possible quality of life. The 5 financing approaches identified were: (i) general taxation, (ii) social or health insurance, (iii) users' fees, (iv) private insurance and (v) use of unpaid personnel (36). Although these approaches were developed for the care of people of all ages who have long-term health problems, due to programme similarities (health personal reaching patients at the community), I consider that the financing approaches identified are also appropriate for HBC.

1.2. Diarrhoea and pneumonia control measures and home-based care

Diarrhoea and pneumonia in children under-five remain the leading cause of death globally, being responsible for an estimated 700,000 and 1.3 million deaths respectively in 2011 (37). Several systematic reviews showed that treatment of diarrhoea with zinc, ORS and feeding strategies, antibiotics for shigella, cholera and cryptosporidiosis, antibiotics for pneumonia and oxygen systems are effective for reducing mortality due to diarrhoea and pneumonia (14). How to make these proven interventions available to those in need is another critical question. The extension and improvement of the quality of formal care, the improvement of informal care and home- based care play an important role in reducing morbidity and mortality due to diarrhoea and pneumonia. The integrated Community Case Management (iCCM) of childhood illness was officially endorsed by UNICEF and WHO in 2012 (38).

1.3. Integrated Management of Childhood Illness

In the 1990s and due to the intolerable number of child deaths from preventable causes, WHO and UNICEF developed the integrated management of childhood illness (IMCI) to reduce the morbidity and mortality of children under- five (39). This strategy includes preventive and curative elements. The IMCI strategy has 3 aims: (i) to improve the management of childhood illness through an integrated approach (as opposed to a disease-specific approach), (ii) to strengthen the health system and (iii) to improve family and community health practices. The last aim is also called community-IMCI.

The rationale behind the preventive component of the IMCI strategy and the aim of improving health and community practice is that good quality of care once sick is insufficient to reduce mortality (40). Families should provide adequate home care to support the healthy growth of their children and to prevent them from being sick. They also need to respond appropriately when their children are sick, seeking appropriate and timely assistance and giving recommended treatments (40, 41).

There are several community and family practices that promote child survival, child growth and development that are supported by community- IMCI. In 2004 Hill et al (42) reviewed the potential impact of 12 key practices identified by UNICEF and WHO on child survival, child growth and development. Subsequent studies and reviews agreed with the potential benefit of these practices and added other preventive strategies to reduce the morbidity and mortality of children particularly due to malaria, diarrhoea, pneumonia and under nutrition (14, 43-45) which are the leading causes

of death in children under- five (46). Some of the practices identified are vaccination, exclusive breastfeeding during the first 6 months of life, adequate complementary feeding after six months of age, deworming, vitamin A supplementation, hand washing, water quality, adequate faeces disposal, continued feeding and increased fluids during illness, use of insecticide treated nets, intermittent preventive treatment for pregnant women and appropriate care seeking behaviour. Finally, not adhering to treatment and referral instructions may cause treatment failure, drug resistance and the later misuse of leftover medicines. In 2009, the Global Action Plan for prevention and control of pneumonia (47) stated that identification of disease signs and appropriate care seeking behaviour is one of the strategies to improve child survival, particularly in areas where child mortality is higher than 40 deaths per 1000 live births. A review conducted in 2014 aiming to estimate the percentage of caregivers in low and middle income countries with a child of less than five years who were able to recognise signs of malaria, diarrhoea and pneumonia in their child, and subsequently sought care (48) suggested that those carers that identify severe signs of the disease are more likely to seek care.

The IMCI strategy has been evaluated in 5 countries with different study designs: Brazil, Peru, Tanzania, Uganda and Bangladesh (49). The study in Brazil showed a better performance in IMCI facilities when compared with facilities not implementing IMCI, particularly in disease assessment, disease classification and in communication with carers of children under- five, although this was not translated into better carers' knowledge on how to administer the treatment (50). In Peru, children under- five visiting IMCI health facilities were better assessed. With regards to treatment, counselling and availability of drugs and supplies, the results were mixed (51). IMCI facilities in Tanzania and Uganda showed better assessment, classification of disease, better counselling and better carer's knowledge on how to take care of their sick children, with less effect on drugs and commodities supply in the facilities and without significant effect in reducing child mortality (52-54). The cluster randomised control trial conducted in Bangladesh showed the IMCI facilities provided a better assessment, treatment and counselling, and increase in exclusive breastfeeding, a reduction in stunting and an increase in the use of health facilities by children under- five with more children with severe signs being taken to a health provider, but without an effect on reducing child mortality (55, 56).

1.4. The epidemiology of Malaria, Diarrhoea and Pneumonia in Ghana

During the past 30 years, the under-five year mortality rate has declined in Ghana from 145/1,000 live births in 1998 to 60/1,000 live births in 2014 (57), with an infant mortality of 41/1,000 and a neonatal mortality of 29/1,000 live births. These mortalities are higher in the north of the country

and in the rural areas. The main causes of under-five mortality are neonatal related causes (38%), malaria (20%), pneumonia (11%) and diarrhoea (8%) (46). Despite this decline in under-five year mortality, the Millennium Development target of 40/1000 was not reached (58). In 2012 the Child Survival Call to Action set "A Promise Renewed" with the target of decreasing under-five mortality rates to 20 or fewer deaths per 1,000 live births by 2035 in all countries (46).

1.5. The Ghana Health System

The Ghana Health Sector comprises the Ministry of Health and 16 Agencies dealing with service delivery, regulation, production of its human resources and purchasing health services. The Ministry of Health (MoH) has the responsibility for policy formulation, monitoring and evaluation, resource mobilization and regulation of health service delivery. The Ghana Health Service (GHS) is one of the 16 agencies of the Ghana Health Sector and is the principle provider of health services, followed by the Christian Health Association of Ghana, the private sector and NGOs, especially in the rural areas (59).

Health service delivery is organized at three main levels: national, regional and district, with the district having a sub-district level and incorporating a community health delivery system. The provision of services or health interventions are packaged and delivered in teaching hospitals, regional hospitals, district hospitals, health centres and in two community- based interventions: Community-based Health Planning and Services (CHPS) and HBC.

The health system in Ghana is financed by the government (including donor funds) covering 38% of the health cost, out of pocket money corresponding to 37%, other private sources (9%) and by the National Health Insurance Scheme (NHIS) covering 16% of the health costs (59).

The NHIS was introduced in Ghana in 2003 through Act 650, which was replaced in 2012 by Act 852 (60). The aim of the scheme is to (i) improve financial access to health services, (ii) improve the quality of the services and (iii) control the prices for services and drugs. The way the NHIS is funded is mixed: (i) Voluntary premiums from subscribers, in an attempt to capture the informal sector (corresponding to 4% of the insurance fund), (ii) Mandatory sales taxes and levis (2.5% of sales) are earmarked for health, which covers the exempt groups (61% of the insurance fund), (iii) Social Security and National Insurance Trust (SSNIT) (2.5% of the social security) which covers contributors and pensioners (15% of insurance fund) and (iv) Other sources like interest earned on NHIS reserves and sector budget support, (19% of insurance fund). Groups exempted from paying

premiums include: pregnant women, children under 18, adults older than 70, contributors and pensioners of the SSNIT, persons with mental disorder and indigents.

The NHIS was designed to cover at least 95% of the burden of all disease. Health services are delivered through NHIS-accredited providers, from hospitals to CHPS compounds, including the private sector. As of 2013, 36.8% of the total population was an active NHIS enrolee while the target was 75% of the total population.

In 2009-2011 the NHIS expenditures exceeded revenues, with the differential being -14, -47, -87.6, -7.5 and -40.6 million US$ in 2009, 2010, 2011, 2012 and 2013 respectively, at the respective annual conversion rate (61-63). Both claim costs and administrative expenses have increased significantly in 2009 and 2011; particularly the administrative cost has tripled (61, 64).

The main NHIS challenges are financial sustainability, identification of indigents, high cost of medicines, ability to pay premiums and renewal challenges.

1.6. Community- based interventions in Ghana

Ghana has developed two main community based interventions or delivery strategies that aim to reduce barriers to physical access to quality treatment: the HBC and the CHPS.

The HBC started on a pilot basis in Ghana in 1999 to treat suspected malaria cases (65). The pilot programme initially used chloroquine, shifting to ACT in 2005 (66). In 2009 and in the context of IMCI, Ghana developed the *Home Management of Malaria, ARI and Diarrhoea in Ghana: Implementation Guidelines*(65). HBC was defined as prevention, early case detection and prompt and appropriate treatment of fevers, acute respiratory infections (ARI) and diarrhoea in the community. Therefore, integrated Community Case Management (iCCM) was introduce in Ghana in 2009.

The HBC strategy corresponds to the lowest level of health care delivery in Ghana and it is designed to be implemented within the health system, reporting activities to CHPS (when existing) or to the next health facility level. Community-Based Agents (CBAs) are provided with Information, Education and Communication (IEC) materials to conduct IEC activities to address the preventive aim of the strategy. All CBAs in the 3 northern regions (Northern, Upper East and Upper West Regions) provide treatment for malaria, diarrhoea and suspected pneumonia cases based on clinical symptoms and with the support of ARI timers for measuring the respiratory rate to diagnose pneumonia cases, mainly with the financial support of the United Nations Children's Fund

(UNICEF). Those in the rest of the country have received the same training as the three northern regions but provide only malaria treatment with the support of the Global Fund to fight AIDS, TB and malaria (GFATM), and refer diarrhoea and suspected pneumonia cases for further management. Other projects implemented by Non-Governmental Organizations (NGOs) support the iCCM on a smaller scale in different regions of the country. The HBC guidelines states that the service provided should be free, although some regions (such as the Northern Region) decided that users should give a small amount of money to CBAs to avoid risking continuity and commitment of the strategy as can be seen in other countries (67-69). No target was set for iCCM utilization as a proportion of other delivery points for treatment of sick children.

The strategic plan for malaria control in Ghana (2008-2015) set the objective to provide community based treatment to all (100%) communities (70). Each targeted community of 2000 people should have at least 2 CBAs. The implementation was planned to be phased, from 2009 to 2013 to reach 100% of the rural districts (123 out of the 138 existing districts in 2006) (71), contributing to the target of 90% of children under-five (an estimated of 4,600,000 children) having access to ACT within 24 hours of the onset of symptoms. Due to urbanization of the country and the increase in number of districts (now 216), the NMCP revised their targets related to the number of districts implementing iCCM prioritising the rural districts.

Using national routine data, it was reported that since the introduction of the strategy, 25,338 CBAs were trained (72) and the strategy has reached all regions (DHIMS2). In 2014, 163,468 cases of fever, cough and/or diarrhoea in children under five years old were seen through the strategy (Figure 1). Based on the under-five population by region, the regions reporting more HBC activity were the Upper West Region, the Upper East Region, the Volta Region and the Eastern Region. It is important to note that level of overall activity of HBC varied between regions, as did HBC's preventive and curative components. The Upper West Region focused on the curative component, while the Upper East Region reports a balance of preventive and treatment activities and the Volta and Eastern Regions reported a high number of preventive activities with lower numbers of treatment. The regions with less activity were Greater Accra and Central region, which corresponds, together with the Ashanti Region, to the regions with the highest urban population (73). Conversely, the Northern Region has the third highest rural population (69.7%) after the Upper East and Upper West Regions, and has one of the lowest reported HBC activity, with a preventive component that is almost non-existent.

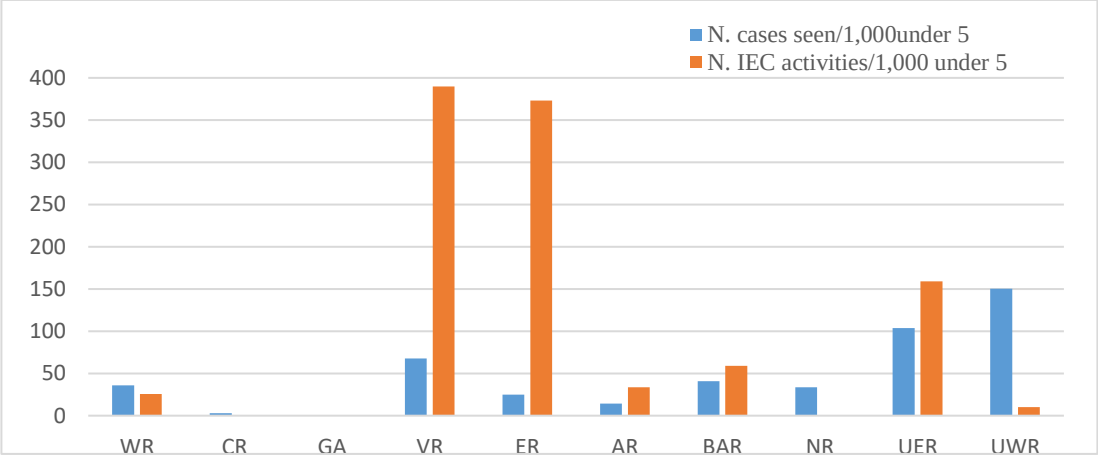

Figure 1. Home-based Care activity by region in 2014. Source: DHIMS2. WR: Western Region; CR: Central Region; GA; Greater Accra Region; VR: Volta Region; ER; Eastern Region; AR; Ashanti Region; BAR: Brong Ahafo Region; NR; Northern Region; UER; Upper East Region; UWR: Upper West Region.

The CHPS strategy was developed in Ghana attempting to respond to the 1978 Alma Ata Conference and the 'Health for All' principle (74). The vision of the CHPS strategy was to accelerate progress towards the Millennium Development Goals 4 and 5 on child health and maternal health respectively. Its goal was to transform the dynamics of rural health care service delivery from community health care providers who passively wait for patients into outreach workers who actively seek patients in communities and their homes, also known as doorstep services (75). This strategy was a result of a collaboration between researchers and health administrators. Ghana developed the CHPS strategy in four phases. Phase 1 (the Navrongo pilot study) was developed between 1994 and 1996 to assess whether the CHPS strategy was culturally appropriate. The phase 2 conducted between 1996 and 2003 (the Navrongo experimental trial) assessed the impact of CHPS on fertility and child mortality. Results showed that in the first 3 years of the project, the total fertility rate declined by 1 birth per women in the intervention communities while it remained the same in the comparison areas (75). In the communities where community nurses were deployed, child mortality declined by one-half in only 3 years. Within 7 years, child mortality declined by two-thirds. Phase 3 occurred between 1998 and 2004 to validate results and approaches of the Navrongo experiment. Replication of the Navrongo experiment in the Nkwanta District (Volta Region), showed that CHPS contributed to an increase in access and use of health care. In the fourth phase (from 2000 and on-going) the CHPS strategy became a national programme that needed to scale up countrywide (75).. In 2008 between 10-80% and 10-40% of the population in the Volta and the Northern Regions were reported as covered by CHPS services (75). To support the scale up and diagnose and address barriers on the CHPS expansion, the Ghana Essential Health Intervention Programme (GEHIP) was created in 2009

A key component of the CHPS strategy is that traditional leaders of the community must accept the CHPS concept and commit themselves to supporting it. The CHPS strategy is based upon a basic facility known as a community health compound where health care is provided by a resident community health nurse or community health officer. These salaried nurses provide basic preventive, curative and promotional health services in homes or in the community health compound. The services provided include immunizations, family planning, supervised delivery (if the nurses have training on child deliveries), antenatal/postnatal care, treatment of common diseases such as malaria, diarrhoea and acute respiratory infections (ARI), first aid for minor injuries and skin conditions, adequate referrals, supervision of CBAs and health education. With the introduction of IMCI in Ghana in 1998 (76), all primary health facilities including CHPS are implementing the IMCI strategy for the management of childhood illnesses. CHPS can also be accredited providers of the National Health Insurance Scheme (NHIS). The services provided at the CHPS are free for those having a valid national health insurance card. The target for CHPS coverage is that a geographical area of a 4 kilometres radius and between 4500-5000 persons should be covered by a CHPS compound (77, 78). The CHPS strategy started a national scale up in 2000 and it continues its expansion (79). In 2008 between 10-80% and 10-40% of the population in the Volta and the Northern Regions were reported as covered by CHPS services (75).

1.7. HBC, CHPS and Health Systems

To achieve national and international goals, including the reduction of child mortality, a well performing health system is necessary. The WHO describes a health system as one that "consists of all organizations, people and actions whose primary intent is to promote, restore or maintain health" (80). The goal of a health system is to improve health and health equity, in ways that are responsive, financially fair, and make the best or most efficient use of available resources. A health system has four vital functions: service provision, resource generation, financing and stewardship.

To promote common understanding of what a health system is and what constitutes health systems strengthening taking into account its vital functions, WHO developed a framework consisting of 6 building blocks (81). These building blocks are: (i) service delivery, which refers to how an effective and safe intervention can reach those that need it, when and where needed, with minimum waste of resources; (ii) well performing health workforce, which refers to availability of sufficient staff, fairly distributed, competent, responsive and productive to deliver interventions; (iii) well-functioning health information system, which refers to the importance of producing health

information on health determinants, health system performance and health status to be analysed, disseminated and used in a reliable and timely manner; (iv) access to medical products, vaccines and technologies, which need to be of good quality, safe, effective and cost-effective; (v) good health financing system, which have to raise adequate funds for health, in ways that ensure people can use needed services, being protected from financial catastrophe or impoverishment; and (vi) leadership and governance, which involves ensuring strategic policy, effective oversight, regulation and accountability.

HBC and CHPS are two delivery strategies to provide effective interventions to those in need, such as ACT for malaria, antibiotics for pneumonia and ORS and zinc for diarrhoea among others. To successfully reach the expected outcomes reducing morbidity and mortality in children under- five through the implementation of these strategies, it is important that the health system building blocks are in place and successfully working. Community drugs distributors and nurses need to have the required skills and be in their posts to attend those in need. The information system should be able to collect the activity done by these interventions to be able to monitor and evaluate the strategies to ensure adequate performance. A good procurement system and distribution chain should be in place to make sure the staff can provide ACT, antibiotics and ORS-zinc to sick children. The financing system must raise funds to finance these strategies, pooling financial risk (spreads financial risks from an individual to all pool members), and allocating or using funds (strategic purchasing of services) in a way that promotes efficiency and equity. (81-83). Finally, policies, regulation and leadership should guide the implementation of these strategies to obtain the expected outcomes while being accountable. If one or more of these blocks are not working appropriately, the strategies will experience challenges to reach their goals.

1.8. Justification for the study and study aim

In Ghana, malaria, pneumonia and diarrhoea continue to be the main causes of under-five mortality. This mortality is higher in the north of the country and in the rural areas. Community-based interventions have the potential to reduce the morbidity and mortality of children under- five years of age and have been endorsed by the Roll Back Malaria, WHO and UNICEF.

Ghana first introduced CHPS in 1994 and then HBC in 1999 to improve access to health services. After several years of national implementation, there is the need to assess the performance of these strategies in delivering preventive messages and care for children under-five with fever, diarrhoea or cough. There are several studies that have looked at HBC in Ghana. However, most of these

studies focused in a few districts, looked particularly at malaria HBC, focused on the curative component and were conducted in a more "controlled" context or under research study conditions rather than in a real life programme context (84-88). The routine information system was not providing enough information about who was using these two strategies and how were they performing in providing appropriate treatment for malaria, diarrhoea and pneumonia, as well as in delivering health promotion and disease prevention messages. In addition, there was no financial plan to support the HBC strategy for the long- term. If the HBC strategy shows benefits to the population, sustainable financing strategies that can effectively integrate HBC into the current health system financing model are crucial for a long-term intervention. HBC inclusion in the NHIS could be a long-term solution.

Based on the points just mentioned, the aim of this study was to assess the national implementation of the HBC and CHPS strategy in Ghana for the prevention and management of malaria, diarrhoea and pneumonia, under programme conditions, in order to provide evidence by which to improve performance and to guide long term financing strategies.

1.9. Structure of the thesis

This thesis is organised in seven chapters. Chapter 1 presents the introduction, justification of the study and study aim. Chapter 2 includes a literature review on the impact of malaria, diarrhoea and pneumonia home-based care on health outcomes and its cost- effectiveness. It also presents relevant literature around monitoring and evaluation. The aim and objectives of the thesis are presented at the end of the chapter. Chapter 3 describes the methods used to address each objective.

The thesis has three results chapters. The structure of these result chapters follows a manuscript structure with a short introduction, a brief summary of methods used- which are described in detail in Chapter 3-, a results section, discussion and conclusions. Chapter 4 assesses the curative component of HBC and CHPS in terms of utilization, appropriate treatment given and client satisfaction. HBC and CHPS utilization were assessed based on treatment- seeking behaviour when the child was sick. Appropriate treatment was based on adherence to national guidelines and satisfaction was based on the perceptions of the carers after the treatment-seeking visit. Chapter 5 assesses the preventive component in terms of carers' disease knowledge and health behaviour. Disease knowledge was assessed based on the identification of causes and signs of severe disease, and its association with the sources of health education messages received. Health behaviour was assessed based on reported prompt care seeking behaviour, reported adherence to treatment,

utilization of mosquito nets and having improved sanitation facilities, and its association with the sources of health education messages received. Chapter 6 analyses the cost per case appropriately diagnosed and treated under the HBC and CHPS.

Chapter 7 includes a general discussion, conclusions and their implications in terms of programme implementation and policy.

Chapter 2. Literature Review

2.1. Introduction

Three reviews were conducted in 2014 to explore the impact of HBC on health outcomes, its cost-effectiveness and to inform my research questions and methods. In addition, I also explored methods to monitor and evaluate health care interventions to better clarify my choices of objectives and study design.

2.2. Methods

Three separate reviews were conducted. For the three reviews, the Medline database and the Cochrane database of systematic review was searched in 2014 and again in 2016.

To explore the impact of home-based care of malaria, the terms used were (malaria or fever) AND (under five or children under five or child*) AND (home-based management or home-based care or home management or community-based or community case management) AND (Africa). The Cochrane database of systematic reviews was also searched looking for home-based care.

To explore the cost-effectiveness of home- based care, I used the words (cost-effectiveness or cost-benefit or economic evaluation) AND (fever or malaria or pneumonia or suspected pneumonia or ARI or cough) AND (under five or children under five or child*) AND (home based care or home management or home management of fever or home care services).

To explore the impact of home-based care of diarrhoea and suspected pneumonia, the terms used were (pneumonia or suspected pneumonia or ARI or cough) AND (under five or children under five or child*) AND (home- based care or home management or case management).

2.3. Impact of home-based care of malaria

Among 370 papers found in Medline database, 2 were systematic reviews conducted in 2007 (37) and in 2014 (38). A third systematic review was found in Cochrane database which was conducted

in 2013 (39). Due to the numerous and recent systematic reviews found (the last one was conducted in 2014), I felt that it was appropriate to focus on these 3 reviews to analyse the effect of HBC.

The inclusion criteria for studies reviewed in 2007 were: (i) the intervention evaluated consisted of administration of presumptive antimalarial treatment for fever illness; (ii) the treatment was administered by local community members without formal training; (iii) the outcomes were malaria morbidity or mortality; and (iv) studies were conducted in Africa. Studies were not excluded based upon their design. Results showed that of the 6 studies conducted in Sub-Saharan Africa that met the inclusion criteria, the impact on morbidity and mortality was mixed. The quality of the evidence of the studies included was not evaluated. Two studies showed no health impact; one study showed decrease in malaria prevalence and incidence; one study showed a decreased in severe malaria cases and another decrease in risk of progression to severe malaria. Only one study in Ethiopia showed a reduction in child mortality (Table 1). This was a randomised control trial (RCT) conducted in Tigray between 1996 and 1998 which showed a reduction in under-five mortality by 40% (95% CI 29·2, 50·6; $p<0·003$) in the intervention localities that provided chloroquine at community level (Annex 1).

The 2013 systematic review included only RCT and quasi-RCT (including controlled before-and-after studies and interrupted time series studies), that evaluated the effect of antimalarial treatment presumptively or after a positive RDT, given by community members without formal training. Therefore, not all 2007 systematic review studies were included. Results from this review addressed the efficacy of HBC or its potential effect in treating malaria under ideal conditions. Conclusions from the 10 studies that met the inclusion criteria were that HBC probably increases the proportion of people with fever who receive an appropriate antimalarial within 24 hours and it may also reduce all-cause mortality, but to date this has only been demonstrated in rural Ethiopia. The quality of the evidence (based on the assessment of risk of bias in included studies) was considered moderate for these findings (89).

The third systematic review conducted in 2014 aimed to expand the 2007 systematic review taking into consideration changes in policy guidance on malaria treatment and the integration with other community interventions such as diarrhoea and suspected pneumonia management. Therefore, it included studies published from 2000 to May 2013 where the main outcome was attributable to malaria community case management. Forty-three studies were included using a variety of study designs: randomized controlled trials (RCT), cluster RCTs, pre-post studies with or without control, interrupted time series designs, qualitative studies, case studies, process evaluations and cost-effectiveness studies. The quality of the studies assessed for the 12 RCTs found was considered high while the quality of the 3 controlled pre-post studies was considered lower than the RCTs. The

conclusions of the systematic review were that HBC can provide good quality malaria care including performing procedures such as rapid diagnostic tests. Adding diarrhoea and suspected pneumonia management to the management of fevers (then called integrated community case management-iCCM) did not reduce the quality of malaria case management if adequate training was provided and supervision was maintained (90). This third review includes three more studies conducted in Ghana (86), Ethiopia (91) and Senegal (92) not included in either of the previous reviews that looked at the effect of HBC on child mortality compared with the standard care. All three of these studies found reductions in child mortality that were statistically significant. The study in Ghana (a cluster- RCT conducted between January 2006 and December 2009) showed a 30% reduction in under-five mortality in the intervention arm which consisted of the provision of ACT at community level (RR= 0.70, 95%CI 0.53, 0.92, p = 0.011). The second study conducted in Ethiopia between May 2005 to April 2007 (a before- after study with control group) tested the deployment of ACT with RDT at community level. Results showed a reduced risk of malaria-specific mortality in the intervention district (RR=0.60, 95%CI 0.40, 0.90, p = 0.013). The study in Senegal also tested the deployment of ACT with RDT at community level. This was a before- after study with controls conducted between August 2009 and May 2010. The mortality data was obtained from routine data (in contrast to the bi-annual census done in the Ghana study and household surveys done in the Ethiopia study). Results showed a decrease in the incidence of in-hospital deaths due to malaria by 62.5% (95% CI 43.8-81.2) in the intervention regions, while the decrease in comparison regions was smaller and not statistically significant.

Issues related to implementation (e.g. availability of community drug distributors, availability of drugs or supervision), may decrease the expected impact of the strategy (93). A 2010 survey conducted in 44 sub- Saharan African countries showed that among the 40 countries that responded, 83% had adopted national policies supportive of treatment by community drug distributers of diarrhoea, 74% for malaria and 65% for pneumonia (94).

2.4. Cost-effectiveness of home-based care

The cost- effectiveness of HBC is another issue to be addressed when deciding its inclusion in a health system. Only four studies were found on Medline that looked at the cost- effectiveness of home management of fevers in Kenya, Uganda, Zambia and Ghana (Annex 2). All of them concluded that malaria HBC was cost- effective, although it might not be appropriate for all settings (95-98). However, there are some differences between these studies worth to be mentioned. The study in Kenya was conducted between 1998 and 2000 and looked at the cost-effectiveness of

training drug shopkeepers to provide adequate chloroquine treatment for suspected malaria cases compared with no training, from the societal perspective. Data for this analysis was obtained from a before-after study with controls where effectiveness data was obtained from 2 households surveys. Results showed that the cost per additional febrile episode appropriately treated was US$4.0 in the early implementation phase and the cost per disability- adjusted life-years (DALYs) averted due to the intervention was US$18.38. The study in Uganda used an interactive Markov Model which calculated the cost per DALYs averted and the ICER of presumptive malaria treatment through community distributors versus conventional care (a mid-size hospital) from the societal and provider perspective. Results showed that even using the most effective antimalarial, home-based care remained cost-effective only in areas of high and medium malaria transmission when access to conventional care is low. The cost-effectiveness study conducted in 2009 in Zambia compared the cost per appropriate treatment of providing ACT and RDT at community level versus the standard care (low-size health facilities) from the provider perspective. Effectiveness data was obtained from community drugs distributors and health facilities registries. Results showed that home-based care for treating malaria was more cost- effective that the conventional care (cost per additional case appropriately diagnosed and treated was US$4.18). The study conducted in Ghana between 2006 and 2009 compared presumptive malaria treatment with ACT at community level versus standard care from the societal perspective. This was a stepped-wedge cluster RCT that measured the effect with and without two different interventions and measured only the cost of the interventions. Therefore, from the information provided it seems that the authors did a cost-outcome analysis. Authors concluded that the cost per DALY averted at community level versus standard care was less than the standard US$150 threshold recommended by the WHO (ICER using ACT alone= US$90.25 and using ACT +Amoxicillin= US$114.21), and was also cost-effective for reducing under- five mortality in rural settings.

2.5. Impact of home-based management of diarrhoea and pneumonia

Five hundred ten papers were found. Among them, 5 systematic reviews looked at effect of diarrhoea and pneumonia HBC in reducing morbidity and mortality (99-103). Due to the numerous and recent systematic reviews found (the last one was conducted in 2015), I felt that it was appropriate to focus on these 5 reviews to analyse the effect of HBC.

The first one (99), conducted in 1992, was a meta-analysis that included six studies looking at pneumonia HBC and child mortality. All six studies showed a reduction in pneumonia related child

mortality. However, it is important to note that (i) two studies did not report P values and 95%CI; (ii) the reduction in child mortality was not significant in another study; and (iii) CHW did not provide pneumonia treatment-the professional health worker did- in one study. Authors concluded that pneumonia HBC reduced infant mortality by 20% and under-five mortality by 25%. In 2003, Sawazal and Black updated their meta-analysis. Nine studies were included, five of them were already included in the 1992 meta-analysis (100). From the 9 studies, (i) treatment was provided by health workers other than CHW in 2 studies and (ii) 1 study did not provide 95% CI or p value. Conclusions from the meta-analyses were that pneumonia HBC reduced overall mortality of neonates, infant and children (by 27%, 95%CI 18-35; 20%, 95%CI 11-28; and by 24%, 95%CI 14-33, respectively). The third systematic review (101) aimed to include a wider range of community interventions. With respect to pneumonia case management, nine articles were included and seven were already included in previous systematic reviews. From the nine studies, (i) one study reported treatment by a midwife instead of a CHW, (ii) the reduction in pneumonia related mortality was not significant in two studies and (iii) one study did not provide 95%CI or p values. Conclusions from the meta-analyses were that community case management can reduce by 35% (95%CI 18-48) pneumonia related child mortality and overall child mortality by 21% (95%CI 12-30). The fourth systematic review aimed to update the previous one on pneumonia, and to include diarrhoea HBC (103). Twenty-four studies were included, eleven studies and two studies were included in the meta-analysis for pneumonia and diarrhoea related mortality, respectively. From the eleven studies, (i) two studies reported treatment provided by professional workers, (ii) the reduction in pneumonia related mortality was not significant in two studies; (iii) one study did not provide 95%CI or P value and (iv) one study did not have enough power to detect an effect on mortality. With regards to studies reporting on diarrhoea related mortality, only one of the two studies showed a significant reduction in mortality. The second study showed a reduction in diarrhoea related mortality, although this was not significant and treatment was provided by professional health staff instead of CHW. Conclusions from this review (Das et al 2013) (103) were that HBC was associated with a 160% increase in the use of ORS for diarrhoea, an 80% increase in zinc use, 13% increase in seeking care for pneumonia, 9% increase in seeking care for diarrhoea, and a 32% reduction in pneumonia specific mortality whereas evidence for diarrhoea- related mortality was weak.

Because of most of the studies included in the four previous reviews were done in Asia, the fifth systematic review included only studies conducted in Africa assessing the community case management of pneumonia. Only studies where CHW received shorter training than professional staff and CHW provided treatment were included (102). Conclusions from this review were that there was a lack of evidence on the efficacy and effectiveness of community case management of

pneumonia, arguing that there were only a few studies (15), with different methodologies, only two out of fifteen were in West Africa and **only two** looked at reductions in mortality. Of these two studies, only one showed a reduction in mortality although the p value and 95% CI was not reported. The main difficulty in terms of CHW experiences was in counting the respiratory rate and therefore classifying pneumonia cases. Authors concluded that adherence to guidelines was lower in integrated interventions than in community case management of pneumonia. Annex 3 presents a summary of the studies included in the five systematic reviews.

2.6. Evaluation of health interventions

Evaluation of interventions increasingly plays a role in health care (as well as in other fields). Stakeholders want to know the value received for the funds given and to use this information to guide their decisions in steering the health system towards better outcomes.

There is a vast bibliography on types of evaluation and on methods to conduct an evaluation. For example, process evaluation assesses if the intervention has been implemented as planned and examines how the context and mechanisms of action lead to the outcomes achieved (104). Outcome evaluation assesses the achievement of short-term, intermediate, and long-term objectives (105). Impact evaluation aims to identify the causal relationship or attribution of the outcome to the intervention under study (105, 106). Formative evaluation informs on-going projects and summative evaluations are conducted at the end of the project (107). Economic evaluations compares different alternatives in terms of both their costs and consequences (108). With regards to the different study design to conduct an evaluation, there are experimental studies, quasi experimental studies, observational studies, qualitative studies, economic studies and mixed methods, particularly when the intervention is complex (106, 109, 110). Different study designs will be selected based on the objectives of the evaluation, resources available, the context and the degree of certainty on causality or attribution required. Experimental studies (impact evaluations) are the gold standard to address causality although they are not always appropriate or possible (for example when resources are constrained, when the intervention has already been tested, or when the interventions is already being implemented). Quasi experimental studies (using techniques such as differences in differences, regression discontinuity and matching and interrupted time series) can be useful when causality needs to be addressed and experimental studies are not feasible to conduct. Observational studies with a control group (cross sectional studies, case-control and cohort studies), may be appropriate depending on the study objective. When no external control group is possible

(as in my study) attribution can be addressed by introducing questions regarding source of the treatment/service received (109, 111).

Frameworks can help to systematically analyse areas where health interventions could have an impact. Although different frameworks may have common dimensions or areas to evaluate, they also have specific areas of attention. For example, the WHO Primary Care Evaluation Tool (112) focuses on the four vital functions of the health system mentioned in section 1.4 (service provision, resource generation, financing and stewardship) and divides service provision into four key characteristics to be evaluated: access to services (understood as use of health services), continuity of care- (or follow up from one visit to the other), comprehensiveness (which refers to a full range of services such as curative and disease prevention) and coordination of care (such as from primary to secondary health care). The Centre for Disease Control and Prevention guide (109) describes 5 areas of evaluation: implementation (or process evaluation), effectiveness (or outcome evaluation), efficiency, cost-effectiveness and attribution. Smith *et al*, described four dimensions to be considered when evaluating a health care intervention (113): equity, effectiveness, efficiency or cost- effectiveness and the humanity of the health care or health care intervention. Smith *et al* defines equity as the fair distribution of a health service (or health state) in a population among groups or individuals. Often, one cause of inequity may be that some groups are less able to access to health services than the others. Effectiveness is defined as the benefits of a health service measured by improvement in health in a real population, under normal circumstances. Efficacy is defined as the benefits of a health intervention under ideal conditions. Cost- effectiveness is defined as the relation of the cost of an intervention to the benefits obtained. Humanity is the quality of being humane. It refers to the social, psychological and ethical acceptability of the services that people received from a health care intervention.

It is important to note that there is a high variation on the meaning and use of different terms depending on the approach. For example, in the evaluation of programmes, outcomes refer to the results of programmes, and outcome evaluations can be called effectiveness evaluation as mentioned above (109, 114). In epidemiology, outcome can also be called response variable and it is a broad term referring to any defined disease, state of health, health related event or death. Also in epidemiology, effect refers to the association between a risk factor, predictor or intervention and the outcome. Efficacy will be called if the relationship between both (intervention and outcome) has been addressed in a controlled context, under ideal conditions. Effectiveness will be assessed under real life conditions (115). In economic evaluations, effectiveness measures can be final health-related measures of outcome, such as life-years gained, intermediate outcomes or outputs- such as percentage of cholesterol reduction- if the link between, the intermediate outcome or output and final outcome can be established. In general though, one should choose an effectiveness measure

related to a final health outcome to allow comparison with other studies and to have a trade-off that guides on the decision if an intervention is more cost-effective than other (108, 116). Efficiency is another term that has different meanings. In the evaluation of programmes, efficiency often refers to the optimal use of resources to achieve intended outcomes (109, 117). In economic evaluations, Drummond *et al* use the term of efficiency evaluation as economic evaluation (108), while Smith *et al* particularly refers efficiency to one type of economic evaluation (cost-effectiveness) (113)

Another aspect is how to measure results of a programme or health intervention. Indicators are used to demonstrate change in a situation, or the progress in, or results of, an activity, project, or programme. Indicators are necessary to help determine what data needs to be collected. They can be classified in different ways. A direct indicator is called when it clearly measures the intended result. Indirect or proxy indicators are linked to the result by one or more assumptions and they are used when the most direct indicator is not practical or not feasible (118). Indicators can measure inputs, process, outputs, and outcomes. Input indicators measure the number of resources involved in an activity, for example, number of people to be trained or training material developed in a year. Process indicators measure the progress of activities in a programme/project and the way these are carried out, such as percentage of people that received a training. Output indicators measure short-term results, the quantity, quality, and timeliness of the products, goods or services resulting from an activity, project or programme (for example, percentage of people that improve in disease knowledge). Outcome indicators measure medium and long-term results generated by programme outputs, such us the use of adequate treatment or change in prevalence of a disease (119). Indicators measuring long-term outcome are sometimes called impact indicators, and the evaluation assessing this long-term goals impact evaluations, making some confusion with the definition of impact evaluation described above which particularly addressed the causal relationship or attribution of the outcome to the intervention (114, 120). Indicators needs to be "SMART": they need to be **s**pecific, **m**easurable, **a**chievable, **r**elevant and **t**ime-boud (121, 122).

The way the indicators selected are collected will depend on the information needed. There are a variety of methods to collect information such as observation, revision of existing records, data or documentation, testing of abilities, biological measurements, in-depth interviews or surveys. Observations can be used to observe behaviour or practices, rather than asking people what they think or how they behave. Revision of records/documentation produced is an important source of information to monitor and evaluate programmes/interventions, but they might not have all the information needed, or it might be necessary to verify some information. Biological measurements are objective, in that they are independent both of the subjects' perceptions and, where instrumental or laboratory methods are used, of the researcher. In-depth interviews are good to explore new ideas or concepts from specific people and they use semi-structured questionnaires or open-ended

questions. Surveys are particularly useful to find small amounts of information from a wider selection of people in the hopes of making a general claim. Surveys use closed-ended questions or structured questionnaires (123-125).

2.7. Discussion

Although with promising results, particularly with respect to malaria HBC, there is still little evidence that malaria, diarrhoea and pneumonia home-cased care can reduce mortality in Africa. With regards to malaria HBC, only seven studies were found reporting on overall and malaria specific mortality. Among these seven studies, six used similar study design and data collection tools (quasi experimental or RCT, with health demographic surveillance and parasitemia surveys). Among these six studies, three studies did not show a reduction in mortality, and authors argued that previous high self-treatment in the community, limited availability of CHW and small sample size could have been the reasons (68, 89, 90). The seventh study, which evaluated the scale up of malaria HBC covering a larger area in Senegal (92), did show an effect on mortality, although this was at facility level using routine data. No study was found assessing the effect of diarrhoea HBC on child mortality in Africa. With regards to pneumonia HBC, only one out of 2 studies showed a reduction on child mortality in Africa, although the P value was not given (Figure 2).

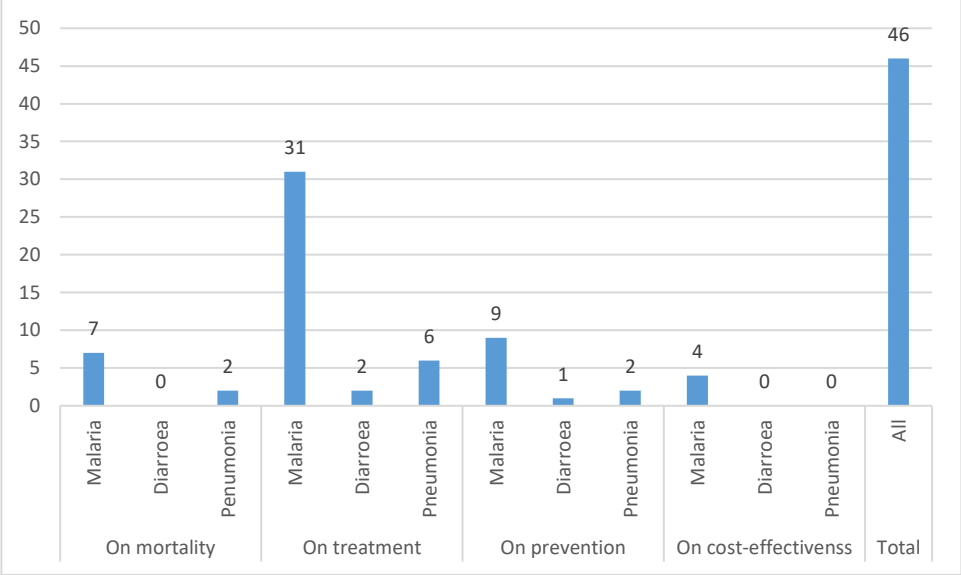

Figure 2. Summary of studies on malaria, diarrhoea and pneumonia HBC conducted in Africa by topic addressed

Among all the studies found conducted in Africa, the majority explored the effect of the curative component of HBC, particularly related to malaria. In those studies, indicators such us HBC utilization, treatment and prompt treatment and referrals were often used. Surprisingly, the preventive component was much less explored (only 12 out of 46 studies). Taking into consideration that HBC normally includes a preventive component and the importance of health and community practices to improve child survival, child growth and development (section 1.3), it seems that the preventive components is often neglected when conducting HBC studies. When included, the outcomes used were related to disease knowledge and health behaviour such as the recognition of severe signs of disease, seeking care practices, use of ITN or compliance with treatment. Studies on cost- effectiveness of HBC were almost non-existent. Excluding the study that addressed the training of shopkeepers, only 3 addressed the management of fevers through community volunteers. And among them, only 2 used a final health outcome (DALYs) as the effectiveness measure. The third one used an intermediate outcome (appropriate diagnosis and treatment) which, although some economists will accept it as an effectiveness measure due to its linkage with the final health outcome (reduction on mortality due to malaria (35)), others do not.

Most of these studies were conducted between 2004 and 2014 (36 out of 46) using a variety of study designs (RCT-13, before-after with controls-10, before -after without controls-5, post study with controls-2 and post study without controls-16). Interestingly, most of them were conducted in few districts with strong supervision. To mention the exceptions, only 3 studies were conducted in large areas with regular/standard supervision (92, 126, 127). With regards to the study duration, 20 out of 47 studies lasted 2 or more years, and only 2 studies lasted 4 or more years.

With regards to the evaluation of health interventions, there is a vast documentation on types of evaluation, methods to conduct evaluation and frameworks to systematically analyse areas that should be addressed when evaluating a health intervention. In addition, the meaning of the terminology used may differ depending on the approach or perspective. Rather than discussing the appropriateness of different terms, it is more appropriate to clearly define what we mean when using a particular term to avoid confusion and misunderstanding.

2.8. Conclusion

There is a quite extensive literature assessing the effect of HBC in Africa, mainly addressing malaria HBC, under controlled circumstances and reaching few districts. There is limited but promising results on the effect of malaria HBC in reducing child mortality, but no evidence

regarding diarrhoea and pneumonia HBC and child mortality in Africa. Studies assessing HBC clearly focus on the curative component, showing positive results particularly in improving access to prompt treatment even when diarrhoea and suspected pneumonia cases are integrated in the strategy. The preventive component has been less explored although with positive results regarding improvements in disease knowledge and on how to administer drugs. HBC cost-effectiveness has been barely addressed although the few studies found (3) showed that HBC was more cost-effective than the standard care.

Exploring the effectiveness of HBC under programme conditions, in large areas and after several years of implementation is necessary to understand implementation issues and how they may decrease the expected outcomes of the strategy. Efforts should be made to conduct comprehensive evaluations, without focusing on only one aspect of the intervention and considering its continuity and coordination with other interventions. An appropriate approach could be to follow the Smith *et al* dimensions, considering its simplicity and clarity. When selecting the study design, this should ensure the attribution of results to the intervention.

Therefore, I decided that the aim of my study was to assess the implementation of the HBC and CHPS strategy in Ghana under programme conditions, in a large area and after several years of implementation in order to provide evidence by which to improve performance. Three objectives were defined:

Objective 1: To assess the curative component of the HBC and CHPS strategies in terms of utilization, appropriate treatment given and client satisfaction.

Objective 2: To assess the preventive component of the HBC and CHPS strategies in terms of carers' disease knowledge and health behaviour.

Objective 3: To determine the cost per case appropriately diagnosed and treated under HBC and CHPS.

These 3 objectives cover the four dimensions of Smith *et al* approach described in section 2.5. Equity will be addressed when analyzing the utilization of the curative component of the HBC and CHPS strategies. Effectiveness will be assessed by analyzing the appropriate treatment given as well as through disease knowledge and health behaviour. These indicators are considered to be proxy indicators of child morbidity and mortality as the data to populate more direct indicators were not possible to obtain (more details in chapter 3). With regards to the third dimension (cost-effectiveness) and considering that (i) my effectiveness measure is an intermediate outcome (not considered the best effectiveness measure to conduct a cost-effectiveness analysis), and (ii) the importance of knowing the cost of interventions, their affordability and the appropriate financing

strategies to support them, I decided to conduct a cost-analysis which will be useful to guide discussions on the long-term financing of HBC. Finally, humanity will be assessed through users' satisfaction with the curative component.

With regards to methods to address these objectives, a post-intervention study without controls through a household survey, taking into consideration that both HBC and CHPS are implemented throughout the study area, was considered an appropriate approach. This design has been used previously in studies assessing HBC (Annex 1 and 3) and it can inform about the current situation, as a complement to information from routine data through the District Health Management Information Systems. In addition, a qualitative study using in-depth interviews might also provide information about the how and why of the results obtain though the household survey, providing more insight of the bottlenecks and enablers of the strategies. However, the qualitative study was not possible to conduct due to availability of funds.

Chapter 3. Methods

3.1. Study site

The Volta and Northern Regions were purposively selected (Figure 3). I wanted to include a region implementing iCCM and one malaria only HBC, to have a better picture of HBC in Ghana. Based on this first requirement, the NMCP suggested the Volta and Northern Regions. The Volta Region targeted only rural districts for the HBC implementation and implements mostly malaria HBC (with the exception of some communities supported by NGOs which implement integrated HBC), despite all districts having received drugs for the management of diarrhoea and suspected pneumonia in 2013. The Northern Region implements iCCM due to availability of funds from UNICEF. Based on the monthly activities reported through the routine monitoring information system (District Health Information System-DHIMS II), the NMCP had some concerns on the low performance of iCCM in Northern Region compared to the other two northern regions (Upper East and Upper West Regions), although the iCCM coordinator in the Northern Region believed this low performance was due to under reporting of activities. In contrast, the NMCP was satisfied with the malaria HBC implementation in the Volta Region. Selecting one "good" and "bad" performing was believed to be a good strategy to contrast results with those of DIMS II and to see possible differences that could help identify enablers and barriers of the HBC implementation in Ghana. The CHPS strategy is uniform across regions of the country.

The Volta Region has a malaria prevalence of 17%, diarrhoea prevalence of 7.6% and suspected pneumonia prevalence of 2.1% in children under five (MICS 2011). The rural population corresponds to a 66% of the total population. Two rainfall seasons occur in the middle and coastal belts, one major season is in April/July with a peak in June and one minor season is in September/November with a peak in October. The north of Volta Region has one rainy season - May to October with a peak in August.

The Northern Region has a malaria prevalence of 48%, diarrhoea prevalence of 21.4% and suspected pneumonia prevalence of 6.3% in children under five (128). The rural population corresponds to 70% of the total population. In the north the rainy season begins in May and ends in October (129). Climatically, religiously, linguistically, and culturally, the Northern Region differs greatly from the politically and economically dominating regions of central and southern Ghana, and it is similar to the two other northern regions (Upper East and Upper West).

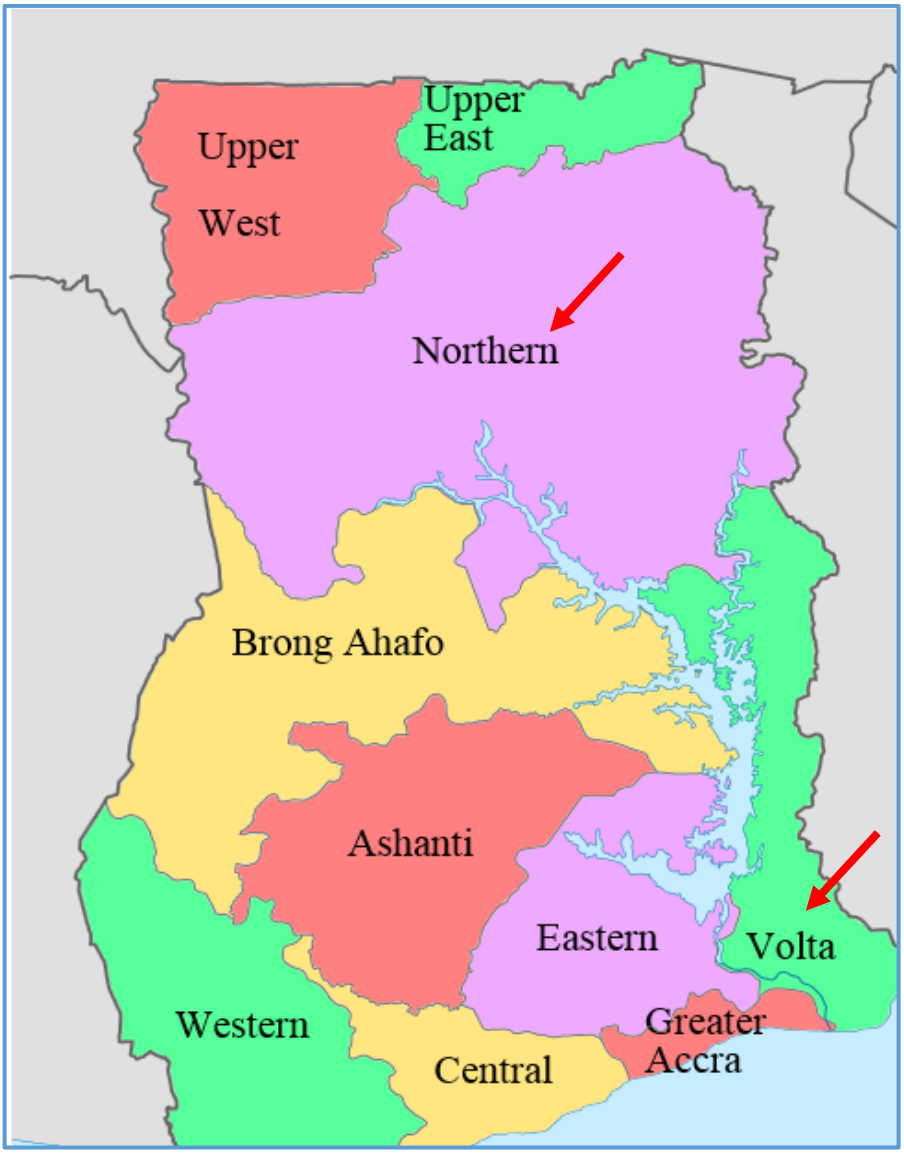

Figure 3. Map of Ghana

3.2. Defining utilization of services

Utilization of services does not have a single definition. There is a vast bibliography defining the utilization of health care, access, and its different dimensions and determinants. Cabieses and Bird (2014) (130), reviewed the different access definitions used and how they evolved over time. One of the first definitions of access had a focus on "demand side" and was referred as the ability to reach health services. Then, more focus has been made on the "supply side" or availability of health services. Other authors like Penchasky and Tomas (1981) defined access as the "fit or interaction" between the user and the system, defining 5 dimensions of access: availability, accessibility, accommodation, affordability and acceptability (131). Since then, several frameworks of access to health care in relation to poverty and identifying barriers to health care have been developed.

Cabieses and Bird in their Glossary of Access defined 3 components and 4 barriers to access to health care (130). The components of access were geographical access (or availability of health care), financial access (or affordability) and socio-cultural access (or acceptability of health care). The barriers were personal barriers (lack of awareness, stigma and lack of information), financial barriers (costs that deter people from accessing care), organizational barriers (structure and process of the health care system) and physical/geographical barriers. Utilization of health care is defined as the realized access or the actual use of the services which is the definition I used in this study. The components and barriers to health care were also addressed and described in this study when looking at factors associated with the use of community services. Analysing the association between socioeconomic status and utilization of HBC and CHPS I also addressed equity in HBC and CHPS utilization (first dimension described in section 2.5).

3.3. Defining appropriate treatment given

I chose appropriate treatment given for children under-five presenting with fever, diarrhoea and cough, as a measure of the effectiveness of the curative component of HBC and CHPS. This indicator was defined in the HBC and CHPS guidelines, can be compared with other studies (Annex 1), it is feasible to obtain from my study and allows me to attribute the results obtained to the different strategies based on the source of treatment. In addition, appropriate treatment given is a proxy indicator of child mortality. Malaria cases can progress rapidly to severe disease and death if malaria treatment is not administered in the first 24-48h from onset of symptoms (35). Prompt treatment with a full course of effective antibiotics is key to reduce pneumonia deaths (132). ORS and zinc are effective therapeutic interventions to reduce diarrhoea mortality (14).

Appropriate treatment refers to those with specific symptoms receiving the treatment and procedures defined in the national guidelines. Therefore, this study will compare the treatment received against national guidelines and not against control groups.

Other studies have used different health outcomes to assess the effectiveness of the curative component of HBC, such as anaemia prevalence, malaria prevalence or mortality due to malaria, diarrhoea or pneumonia. However, measuring anaemia or malaria prevalence requires laboratory resources while malaria, diarrhoea and suspected pneumonia related mortality would require a much bigger sample size. In addition, as the interventions are implemented in all districts under study (there are no intervention and control groups), it would have been difficult to attribute these outcomes to these particular interventions.

There are two other outcome measures or effectiveness measures, particularly used when doing economic evaluation, which allow comparison with other diseases. These are the Disability Adjusted Life Years (DALYs) averted and the Quality Adjusted Live Years (QALYs) gained (chapter 6). Calculating DALYs using a simple tree model could have been a good option to consider instead of appropriate treatment given. However, during the DrPH review it was considered that using DALYs would be too much work for a DrPH thesis while using cost per appropriate treatment was a good and realistic alternative, also comparable with other studies (98). Calculating QALYs was not considered because (i) the studies found on HBC cost effectiveness used DALYs (Table 2) and (ii) it requires an extra cost to calculate the quality-adjustment weight for malaria which rely on preference-based measures directly elicited from general population samples or from groups of patients (133).

3.4. Defining users' satisfaction

Users' satisfaction with the way health care is provided is used to assess the humanity of the health care, one of the four dimensions of a health care evaluation which involves respecting the principles of autonomy, dignity, beneficence and non-maleficence of every patient (113, 134). Fitzpatrick (1997) described 5 areas that address the principles mentioned above: interpersonal skills, information given, technical competence, the organization of health care and time spent with the patient (113). Several authors have indicated the importance of exploring all these areas (as opposed to a single general question) to assess satisfaction, as it may vary based on the domain explored (135-137). A minimum of 5 alternative responses are recommended to allow a more precise expression of users views and to increase reliability of the instrument (138, 139). Satisfaction rates will be influenced by characteristics of the patient (such as age of respondent, expectations and health status) and those related to the health system (139, 140) although in general, expressed levels of satisfaction are typically high (134, 135, 141). Therefore, some authors recommend to focus on the dissatisfaction data, to compare with other groups or trends (134) and to look at experiences with the health services rather that asking for satisfaction (141, 142).

3.5. Defining disease knowledge and health behaviour

Disease knowledge and health behaviour were chosen to assess the effectiveness of iCCM and CHPS on family and community health practices regarding malaria, diarrhoea and pneumonia. Health behaviour is understood as the combination of knowledge, practices, and attitudes that

together contribute to motivate the actions we take regarding health. Indicators chosen to measure disease knowledge were: (i) carers of febrile children under-five being able to identify the cause and practices that can cause malaria, diarrhoea and pneumonia and (ii) carers of febrile children under-five years of age being able to identify signs of severe disease. Indicators chosen to measure health behaviour were: (iii) children under- five sleeping under ITNs, (iv) improved sanitation facilities in the household, (v) promptness in seeking care and (vi) adherence to treatment.

I believe these indicators are appropriate to measure the effectiveness of the preventive component of the HBC and CHPS strategies because (i) they can measure the objectives of the HBC and CHPS; (ii) they can be comparable with other studies (Annex 1, (49)), (iii) they are feasible to obtain from my study and (iv) allow me to attribute the results obtained to the different strategies based on the source of health messages. In addition, these indicators are proxy indicators of child survival, child growth and development as described in section 1.3.

As mentioned in section 2.5, there are other study designs that can address the causal relationship between the interventions and the outcomes. However, as the objective of this study was not to test a new hypothesis but to assess the implementation of two national strategies already in place, I consider that a cross sectional study, being able to identify the source of the health messages, and attribute these to the strategies under evaluation, is appropriate for my study objective.

3.6. Defining case appropriately diagnosed and treated

The definition of 'case appropriately diagnosed and treated' was used to address objective 3. It refers to a malaria, diarrhoea or suspected pneumonia case that received treatment according to guidelines (section 3.3) or a child without malaria, diarrhoea or suspected pneumonia that was not prescribed the recommended drugs to treat malaria, diarrhoea or pneumonia.

The use of two different but similar measures (*appropriate treatment given* to measure the effectiveness of the curative component and *case appropriately diagnosed and treated* for the cost analysis) have an explanation. Appropriate treatment given was an indicator used in many studies as described in Chapter 2 and in Annex 1. Using the same indicator will allow me to compare my findings with the other studies as mentioned above. Case appropriately diagnosed and treated also takes into consideration those cases that were un-necessarily treated which is important when analysing costs.

3.7. Other study definitions

The following study definitions were used for the data analysis:

(i) Appropriate provider refers to public or private medical facility, CHPS, CBAs or licensed chemical shop (128). HBC is delivered by CBAs.

(ii) Utilisation of HBC or CHPS is defined as carers taking their child under five, to a CBA or a CHPS, respectively, when the child has symptoms of fever, cough or diarrhoea.

(iii) Flexibility of time of a CBA or of a health facility for a child to attend, refers to carers' opinion on "open hours", or "open service" meaning the times during the day that a child can be seen by a provider.

(iv) User satisfaction refers to carers experience with the service received after the treatment seeking visit.

(v) Definitions specific to case management of malaria, pneumonia and diarrhoea, and their differentials by HBC and CHPS used in the study are presented in Table 1.

(vi) Definitions specific to disease knowledge and health behaviour under HBC and CHPS strategies are presented in Table 2.

Table 1. Definitions specific to case management of malaria, pneumonia and diarrhoea under HBC and CHPS strategies

Definitions	HBC (65)	CHPS (143)
Malaria	All fever cases when no laboratory tests are available.	All fever cases when no laboratory tests are available **or when malaria test was positive**.
General danger signs	Vomiting, convulsions, unconscious or not breastfeeding.	The same definition as in HBC
Severe malaria signs	Little or no urine, dark coloured urine, marked jaundice or abnormal bleeding.	The same definition as in HBC
Appropriate treatment of malaria	Children aged **6** months to 5 years diagnosed with malaria receiving 3 days of ACT. If more than 7 days with fever, general danger signs or severe malaria signs, child must be referred with rectal artesunate.	Children aged **2** months to 5 years diagnosed with malaria receiving 3 days of ACT. If more than 7 days with fever, general danger signs or severe malaria signs, child must be referred with **IM quinine, IM or EV** or rectal artesunate **plus an IM dose of chloramphenicol.**
Prompt treatment of malaria	Malaria cases that received an antimalarial drug in within the first 24 hours of the onset of symptoms.	The same definition as in HBC.
Diarrhoea	3 or more loose or watery stools in a 24-hour period.	The same definition as in HBC.
Appropriate treatment of diarrhoea	Children **older than 6 months** with diarrhoea of less than 7 days that receive ORS and zinc for 14 days. **If the child is less than 6 months,** had diarrhoea for 7 days or more, blood in stools or is dehydrated, he/she should be referred with ORS.	Children with diarrhoea of less than **14** days receiving ORS and zinc for 14 days. If diarrhoea for 14 days or more, blood in stools or is **severely** dehydrated, he/she should be referred to hospital with ORS.
ARI or suspected pneumonia	Cough with fast or difficult breathing*	The same definition as in HBC
Severe pneumonia	Noisy breathing or chest in-drawing	The same definition as in HBC
Appropriate treatment for suspected pneumonia	Children **older than 6 months** with cough and fast or difficult breathing of less than 7 days receiving amoxicillin for 5 days. If the child is less than **6** months or had symptoms for **7** days or more, he/she should be referred. If there are signs of severe pneumonia, he/she should be referred with amoxicillin.	Children older than 2 months with cough and fast or difficult breathing of less than **14** days receiving amoxicillin **or cotrimoxazol** for 5 days. If the child is less than **2** months or had symptoms for **14** days or more, he/she should be referred. If there are signs of severe pneumonia, he/she should be referred **with IM chloramphenicol**

*ARI timers are available in the Northern Region under the iCCM strategy to help diagnose suspected pneumonia. If severe pneumonia is suspected, the child must be referred to a CHPS compound or a Health Centre. **Nurses at CHPS compounds do not have ARI timers. The diagnosis is made based on clinical signs. If a severe pneumonia case is suspected, the children must be referred to a higher level of health facility. Some district hospitals, all regional hospitals and teaching hospitals have X-Rays to help diagnose pneumonia. Health centres, district hospitals, regional hospitals and teaching hospitals have laboratory facilities to help diagnose malaria, diarrhoea and pneumonia.

Table 2. Definitions specific to disease knowledge and health behaviour under HBC and CHPS strategies

Definitions	HBC and CHPS strategies
Knowledge of the cause of malaria	Identification of mosquitoes as vectors of malaria transmission.
Knowledge of the causal behaviours/practices of diarrhoea	Identification of at least 2 practices that cause diarrhoea among (i) not washing hands before eating, (ii) not washing hands after defecation, (iii) not drinking clean/boiled water and (iv) having flies on food. No other responses were considered as correct knowledge.
Knowledge of the cause of pneumonia	Identification of microorganisms as responsible for the disease.
knowledge of causal behaviours/practices of pneumonia	Identification of children not having been vaccinated. No other responses were considered as correct knowledge.
Knowledge of signs of severe malaria	Identification of at least 2 signs among (i) unconsciousness, (ii) convulsions, (iii) very pale, (iv) yellow coloured, (v) not breastfeeding and (vi) vomiting everything.
Knowledge of signs of severe diarrhoea	Identification of at least 2 signs among (i) more than 7 days duration, (ii) blood in faeces, (iii) dehydrated and (iv) not breastfeeding/feeding.
Knowledge of signs of severe pneumonia	Identification of both: (i) chest in drawing and (ii) noisy breathing.
Having a mosquito net hanging	At least 1 net over any bed / mat
Improved sanitation facility	Flush toilet, pit latrine or ventilated improved latrine
Prompt treatment	Care seeking in the first 24 hours of onset of symptoms
Adherence to treatment	Following the instructions received from providers on how to take the medicine prescribed.

3.8. Study design and sampling procedures

To address objectives 1 and 2, a cross sectional household survey was conducted. To address objective 3, a cost analysis was conducted (Figure 4).

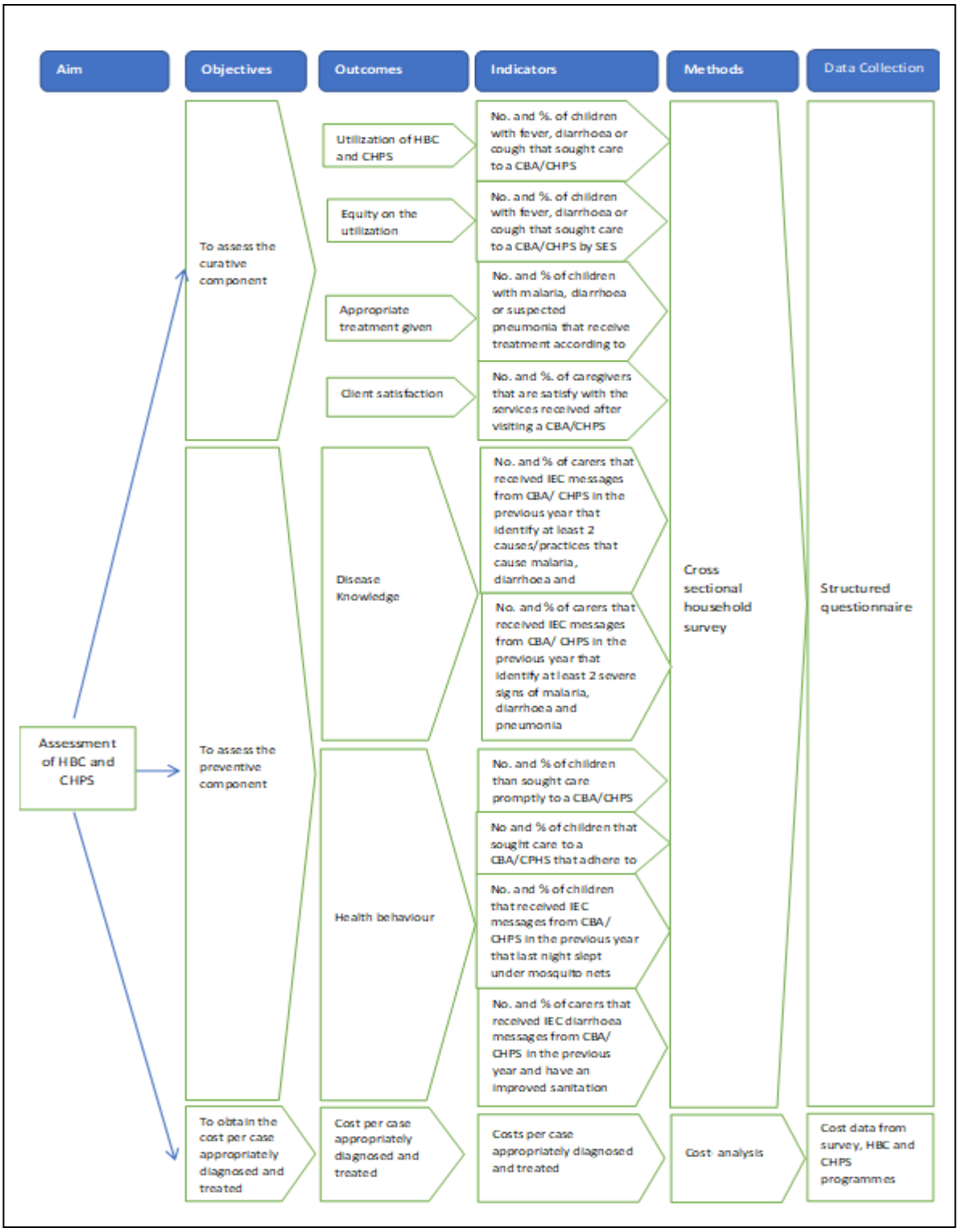

Figure 4. Conceptual Framework of the study

3.8.1. Cross Sectional Household Survey

The cross sectional household survey was an observational study, post implementation and without controls. The effectiveness of the delivery of the curative and preventive components was assessed against national guidelines and standard definitions. The study population were carers of children under- five who had a fever, cough and or diarrhoea in the last two weeks.

The sample size was estimated using the standard formula for estimation of a proportion and adjusting for clustering: $3.84p(1-p)/e^2$ *DE (144). A prevalence of 50% of the population who are satisfied with the strategies was used to obtain a conservative sample size and ensure sufficiency for the estimation of utilization of the community services and several outcomes. A design effect of 1.5 (145) and a precision of 5% were used. Adding 10% for non-response, the sample size required in each region was 633, giving a total sample size of 1267 households across the two regions.

A stratified three stage cluster survey was conducted in each region. In order to have the sample representative of the whole region, whilst being logistically feasible, regions were divided into 3 areas. From each area, 2 districts and from each district four clusters were selected using probability proportional to size (PPS). Then, from each cluster 27 households were selected, making a total of 648 in each region. To select the districts (first stage) the list of districts implementing HBC (all districts implement the CHPS strategy) with its population was used. To select the clusters (second stage) the list of communities implementing HBC with its population was used. From the 24 districts in the Volta Region, only 8 were targeted for the implementation of HBC because of their rural population and were included in the sampling (Annex 1). In the Northern Region, all districts and communities were included in the sampling, as HBC was implemented everywhere.

Households with children under- five that had fever, diarrhoea or cough in the last two weeks prior to the interview were randomly selected in each cluster using a modified EPI sampling technique (third stage) (146). To select households, a location near the centre of the community was first identified and a random direction was defined by spinning a pen. A random household (the first household) along the chosen direction pointing outwards from the centre of the community to its boundary was chosen and checked for compliance with the inclusion and exclusion criteria. Whether the criteria were met or not, the next closest household was visited until the required number of households with a child with a fever, diarrhoea or cough in the 2 weeks preceding the survey were surveyed. Interviews were conducted with the carer of the sick child. In cases where there was more than 1 eligible child in a household, only one of them was selected randomly by ballot paper.

The cross sectional study design selected was appropriate to evaluate the implementation of the preventive and curative components of HBC and CHPS strategies for children-under five in the two

regions, based on the outcomes of interest. This study was not a proof of concept, but an evaluation of an on-going programme that is already implemented at the national level. It was not possible therefore, to adopt study designs including interventions and controls, or indeed randomly selected intervention and control areas. To attribute the outcomes to the delivery strategies under study, the questionnaire included different question such us “where did you seek care”, “from where did you receive the drug”, “from where did you receive malaria preventive messages”, as used previously in a similar study in Ghana (147).

Cross sectional studies have been used in many HBC studies (Annex 1), making it possible to compare my results to those of other studies. However, this cross sectional study would ideally have been complemented with a qualitative study that could help to explore barriers and enablers of delivery of appropriate curative and preventive care for malaria, diarrhoea and pneumonia through HBC and CHPS. Validating carers’ responses obtained from the household survey with CBAs records or with CBAs observation would have strengthened my results. Carers’ responses may be subject to recall bias, and may be influenced by understanding of instructions and by difficulties in the identification of symptoms, particularly those related to suspected pneumonia which are more difficult to identify. CBA records may suffer from inaccurate or incomplete reporting. Observation is considered the gold standard (90) but also has the limitation of potentially influencing performance (CBAs might perform better when under observation than when alone in the community, also called the Hawthorne effect (148)) and conducting observations is more time consuming and required more resources. A data validation exercise using reviews of CBA registers was originally planned together with a qualitative study. However, these sub-studies were not possible to conduct as the organization that had promised to finance the studies withdrew one month before planned implementation.

The sampling scheme chosen is also appropriate for the study aim. Stratified 3 stage sampling with PPS ensures that all participants have an equal probability of being selected (avoiding selection bias) and it is cheaper and more feasible to conduct than simple random sampling. As the aim of the study was to evaluate the HBC and CHPS strategies, only communities designated by policy as implementing both strategies were included in the sampling. In the case of the Northern Region, all communities were designated as implementing both strategies, so all districts and communities were included in the sampling and the results represent the population of children under five that had fever, diarrhoea or cough in the 2 weeks previous to the survey in the Northern Region as a whole. In the Volta Region, HBC was targeted to some rural districts leaving out the urban ones. The results from the Volta Region therefore do not represent the whole region: only the population of children under- five that had fever, diarrhoea or cough in the 2 weeks previous to the survey in the communities designated as implementing HBC and CHPS (Annex 4 describes the districts

included in the sampling). Finally, it is important to note that I am not comparing the Volta Region with the Northern Region, nor malaria HBC with iCCM as both regions are different culturally and epidemiologically. I am only describing results found in each region and in each strategy.

3.8.2. Cost analysis

A cost analysis was conducted to determine the cost per case appropriately diagnosed and treated under the HBC and CHPS, addressing objective 3. The definition of case appropriately diagnosed and treated has been defined in Chapter 3, section 6.

Economic costing was done from the societal perspective, which considers costs to households and the health system. The unit cost was defined as total cost incurred in treating one case of malaria, diarrhoea and pneumonia. Details on how the cost was calculated are described in chapter 6.

Once the unit cost for diagnosing and treating a malaria, diarrhoea and pneumonia case under the HBC and CHPS strategy was obtained, the cost per case appropriately diagnosed and treated was calculated using a sample of 100 eligible children from the survey. Finally, a sensitivity analysis was conducted.

Results from economic evaluations may suffer from bias or uncertainty. There are four types of uncertainty that might affect results of economic evaluations: methodological uncertainty, parameter uncertainty, structural uncertainty and generalizability. Methodological uncertainty refers to the analytic methods used in the analysis, for example the methods used to estimate productivity loses. If a methodological uncertainty is suspected, repeated analyses should be run using different methods. Parameter uncertainty arises from the imperfect knowledge of true values of the parameters that are used in the analysis, for example due to sampling variability. Parameter uncertainty can be dealt with by using both deterministic (one-way and multi-way sensitivity analysis) and probabilistic sensitivity analysis (PSA). Structural uncertainty refers to the appropriate methodology for combining the input parameters. If a structural uncertainty is suspected, repeated analyses should be run using different models where uncertainties regarding model structure exist. Finally, generalisability refers to the extent to which study results can be applied to another context or setting (149). Using data from systematic reviews instead of from one study and modelling are two approaches to deal with generalisability of findings.

Sensitivity analysis allows exploration of how these uncertainties could affect the cost and cost-effectiveness results. There are several types of sensitivity analysis as mentioned above. One- way sensitivity analysis is the simplest type of sensitivity analysis where values of different parameter are modified one at a time across a plausible range, while the other parameters remain at their

baseline values. Threshold analysis (a type of one-way sensitivity analysis) aims to identify the value of a parameter above or below which the intervention is cost-effective. One-way sensitivity analyses are easy to use, provide flexibility in parameter choice, they are logical, and they could be a good starting point to understand the structure of a particular cost or cost-effectiveness analysis. However, they have also been criticised particularly due to the fact that the incremental cost or cost-effectiveness ratio might be influenced by more than one parameter at a time. Multivariate sensitivity analysis allows a variation of the value of several parameters at the same time. Scenario analysis is a type of multi-way sensitivity analysis were the worst and best- case values are used for the cost-effectiveness analysis. Multi-way sensitivity analysis also has some weaknesses: the interaction among different parameters might imply that the simple addition of different parameters might not be appropriate. In addition, the presentation and interpretation of a multi-way sensitivity analysis can also be difficult as the number of parameters modified increases. Finally, probabilistic sensitivity analysis (PSA) uses distributions which randomly generates a large number of mean cost and effectiveness estimates. This sensitivity analysis is believed to be the most comprehensive way of dealing with some forms of uncertainty in economic evaluation. However, practicality issues like the choice of the distribution, the assumption of independence between parameters, or the fact that PSA do not address generalizability, are their weaknesses (149, 150).

To deal with uncertainty in this study, I decided to conduct a one-way sensitivity analysis. I believed that parameter uncertainty was the uncertainty that could most affect my results. Even though PSA can be considered as the best approach to deal with it, one-way sensitivity analysis is a good starting point to see how different values may affect the cost analysis, while being a more reasonable methodology to choose when compared to PSA, particularly due to the amount of time available to conduct the DrPH thesis. The parameters chosen for the sensitivity analysis were different discounting rates, different facility cost, different HBC and CHPS utilization and different HBC effectiveness. Different discounting rates to annualise capital values affect the cost of treating a malaria, diarrhoea or suspected pneumonia case particularly in the CHPS facilities. Therefore, I decided to explore whether using a discounting rate of 5% and 7% (instead of 3%) would affect the cost-effectiveness analysis. With regards to different facility costs, and as mentioned in section 5.3.1, I conducted a cost analysis in two CHPS facilities in each region. Average CHPS costs in each region were used to conduct the cost- effectiveness analysis. However, I believed that it is also important to take into consideration not only average costs but also the less and more costly CHPS as this variation could influence results. Different HBC and CHPS utilization might influence the cost per case appropriately diagnosed and treated under both strategies. For example, if HBC invests in training CBAs but few people visit them, the cost per treatment under HBC would be high and therefore, it may influence the cost-effectiveness results. Data from the household survey

gave a point estimate and a 95%CI of the HBC and CHPS utilization. I considered that using the limits of the 95%CI as the values for the sensitivity analysis was the most appropriate approach. The 95%CI limits for the HBC utilization in the Volta Region were 5.8% and 45.7%; for CHPS utilization in the Volta Region were 6.7% and 22.9%; for HBC utilization in Northern Region were 0.2% and 3.9% and for CHPS utilization in Northern Region were 10.6%, 68.6%. Similarly, the effectiveness of the HBC strategy (understood as the number of cases appropriately diagnosed and treated) may also influence the cost analysis. However, it was not possible to calculate the 95%CI of HBC the effectiveness for the three diseases in both regions. Considering the low effectiveness found (see Chapter 3), I consider that a 50% increase or decrease in HBC effectiveness was a good criteria to see how a change in HBC effectiveness might affect the cost analysis (as a lower % of increase or decrease was too low to see a difference in number of cases appropriately diagnose and treated) (Table 3).

Table 3. Parameters used for the sensitivity analysis

Parameters	Values tested	Rational
Discounting rates	3%, 5% and 7%	Different discount rates to analyse capital values may influence the cost of diagnosing and treating a case, particularly in a CHPS facility. 3 % was chosen following a standard practice. 5% and 7% was believed to be a good range for comparison found in other studies.
Facility costs	Average, higher and lower costs	Average cost of the CHPS facilities was used to do the cost analysis. However, different facility costs may influence the comparison with HBC.
HBC and CHPS utilization	95% CI	The use of HBC and CHPS affects the cost per diagnosis and treatment. Using the 95%CI obtained from the survey was believed to be the best approach to explore higher and lower utilization.
HBC effectiveness	50% higher and lower effectiveness	Being HBC the "new" intervention, it seemed important to explore how better or worse performance will influence cost. Due to the low numbers, it was not possible to obtain the 95%CI of the HBC effectiveness in both regions. Therefore, a 50% increase and decrease in effectiveness (understood and the number of cases appropriately diagnosed and treated) was a good range to see changes in number of cases appropriately diagnosed and treated.

3.9. Data collection

Survey data collection was done during the 5th to 16th April 2014 in the Volta Region and during the 23rd June to 3rd July 2014 in the Northern Region. Three teams of 4 field workers with one field supervisor were recruited in Dodowa Health Research Centre (DHRC) for the Volta Region data collection and in the regional directorate in Tamale for the Northern Region data collection. The recruitment process and selection criteria included an interview, previous experience as a field

worker and in DHRC, and secondary education level. The training was done in DHRC for the Volta Region team and in Tamale for the Northern Region team. The training was of one week duration and included one day piloting the questionnaire. The same field supervisors and the trainers were used in both regions.

Data collection was done using a structured questionnaire which included socio-demographic information of the carer, care seeking behaviour, experience with CBAs and other health providers, costs involved when seeking care, exposure to health education messages, knowledge of the 3 diseases, health behaviour and household characteristics. To ensure that the data collected was of good quality, supervisors conducted checks for errors on the questionnaires, daily. This exercise was followed by a meeting with field workers to give feedback on issues found and discuss how to solve the problems identified.

Data on costing was collected from the household survey, from the Health Administration and Support services, from the National Malaria Control Programme, from CHPS and from the NGO Plan International which supports the HBC in the Volta Region. Data costing started during data collection but last much longer, until the end of the thesis.

3.10. Data management and analysis

Survey data were double entered and validated using EpiData 3.1. Survey data processing and analysis was done using STATA 12. Initial data examination and prevalence estimates were obtained using tabulations adjusted for survey design. Pearson's design based chi-square was used to test for associations. Survey logistic regression was used to obtain adjusted estimates.

Principal components analysis (PCA) was used to create socio-economic quintiles and compare outcomes across these quintiles. The variables used to generate the socioeconomic quintiles were ownership of the house, number of rooms, type of flooring, availability of electricity, radio, television, refrigerator, telephone, bicycle, motorcycle, car, canoe, tractor, source of water, type of sanitation, main source for cooking and number of people living in the household. The advantage of using a PCA over the more traditional methods based on income and consumption expenditure is that it avoids many measurement problems such as recall bias, seasonality and data collection time. PCA is easy to calculate and it can use the type of data that can be easily collected in household surveys. Socio-economic categorization is obtained by ranking then classifying households within the distribution into various groupings. Therefore, while it is useful for considering inequality between households, it cannot provide information on absolute levels of poverty within a community. It can be used for comparison across countries, settings or over time, provided the separate indices are calculated with the same variables. Critics of PCA argue that the technique is

arbitrary, that the method of choosing the number of components and the variables to include is not well defined. Whether the first principal component can predict SES status will depend on the nature of data and the relationships between variables that are being considered, the validity of the variables included and their reliability (151).

To ensure good quality data at this stage I used three strategies. When creating the data entry interface in EpiData and before entering the data, I set up data checks to avoid data entry errors. For example, restricting data entry to certain values or accepting values only on a certain conditions (jumps). Once all checks were done and tested, a double entered and validation was done to identify errors during the data entry. Entering the data a second time allows to check both files for inconsistencies. Finally, and before the data analysis, I cleaned the data looking for possible errors, inconsistences and missing values, revising filled in questionnaires if needed.

3.11. Ethics

Ethical approval was obtained from the Ghana Health Service-Ethical review committee (ID NO; GHS-ERC: 04/09/13) and from the Ethics Committee of LSHTM (ethics ref: 6442). Administrative approval was obtained from the respective regions and districts. Carers of children gave written consent to be interviewed (Annex 9).

Chapter 4. Assessment of the HBC and CHPS curative component

4.1. Introduction

As mentioned in Chapter 1, section6, Ghana has developed two main community- based interventions or delivery strategies that aim to reduce barriers to physical access to quality treatment, contributing to reducing the morbidity and mortality of children under- five years of age. These community-based interventions are HBC and CHPS. HBC started in Ghana in 1999 to treat suspected malaria cases (65). In 2009 and in the context of Integrated Management of Childhood Illness (IMCI), Ghana introduced the iCCM to address fevers, ARI and diarrhoea in the community. The CHPS strategy started in a pilot phase in 1994 (74) with the aim of improving access to health care. Among other services, CHPS provided treatment of common diseases such as malaria, diarrhoea and acute respiratory infections (ARI).

This chapter reports on the assessment of the curative component of the HBC and CHPS strategies (objective 1 of the thesis) in terms of utilization of services, appropriate treatment given and users' satisfaction in the current context, without additional supervision, in a large geographic area and considering the management of fever, diarrhoea and cough for children under- five years of age.

4.2. Household survey

A household survey was conducted 2 years and 8 years after implementation of HBC in the Volta and Northern Regions of Ghana respectively. Details of the study design were described in Chapter 3, section7. This was a stratified three stage cluster survey where carers of children under-five years of age presenting with fever, diarrhoea or cough in the previous two weeks were interviewed on their care seeking behaviour, the treatment received and their experiences with the providers.

I also mentioned that validating carers' responses obtained from the household survey with CBAs records or with CBAs observation would have strengthened my results. It was not possible to conduct this sub-study. However, two studies on antimalarial use and dosage used where carer's reports were compared to HBC records showed similar results (87, 88), and therefore support my study design.

4.3. Data analysis

Assessing which factors or predictors that are associated with the utilization of these interventions might help to understand who is using the service and under which circumstances. This information can be useful to address equity (when the predictor is the socioeconomic status), to identify enablers or barriers as well as for planning purposes.

To explore the potential association between HBC and CHPS utilization and potential predictors, the crude OR was obtained using univariate logistic regression, and the adjusted OR using multivariate analysis based on a framework that I developed (Figure 5 and Table 4). To do this, firstly, the association of each factor (adjusted only for district) with the HBC and CHPS utilization was estimated. All individual factors whose association reached significance at $p<0.1$ were included in a multivariate analysis. All factors that remained significantly associated with the outcome ($p<0.1$) in this model were retained. The variables included in this model were the core group of individual variables. Secondly, all community factors whose association reached significance at $p<0.1$ (adjusted only for district) were added into the core group of individual variables. All factors that remained significantly associated with the outcome ($p<0.1$) in this model were retained. Thirdly, all health system factors whose association reached significance at $p<0.1$ (adjusted only for district) were added into the core group of individual and community variables in a multivariate analysis. All variables that remained significantly associated with the outcome ($p<0.05$) in this model were retained in the final model. Two- way interactions were tested with all the variables retained in the final model.

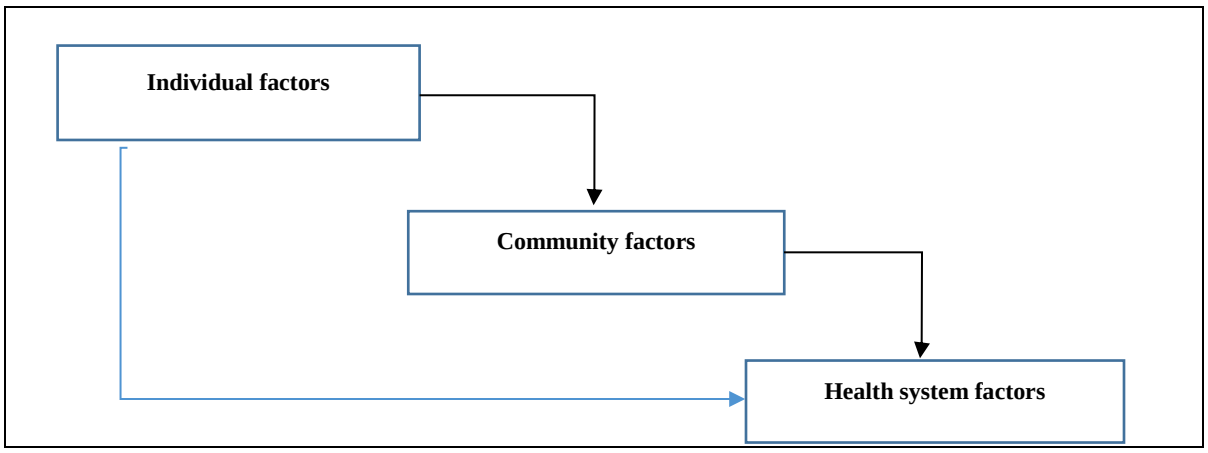

Figure 5. Simplified conceptual hierarchical framework for HBC and CHPS utilization

Table 4. Potential predictors of the framework for HBC and CHPS utilization

Category	Variable
Individual factors	Age of child
	Sex of child
	Age of care taker
	Education of care taker
	Household socio economic status
Community factors	Preventive messages sent by CBAs and CHPS
	Preventive messages sent by other sources
	Open hours (flexibility of time) of a CBA and CHPS to attend a child
Health system factors	Active NHIS card
	Distance to a health facility
	Type of closest facility
	Open hours (flexibility of time) of the closest facility

4.4. Results

A total of 1,356 interviews were conducted in the Volta and Northern Regions (685 and 671 respectively) (Table 5).

Table 5. Number of interviews conducted by district and region

Volta Region		Northern Region	
District Name	**Freq.**	**District Name**	**Freq.**
Hohoe municipality	115	Central Gonja	114
Jasikan	113	East Gonja	118
Ketu North	98	East Mamprusi	120
Krachi East	114	Saboba	110
Krachi West	121	Sawla-Tuna-Kalba	106
North Tongu	110	Tolon Kumbugu	117
Total interviews	**671**	**Total interviews**	**685**

Among the children included in the study, fever was the most prevalent reported symptom during the last two weeks prior to the survey [621/671 (90.9%) in the Volta Region and 635/685 (94.4%) in the Northern Region], followed by cough [408/671 (65.9%) in the Volta Region and 334/685 (53.1%) in the Northern Region] and diarrhoea [287/671 (49%) in the Volta and 291/685 (42.7%) in the Northern Region] (Table 6).

Table 6. Prevalence of symptoms and care seeking behaviour by region

Indicator	Volta Region		Northern Region	
	N	%**	N	%**
Had Fever during past two weeks*	621/671	90.9	635/685	94.4
Had Diarrhoea during past two weeks	287/671	49.0	291/685	42.7
Had Cough during past two weeks	408/671	65.9	334/685	53.1
Had suspected pneumonia during past two weeks	153/671	21.4	80/685	10.2
Sought care (for any of the 3 symptoms)	639/671	93.1	626/685	92.8
- From CBA	90/671	17.3	8/685	1.0
- From CHPS	61/671	11.8	228/685	31.3
- From Health Centre	130/671	12.2	155/685	21.1
- From Hospital	153/671	24.2	83/685	13.0
- From Private clinic	19/671	4.0	25/685	7.3
- From Licensed chemical seller	153/671	19.5	88/685	14.9
- From Drug peddler	29/671	3.3	33/685	5.5
- From Traditional healer	0/671	0	6/685	0.6
- From Other providers	4/671	0.4	0/685	0
- Care not sought	32/671	6.8	59/685	7.3
Not aware/ Don't have CBA	213/671	29.8	314/685	40.6
Sought care in the first 24h (for any of the 3 symptoms)	299/671	40.0	413/685	62.5
- From CBA	58/90	56.0	6/8	79.9
- From CHPS	22/61	36.3	163/228	76.9
- From Health Centre	62/130	33.8	104/155	72.4
- From Hospital	60/153	45.7	54/83	59.0
- From Private clinic	4/19	20.6	12/25	47.8
- From Licensed chemical seller	74/153	40.8	58/88	59.1
- From Drug peddler	16/29	49.7	14/33	55.6
- From Traditional healer	0	0	2/6	43.2
- From Other providers	3/4	54.7	0	0
Sought care in the first 24h in case of fever	278/621	40.2	385/635	62.5
Sought care in the first 24h in case of diarrhoea	140/287	40.6	159/291	58.3
Sought care in the first 24h in case of cough	178/408	39.4	188/334	54.9
Sought care in the first 24h in case of suspected pneumonia	71/153	33.4	47/80	56.4
Sought care from appropriate provider (for any of the 3 symptoms)	609/671	89.6	587/685	86.4
Sought care from appropriate provider in first 24h (for any of the 3 symptoms)	282/671	38.1	397/685	59.1

* Fever refers to hot body or chills. ** Weighted estimates.

4.4.1. Utilization of HBC and CHPS strategies

Almost all respondents in both regions (93%) indicated that they sought some form of care when the child's symptoms started in the past two weeks preceding the survey, and more than 86% did it from an appropriate provider (Table 6). Seeking care from an appropriate provider was not associated with the SES (p=0.6 and p=0.2 in the Volta and Northern Regions) but it was associated with having an active NHIS card in the Northern Region (p=0.01) (data not shown in table).

About 30% of carers visited a community-based health provider (HBC or CHPS) when their child had fever, cough or diarrhoea (29.1% and 32.3% in the Volta and Northern Region). Although CHPS coverage was found to be similar in both regions (41% and 43% of households have a CHPS as the closest health facility in the Volta and Northern Region) and the distance to the closest health facility is larger in the Northern Region (61% versus 45% have a health facility at less than 1 hour walking in the Volta and the Northern Region), HBC was more utilised than CHPS in the Volta

Region (17.3% of carers visited a CBA) and CHPS were much more used than HBC in the Northern Region (31.3% of carers visited a CHPS) (Table 6).

Within regions the utilization of HBC and CHPS varied by districts (Table 7). HBC utilization in the Volta Region ranged from 35.3% (95% Confidence Interval (CI) 20.8 to 53) in Krachi East to 0.3% (95% CI 0.01, 0.9) in Jasikan (p=0.001). In the Northern Region HBC utilization was generally very low and the percentage of carers reporting that they were not aware of CBAs or that they don't have CBAs in the community was higher than in the Volta Region [314/685 (40.6%) versus 213/671 (29.8%) respectively]. The utilization of CHPS in the Volta Region varied from 27.1% (95% CI 2.5, 84.3) in Krachi West to 2.5% (95% CI 0.3, 15.2) in Hohoe municipal (p=0.2). In the Northern Region, the utilization of CHPS ranged from 56.5% (95%CI 27.9, 81.2) in Saboba to 4.7% (95%CI 2.4, 9.2) in Central Gonja (p=0.004).

Only 282/671 (38.1%) of carers in the Volta Region and 397/685 (59.1%) in the Northern Region sought care from an appropriate provider the same day or the day after the onset of fever, diarrhoea or cough (Table 6). While children seeking care from a CBA within 24h of onset of symptoms was significantly higher when compared with other appropriate providers collated in the Volta Region [58/90, 56.0% (95%CI 48.7, 63.08) versus 224/519, 39.4% (95%CI 29.2, 50.5), p=0.03], children seeking care from CHPS in the Northern Region also tended to do it more promptly when compared with other appropriate providers collated [163/227, 77.0% (95%CI 70.2, 82.7) versus 234/357, 63.6% (95%CI 50.2, 75.2), p=0.02]. In the Northern Region, a higher percentage of fever cases sought care in the first 24hours of the onset of symptoms than diarrhoea or cough cases [385/635 (62.5%) of fever cases, 159/291 (58.3%) of diarrhoea cases and 188/334 (54.9%) of diarrhoea cases sought prompt care). If comparing fever versus diarrhoea and versus cough (excluding those that have both symptoms) in seeking prompt treatment, the differences were not significant: 72.8% of fever cases (95%CI 62.1, 81.5) versus 60.8% of diarrhoea cases (95%CI 13.5, 93.9), p=0.5] sought prompt care; 79.2% of fever cases (95%CI 69.5, 86.5%) versus 57.3% of cough cases (95%CI 10.5, 93.8, p=0.3] sought prompt care (data not shown in table).

Factors associated with HBC and CHPS utilization in the Volta Region

The final model showed that, compared to carers of sick children younger than 6 months, carers of sick children were more likely to visit a CBA if children were older than 6 months (adjusted OR 6-23 months 4.1, 95% CI 3, 5.5; adjusted OR ≥24months 4.1, 95% CI 1.4, 11 ; p=0.01), or if, compared to those living at less than 15 min walking, they lived further than 15min walking distance to a health facility (adjusted OR health facility 15-30min walking 36.9, 95% CI 1.6, 805), p=0.03; 30min-1 hour adjusted OR 61.8, 95% CI 4.8, 788, p=0.01; 1-2 hours adjusted OR 85, 95% CI 6.8, 1056, p=0.01; ≥2hours adjusted OR 36.4 (1.5, 851), p=0.03). Flexibility of time of the

CBA to attend to a child had a borderline association with utilization of HBC: compared to carers reporting that CBAs were not flexible, adjusted OR CBAs flexible 14 (95% CI 0.4, 417), p=0.08. Carers from households in higher socio-economic quintiles were less likely to take their children to a CBA than those in the lowest socio-economic quintile (adjusted OR lower middle quintile 0.2, 95% CI 0.08, 0.7, p=0.03; adjusted OR upper middle quintile 0.3, 95% CI 0.06, 1.4, p=0.09; adjusted OR upper quintile 0.3, 95% CI 0.01, 1.5, p=0.08). No association with the middle SES quintile compared with the lower level was found (Table 8).

No interaction was found between HBC utilization and any other variable. No factor was found to be associated with the utilization of CHPS compounds.

Factors associated with HBC and CHPS utilization in the Northern Region

Due to low HBC utilization in the Northern Region (n=8) it was not possible or useful to look for predictors of HBC utilization.

With regards to CHPS utilization, carers having as the closest facility a health centre or a private clinic were less likely to go to a CHPS compound (adjusted OR health centre 0.01, 95% CI 0.002, 0.08; adjusted OR private clinic 0.008, 95% CI 0.001, 0.5, p=0.02 (Table 9). No interaction was found.

Table 7. Utilization of HBC and CHPS by district and region

Volta Region							Northern Region						
	HBC			CHPS				HBC			CHPS		
Districts	**n/N**	**% (95% CI)***	**P**	**n/N**	**% (95% CI)***	**P**	**Districts**	**n/N**	**% (95% CI)***	**P**	**n/N**	**% (95% CI)***	**P**
Jasikan	2/107	0.3 (0.01, 0.9)	0.001	13/107	11.3 (7.2, 15.5)	0.2	Sawla-Tuna –Kalba	1/97	1.1 (0.08, 13)	0.3	61/97	52.4 (22.3, 80.8)	0.004
Krachi East	22/111	35.3 (20.8, 53)		10/111	17.9 (11.5,26.9)		Central Gonja	1/100	0.1 (0.009, 3.3)		8/100	4.7 (2.4, 9.2)	
Krachi West	23/119	12.7 (0.5, 78)		17/119	27.1 (2.5, 84.3)		Tolon Kumbugu	2/103	3.7 (1.6, 8.4)		24/103	20.0 (6.1, 48.7)	
Hohoe Mun.	10/111	10.9 (4.5, 23.9)		4/111	2.5 (0.3, 15.2)		East Gonja	0/112	0		46/112	22.6 (5.8, 57.7)	
Ketu North	12/91	12.2 (3.6, 33.7)		6/91	7.9 (5.1, 11.9)		Saboba	1/102	1.1 (0.3, 3.8)		55/102	56.5 (27.9, 81.2	
North Tongu	21/100	19.9 (8.1, 41.2)		11/100	10.6 (1.4, 49.0)		East Mamprusi	3/112	2.4 (0.7, 7.5)		34/112	22.5 (14.6, 57.5)	
TOTAL	90/639	18.5 (5.8, 45.7)		61/639	12.7 (6.7, 22.9)		TOTAL	8/626	1.0 (0.2,3.9)		228/626	33.7 (10.6,68.6)	

* Weighted estimates.

Table 8. Unadjusted and adjusted predictors of HBC and CHPS utilization in the Volta Region

Potential predictors	HBC						CHPS					
			Unadjusted		Adjusted				Unadjusted		Adjusted	
	n/N	**%***	**OR (95% CI)**	**P ****	**OR (95% CI)**	**P**	**n/N**	**%***	**OR (95% CI)**	**P ****	**OR (95% CI)**	**P**
Sex child												
Female	38/273	12.5	1.0	0.3			20/273	8.2	1.0	0.1		
Male	43/335	18.1	1.5 (0.4, 5.1)				37/335	15.3	2.0 (0.6, 6.4)			
Age group												
<6 months	4/48	13.1	1.0	0.07	1.0	0.01	6/48	24.6	1.0	0.2		
6-23 months	37/244	24	2.3 (1.4, 3.7)		4.1 (3, 5.5)		25/244	13.2	0.4 (0.1, 1.4)			
>=24 months	49/347	16.4	1.7 (0.3, 7.8)		4.1 (1.4, 11)		30/347	10.3	0.3 (0.1, 1.0)			
Marital status												
Single	5/44	5.1	1.0	0.6			5/44	13.4	1.0	0.3		
Married/co-habited	82/548	19.6	5.8 (0.6, 56)				54/548	14.1	0.9 (0.1, 8.1)			
Separated/divorced	2/34	1.8	0.5 (0.0, 6.5)				1/34	0.1	0.008 (0.0001, 0.3)			
Widowed	1/13	53.8	24 (0.3, 1567)				1/13	0.4	0.02 (0.0004, 1.08)			
Age respondent												
<20 years	3/33	8.4	1.0	0.9			1/33	1.7	1.0	0.6		
20-29 years	36/281	20.7	1.2 (0.04, 33)				27/281	13.5	6.9 (0.2, 198)			
30-39	34/215	13.9	0.7 (0.01, 33)				25/215	14.3	7.2 (0.2, 176)			
>=40 years	15/106	23.6	1.5 (0.03, 66)				7/106	8.5	4.3 (0.06, 292)			
Education of care taker												
None formal	51/243	30.3	1.0	0.5			27/213	16.5	1.0	0.1		
Primary	14/142	6.6	0.2 (0.09, 0.9)				22/142	15.3	1.3 (0.1, 9.4)			
Middle/secondary	24/246	10.2	0.4 (0.08, 2.1)				12/246	5.8	0.4 (0.06, 2.5)			
Technical/Tertiary	1/8	4.9	0.3 (0.003, 41)				0/8	0	-			
Socioeconomic status												
Lower	20/129	41.7	1.0		1.0		24/129	16.5	1.0			
Lower middle	21/122	14.7	0.2 (0.07, 0.7)	0.03	0.2 (0.08, 0.7)	0.03	14/122	18.8	1.3 (0.8, 2.1)	0.14		
Middle	23/126	13	0.2 (0.03, 23)	0.15	0.3 (0.04, 3.3)	0.2	10/126	10.0	0.8 (0.1, 4.4)	0.7		
Upper Middle	16/125	10.6	0.2 (0.004, 1.4)	0.08	0.3 (0.06, 1.4)	0.09	5/125	5.9	0.4 (0.01, 17.4)	0.5		
Upper	9/128	6.3	0.1 (0.01, 1.5)	0.08	0.1 (0.01, 1.5)	0.08	7/128	9.1	0.7 (0.09, 6.7)	0.7		
CBA accessibility												
Not flexible	4/82	4.3	1.0	0.09	1.0	0.08	3/82	1.9	1.0	0.2		
Flexible	86/299	36.6	14 (0.3, 537)		14 (0.4, 417)		29/299	17.6	10.8 (0.6, 182)			
Not aware/don't have CBA	0/202	0	-				29/202	12.9	7.4 (0.3, 159)			
Don't know	0/56	0	-									
Receiving preventive messages from												

CBA/CHPS compounds										
No	30/479	6.9	1.0	0.003	1.0	0.9	13/427	3.9	1.0	0.4
Yes	40/87	58.7	12.2 (4.9, 30.2)		0.9 (0.9. 1)		42/139	29.3	1.2 (0.5, 3.0)	
Active NHIS										
Yes	65/452	16.4	1.0	0.3			42/452	11.9	1.0	0.5
No	25/187	23.8	1.4 (0.4, 4.4)				19/187	14.6	1.2 (0.3, 4.1)	
Distance to facility (including CHPS)										
Less than 15 min walking	4/50	0.4	1.0		1.0		14/143	11.2	1.0	
Between 15 min- 30 walking	6/92	8.9	36 (0.7, 1793)	0.04	36.9 (1.6, 805)	0.03	16/180	9.5	0.7 (0.2, 2.6)	0.5
Between 30 min- 1 hour walking	38/180	20.8	58.8 (5.3, 645)	0.01	61.8 (4.8, 788)	0.01	23/191	16.2	1.1 (0.3, 3.4)	0.7
Between 1 and 2 hours walking	31/191	26.6	69.1 (5, 950)	0.01	85 (6.8, 1056)	0.01	6/69	16.5	1.2 (0.1, 12.2)	0.7
Health facility accessibility/ CHPS accessibility										
Not flexible	6/81	19.9	1.0	0.5			15/46	29.5	1.0	0.9
Flexible	81/535	17.9	1.1 (0.6, 2.1)				40/110	27.4	1.0 (0.4, 2.1)	
Closest facility										
CHPS	22/165	27.2	1.0	0.6			55/165	26.0	1.0	0.1
Health Centre	27/275	14.8	0.4 (0.09, 1.7)				2/275	0.7	0.02 (0.0009, 0.5)	
District Hospital	36/167	10.7	0.7 (0.06, 7.4)				4/167	5.9	0.2 (0.01, 2.6)	
Regional hospital	0/3	0	-				0/3	0	-	
Private clinic	5/24	11.1	0.5 (0.02,11.4)				0/24	0	-	
Other	0/5	0	-				0/5	0	-	

*Weighted estimates. ** Overall P-value not available for all variables due to sparse data within stratified categories'

Table 9. Unadjusted and adjusted predictors of CHPS utilization in the Northern Region

Potential predictors	CHIPS					
			Unadjusted		Adjusted	
	n/N	%*	OR (95% CI)	P **	OR (95% CI)	P
Sex child						
Female	103/267	35.0	1.0	0.1		
Male	101/278	36.1	1.2 (0.8, 1.8)			
Age group						
<6 months	20/51	34.6	1.0	0.5		
6-23 months	84/228	29.6	0.5 (0.1, 1.9)			
>=24 months	124/347	36.5	0.7 (0.09, 5.2)			
Marital status						
Single	4/9	27.4	1.0	0.8		
Married/co-habited	219/597	33.8	0.6 (0.08, 5.5)			
Separated/divorced	2/4	57.6	0.8 (0.03, 18.6)			
Widowed	3/15	36.1	0.4 (0.04, 4.3)			
Age respondent						
<20 years	8/24	25.6	1.0	0.6		
20-29 years	108/259	36.4	2.1 (0.6, 6.6)			
30-39	76/230	30.7	1.5 (0.5, 4.9)			
>=40 years	36/111	35.5	1.8 (0.7, 4.7)			
Education of care taker						
None formal	183/510	35.4	1.0	0.4		
Primary	21/56	13.8	0.4 (0.1, 1.0)			
Middle/secondary	22/51	44	1 (0.3, 3.2)			
Technical/Tertiary	2/8	2	0.01 (0.0002, 1.1)			
Socioeconomic status						
Lower	38/119	39.8	1.0			
Lower middle	43/125	36.6	1.0 (0.4, 2.1)	1		
Middle	49/120	37.4	1.0 (0.1, 7.4)	0.9		
Upper Middle	50/122	29.8	0.6 (0.1, 3.8)	0.4		
Upper	42/128	12.1	0.1 (0.003, 10.1)	0.2		
CBA accessibility						
Flexible	93/212	48.3	1.0	0.2		
Not flexible	38/100	35.1	0.5 (0.001, 17.9)			
Not aware/don't have CBA	87/292	19.5	0.2 (0.06, 1.1)			
Receiving preventive messages from CHPS compounds						
No	61/354	16.1	1.0	0.2		
Yes	150/194	77.2	2.2 (0.3, 14.6)			
Active NHIS				0.9		
No	55/204	25.3	1.0			
Yes	173/422	38.9	1 (0.5, 1.9)			
Distance to facility						
Less than 15 min walking	166/283	54.2	1.0			
Between 15 min- 30 walking	23/113	25.1	0.3 (0.09, 1.2)	0.07	0.2 (0.01, 3.0)	0.1
Between 30 min-1 hour walking	23/103	27.1	0.4 (0.1, 1.4)	0.1	1.1 (0.04, 26.2)	0.9
Between 1 and 2 hours walking	7/50	12.8	0.1 (0.01, 1.20	0.06	0.3 (0.001, 71)	0.5
More than 2 hours walking	9/71	8.1	0.1 (0.03, 0.7)	0.03	0.6 (0.02, 16.0)	0.7
CHPS accessibility						
Not flexible	18/34	46.5	1.0	0.3		
Flexible	205/293	76	2.6 (0.1, 51.2)			
Closest facility						
CHPS	223/327	73.9	1.0	0.02	1.0	0.02
Health Centre	4/216	4.3	0.01 (0.003, 0.09)		0.01 (0.002, 0.08)	
District Hospital	0/42	0	-			
Regional hospital	0/0	0	-			
Private clinic	1/26	4.4	0.008 (0.0001, 0.6)		0.008 (0.0001, 0.5)	

*Weighted estimates. ** Overall P-value not available for all variables

4.4.2. Appropriate treatment given for malaria, diarrhoea and suspected pneumonia

Appropriate treatment of malaria under the HBC and CHPS strategies

Regarding appropriate treatment of malaria, 19/77 (45.3%) and 1/7 (14.9%) of the children with fever that were taken to a CBA received ACT or were referred with artesunate to a health facility in the Volta and Northern Regions respectively (Table 10); 18/77 (45.0%) and 1/7 (14.9%) in the Volta and Northern Regions received ACT and 12/77 (14.9%) and 1/7 (14.9%) in the Volta and Northern Regions received ACT within 24 hours of the onset of symptoms. In Volta Region, some carers reported that they were prescribed amodiaquine monotherapy (6/78) and quinine (2/77) from CBAs. CBAs are not licensed to prescribe amodiaquine or quinine and amodiaquine should not be given as a monotherapy. However, it is difficult to determine if carers were actually given amodiaquine in monotherapy or if carers reported "amodiaquine" as a short name of "artesunate-amodiaquine". How CBAs have access to these two drugs is not clear: they may have been provided from the health facilities or CBAs may have purchased them at a local pharmacy for selling on to patients. However, carers did not report to have paid for these drugs.

In the case of the CHPS, 34/55 (65.3%) and 86/209 (41.7%) of the children with fever were tested for malaria in the Volta and Northern Regions. A high proportion of carers did not know the results of the test [9/37 (19.0%) and 21/92 (24.9%) in the Volta and Northern Regions respectively. Of those tested positive, 6/23 (20.8%) and 14/67 (8.6%) in the Volta and Northern Regions were given an ACT; 0/23 (0%) and 13/62 (35.1%) were given quinine (reserved for severe malaria cases that should be treated in hospital (152)) and 3/23 (22.3%) and 2/62 (3.8%) were given amodiaquine. When tested negative, only one case in the Volta Region was given ACT and none in the Northern Region. If considering together all uncomplicated malaria cases (those tested positive and fever cases without laboratory confirmation that were not referred), 7/40 (14.7%) and 26/183 (7.4%) in the Volta and Northern Regions received ACT (Figure 6). If malaria cases treated with quinine are included, then the proportion of children appropriately treated increases especially in the Northern Region although still not satisfactory: 8/40 (15.5%) and 57/183 (35.9%) in the Volta and Northern Regions. Prompt treatment with ACT or quinine was also low: 1/40 (2.3%) and 43/183 (27.3%) in the Volta and Northern Regions respectively.

Table 10. Proportion of symptomatic children receiving appropriate treatment under the HBC and CHPS by region

Indicator	Volta Region		Northern Region	
	N	%*	N	%*
HBC				
Fever received ACT or referred with artesunate	19/77	45.3	1/7	14.9
Fever received ACT	18/77	45.0	1/7	14.9
Fever received prompt ACT	12/77	14.9	1/7	14.9
Fever prescribed 3 days of ACT	16/77**	44.9	0/7***	0
Fever received 3 days ACT	14/77	40.7	0/7	0
Fever received Amodiaquine	6/78	9.2	0/7	0
Fever received quinine	2/77	0.3	0/7	0
Diarrhoea received ORS	2/38	2.2	1/4	35.6
Diarrhoea received ORS or was referred****	4/38	7.6	NA	
Diarrhoea received zinc	3/38	16.3	1/4	8.9
Diarrhoea received zinc or was referred****	6/38	22.1	NA	
Diarrhoea received zinc for 15 days	0/38	0	0/4	0
Diarrhoea received zinc and ORS or was referred****	3/38	5.7	NA	
Suspected pneumonia received amoxicillin	6/25	14.1	0/1	0
Suspected pneumonia received amoxicillin or was referred****	7/25	31.8	NA	
Follow up visit	38/88	68.8	4/8	32.3
Referred with a referral form	5/9	62.9	0/2	0
Referred with artesunate suppository in case of fever	2/6	6.9	0/2	0
Referred with amoxicillin in case of cough	2/8	59.9	0/2	0
Referred with amoxicillin in case of suspected pneumonia	0/3	0	0/1	0
Referred with amoxicillin in case of severe pneumonia signs	0/2	0	0/2	0
CHPS				
Fever cases tested for malaria	34/55	65.3	86/209	41.7
Test positive for malaria (some cases with no fever were tested)	23/37	62.1	67/92	71.2
- Received ACT	6/23	20.8	14/67	8.6
- Received prompt ACT	1/23	3.3	12/67	17.9
- Prescribed 3 days of ACT	4/23	16.8	3/67	0.7
- Received 3 days ACT	4/23	16.8	3/67	0.7
- Received quinine	0/23	0	13/62	35.1
- Received Amodiaquine (not recommended)	3/23	22.3	2/62	3.8
- Referred with IM quinine or IM, EV or rectal Artesunate	0/5	0	2/4	4.5
Test negative for malaria	5/37	13.5	4/92	4.3
- Received ACT	1/5	4.0	0/4	0
- Received quinine	0/5	0	0/4	0
- Received Amodiaquine	0/5	0	0/4	0
- Referred with IM quinine or IM, EV or rectal Artesunate	0/1	0	0/0	0
Unknown results for malaria test	9/37	19.0	21/92	24.9
Malaria clinical diagnosis	21/55	23.8	123/133	93.4
- Received ACT	1/21	0.2	13/123	7.6
- Received prompt ACT	0/21	0	10/123	6.4
- Prescribed 3 days of ACT	1/21	0.2	4/123	1.5
- Received 3 days ACT	1/21	0.2	2/123	0.1
- Received quinine	1/20	2.4	19/123	26.3
- Received amodiaquine	1/20	5.0	7/113	2.2
- Referred with IM quinine or IM or rectal Artesunate	0/1	0	0/1	0
Diarrhoea received zinc	7/31*****	31.3	4/86	5.5
Diarrhoea received zinc for 14 days	0/31	0	0/86	0
Diarrhoea received ORS	6/31	22.1	8/86	5.6
Diarrhoea received ORS and zinc	1/30	0.3	0/86	0
Suspected pneumonia received amoxicillin or cotrimoxazole	1/9	18.7	4/15	33.0
Suspected pneumonia received 5 days of amoxicillin or co-trimoxazole	1/9	18.7	4/15	33.0
Suspected pneumonia received any antibiotic******	2/9	20.0	5/15	50.3
Cough received amoxicillin or co-trimoxazole	7/34	30.1	30/104	27.3

*Weighted estimates. **A high number of carers were not told about the number of days to give the medicines. ***Was prescribed and took ACT for 7 days. **** Only in the Volta Region as CBAs are only provided with malaria treatment. ***** Zinc was taken for 10 days; ******amoxicillin, PNC V, ampicillin, co-trimoxazole, cefuroxime, Azitromicin, cloxacilline, eritromicin flucloxacilline, or chloramphenicol.

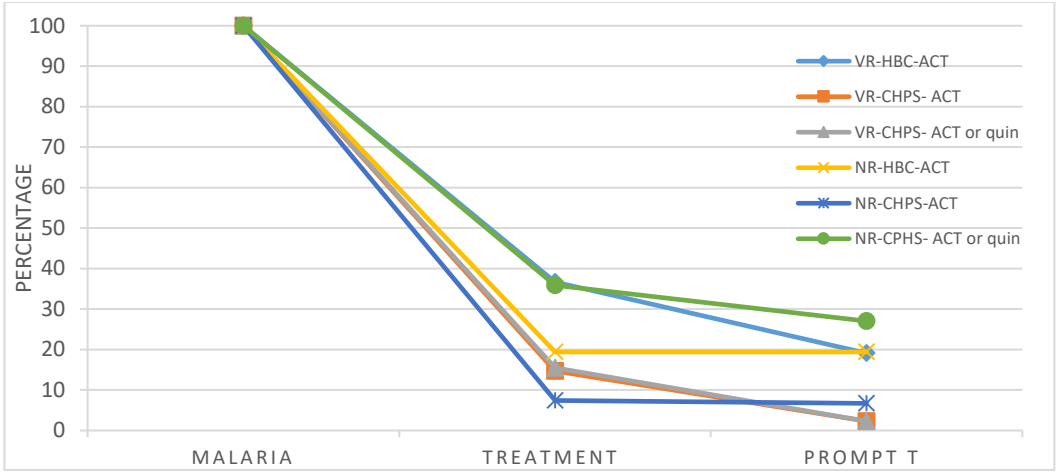

Figure 6. Case management of uncomplicated malaria under the HBC and CHPS by region. (Uncomplicated malaria = cases tested positive or fevers when no test was conducted that were not referred). VR= Volta Region; NR= Northern Region; quin=quinine. T= Treatment. Differences between HBC and CHPS in the Volta Region were statistically significant. No test was conducted in the NR due to low numbers

Appropriate treatment of diarrhoea under the HBC and CHPS strategies

Of the children with diarrhoea that were taken to a CBA in the Volta Region, 4/38 (7.6%) and 3/38 (5.7%) received ORS or were referred and received ORS plus ZINC or were referred respectively. In the case of the CHPS, only 6/31 (22.1%) and 8/86 (5.6%) of children with diarrhoea received ORS, 7/31 (31.3%) and 4/86 (5.5%) received zinc and 1/30 (0.3%) and 0/86 (0%) received ORS plus zinc in the Volta and Northern Regions respectively.

Appropriate treatment of suspected pneumonia under the HBC and CHPS strategies

Of the children with cough with fast or difficult breathing that were taken to a CBA 7/25 (31.8%) received amoxicillin or were referred in the Volta Region and 0/1 (0%) received amoxicillin in the Northern Region. In the case of the CHPS, 1/9 (18.7%) and 4/15 (33.0%) in the Volta and in the Northern Region received amoxicillin or co-trimoxazole according to the protocol.

Follow up visits, referrals and second providers' visits

National guidelines state the CBA must conduct a follow-up visit one day after the first visit (65). This follow-up visit was conducted for 38/88 (68.8%) and 4/8 (32.3%) of the cases in the Volta and Northern Regions (Table 10). Artesunate suppositories were given along with a written referral in 2 of the 6 fever cases referred in the Volta Region and in none of the 2 cases in the Northern Region. No amoxicillin was given in case of referral because of suspected pneumonia in either region and 2/8 (59.9%) of the cough cases referred received amoxicillin in the Volta Region.

After visiting a CBA, 28/90 (42.4%) and 4/8 (63.3%) of the carers in the Volta and in the Northern Region went to a second provider. The main reason for this second visit in the Volta Region was children not getting better [24/28 (98.7%)] while in the Northern Region the reported reasons were not getting better [2/4 (25.5%)] and to get drugs [2/4 74.5%)] (Table 11, Figure 7). After visiting a CHPS, 14/61 (28.0%) and 21/228 (7.9%) of carers in the Volta and in the Northern Region went to a second provider. The facilities more often visited were the licensed chemical sellers in the Volta Region to buy drugs [8/14 (50.4%)] and health centres in the Northern Region because the child was not getting better [9/21 (23.8%)].

Table 11. Places and reasons for seeking care elsewhere after visiting CBA or a CHPS by region

	Volta Region		**Northern Region**	
	n/N	**%***	**n/N**	**%***
Seeking care elsewhere after CBA	**28/90**	**42.4**	**4/8**	**63.3**
Seeking care elsewhere in case of fever	25/28	82.6	4/4	100
Seeking care elsewhere in case of diarrhoea	12/28	66.4	3/4	36.8
Seeking care elsewhere in case of suspected pneumonia	6/28	10.2	1/4	20.3
Second provider sought				
- CHPS	4/28	54.5	2/4	68.3
- Health Centre	7/28	21.8	1/4	11.3
- Hospital	10/28	16.3	1/4	20.3
- Licensed Chemical seller	3/27	2.2	0	0
- Private health facility	4/28	4.9	0	0
Reasons for seeking care elsewhere				
- Not getting better	24/28	98.7	2/4	25.5
- To buy medicines	3/28	1.1	2/4	74.5
- CBA not available	1/28	0.1	0	0
Seeking care elsewhere after CHPS	**14/61**	**28.0**	**21/228**	**7.9**
Second provider sought				
- CHPS	2/14	11.6	1/21	9.2
- Health Centre	0/14	0	9/21	23.8
- Hospital	3/14	1.1	4/21	49.5
- Licensed Chemical seller	8/14	50.4	6/21	16.8
- Drug peddler	1/14	36.7	0/21	0
- Traditional healer	0/14	0	1/21	0.5
Reasons for seeking care elsewhere				
- Not getting better	5/14	51.7	20/21	99.4
- To buy medicines	8/14	42.4	1/21	0.5
- Nurse/doctor not available	1/14	5.8	0/21	0

*Weighted estimates

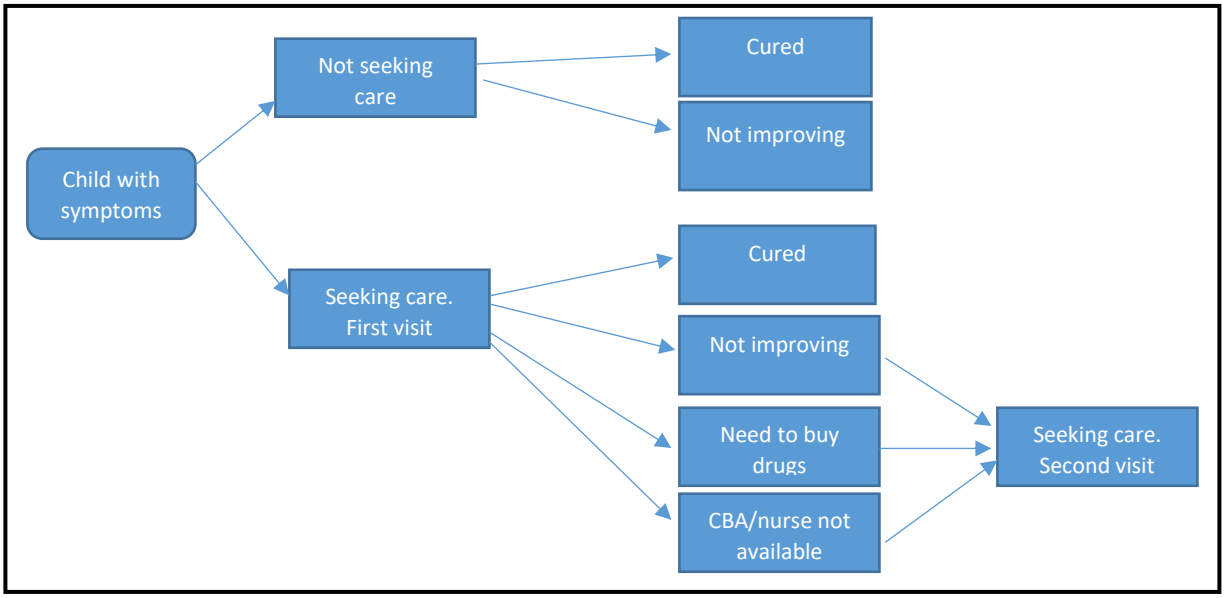

Figure 7. Pathway for care seeking

4.4.3. Users' reported satisfaction

In general, users of HBC and CHPS in both regions reported that they were satisfied, although consistently more in the Volta Region (Table 12). Lack of affordability and availability of drugs were the factors more often reported as reasons for dissatisfaction with the services received.

The main reason for not being satisfied when using HBC in the Volta Region was unavailability of drugs [5/8 (80.24%)], while drugs not available, drugs not affordable and drugs not free [1/1, (100%)] were the concerns in the Northern Region. It is important to note that 3 of the 7 drugs (42%) and 3/138 (2.1%) given by the CBA in the Northern and the Volta Regions were sold to the carers.

Likewise, the main reason for not being satisfied when visiting a CHPS in the Northern Region was drugs not available (5/23, 39.1%). CHPS users in the Volta Region reported a higher variety of reasons for not being satisfied (drugs not available, travel long distances, not time for seeking care and staff not giving information).

Table 12. Users' satisfaction after visiting CBA or a CHPS by region

		Very satisfied		Satisfied		Not sure		Not satisfied		Absolutely not satisfied	
		n/N	%	n/N	%	n/N	%	n/N	%	n/N	%
Volta	CBA	29/89	32.6	52/89	58.4	0/89	0	6/89	6.7	2/89	2.2
Region	CHPS	15/61	24.6	42/61	68.8	0/61	0	2/61	3.3	2/61	3.3
Northern	CBA	2/8	16.1	4/8	30.1	1/8	13.6	0/8	0	1/8	39.9
Region	CHPS	29/228	8.4	175/228	85.2	1/228	0.1	21/228	5.3	2/228	0.8

4.5. Discussion

This study assessed the performance of HBC and CHPS in terms of utilization, appropriate treatment given and satisfaction of carers of children under-five years of age with a fever, diarrhoea or suspected pneumonia in the last two weeks prior to the interview.

4.5.1. Utilization of HBC and CHPS strategies

My study showed that seeking care from an appropriate provider in case of fever, diarrhoea or cough was high in both regions. In the case of fever, 89.9% and 86.7% of children with fever sought care from an appropriate provider and 38.1% and 59.3% did it in the first 24hours of onset of symptoms in the Volta and Northern Regions respectively. Those percentages are higher than previous surveys but they are coherent with the increased trend on care- seeking behaviour because of fever: the 2011MICS survey showed that approximately 44% and 43% of fever cases in under-fives in the Volta and Northern Regions sought care from an appropriate provider at any time (128); the 2013 LQAS survey showed that 60% of fever cases in under-fives in the Northern Region sought care at any time and 30% in the first 24hours of onset of symptoms (153) and in the 2014 DHS 73.6% and 83.6% of fever cases in the Volta and Northern Region sought care at any time (57). It should be noted that the Lot Quality Assurance Sampling (LQAS) is a method for assessing a programme by analysing the data produced by a small sample. While DHS and MICS serves for international comparison, the LQAS serves for intra-national comparison and for health system management (154). Depending on the objectives of the study, the sample size and the rigour of the sampling methods chosen, results can be representative or not of the whole population (155).The results from the LQAS survey are not representative of the Northern Region as they purposively selected 10 districts out of 20 based on their iCCM lower performance compared with the other 10 districts. The MICS and the DHS surveys, use a similar sampling methodology than my study (156) but their sample size of children under five presenting with fever was between 3 and 11 times smaller than this study (the study population in the MICS and DHS survey includes children under-five with and without symptoms, while my study only included children under- five with symptoms).

Having an active NHIS card was associated with seeking care from an appropriate provider in the Northern Region as it can also be found in other studies in Ghana (157-160). Therefore, it seems important to continue promoting the NHIS to eliminate one of the barriers to access to care. However, having an active NHIS card was not associated with HBC or CHPS utilization. This is not surprising as the HBC is free and it is not covered by the NHIS. Although CHPS services can be covered by the NHIS if they are accredited, the number of services offered are fewer and less costly

than those offered in other health facilities. It could also be possible that if these CHPS were not accredited, and therefore, its services were not covered by the NHIS, those with an active NHIS card might prefer to seek care in another health provider covered by the insurance. However, I do not have information regarding if the CHPS included in the study area were accredited or not.

The total utilization of community-based interventions was similar and slightly higher in the Northern Region when compared with the Volta Region (32.3% 95%CI 10.8, 65.1 versus 29.1% 95%CI 10.9, 58.0). However, utilisation of HBC versus CHPS was different: HBC was used more in the Volta Region while CHPS was used more in the Northern Region.

My results showed a similar HBC utilization to the 2013 LQAS survey in the Northern Region (95% CI 0.7, 6.5. However, another study conducted in one district of the Ashanti and Volta Regions in 2008 (87) showed higher HBC utilization (more than 68% and 75% respectively used HBC a year after the HBC implementation). When compared with other evaluations conducted in Uganda in 2007 (127)- a quasi-experimental study before and after 18months implementation of malaria HBC, in Uganda in 2015 (161)- a quasi-experimental study after 14 month implementing iCCM, and Burkina Faso in 2003 (126)- a cross sectional study conducted before and after one year implementation of HBC, a higher utilization of HBC (25%, 39% and 56% respectively) was found. On the contrary, a recent study conducted in Burkina Faso in 2015 (cross- sectional study after 3 years of the introduction of HBC and under programme conditions (162) showed a similar HBC utilization as my study (1%-9% in rural areas). Another study conducted in Ethiopia in 2015 (a RCT where the intervention arm implemented iCCM- with support from UNICEF for monitoring and for drug supply-, and the control arm implemented malaria and diarrhoea HBC with routine monitoring and drug supply after more than 2 years of implementation) showed 10.8% and 7,7% HBC utilization respectively (163). Two reasons could explain these different results in terms of HBC utilization. Firstly, due to differences between districts: the study in the Ashanti and Volta Region only focussed on 1 district per region and this current study has shown the variation of HBC utilization among districts specially in the Volta Region). Secondly, due to differences between research projects and programme implementation: the length of the projects is generally shorter and the quality and intensity of supervision is usually better in research projects than in routine programme implementation. For example, the HBC strategy in the Northern Region was being implemented for about 8 years before my survey and for 2 years in the Volta Region. Longer time implementing the strategy might bring expertise but also tiredness of the CBAs and the supervisors, stock-out of drugs and the need for CBA replenishment and training. The lower effectiveness of an intervention in the “real world” as compared to that found in research projects is already being discussed and addressed within the field of implementation research (164-166) which aims to bridge the implementation gap between knowledge and action.

Large differences in HBC utilization were observed between the Volta and Northern Regions. However, the HBC strategy in the two regions started at different times and includes different interventions. In the Northern Region, HBC started in 2007 first addressing malaria cases, and in 2010 the management of diarrhoea and suspected pneumonia cases were included with the technical and financial support of UNICEF. The HBC in the Volta Region started in 2012 and includes only drugs for the management of malaria cases with the financial support of the GFATM, while diarrhoea and suspected pneumonia cases should be referred for further treatment. Therefore, one could argue that a higher HBC utilization in the Northern Region would be expected as a wider range of conditions are treated by the CBAs compared with Volta Region (which was not the case). Considering that this study was conducted in communities where according to policy HBC is being implemented, it is surprising that 30% of carers in the Volta Region and 41% in the Northern region indicated that they were not aware of the presence of CBAs or they did not have CBAs in the community. The two recent studies conducted in Burkina Faso and Ethiopia also reported that 33% and 43% of carers did not know a CBA after three and two years of HBC implementation respectively (162, 163). During informal communications with CBAs and community chiefs while conducting the survey, the field team was informed that some CBAs travelled and no one had replaced them yet, others stopped working as they did not have drugs to work with and some CBAs were known in one area of the community while not in another area, suggesting that social and personal issues might also affect the knowledge and the utilization of the CBA services. Therefore, sociocultural issues, stock out of CBA drugs or high turnover of CBAs could explain the lower utilization of HBC in the Northern Region as they have also been reported in other studies in Ghana and elsewhere as a barrier to implementation (88, 127). A further qualitative study might help to understand causes of the low HBC utilization in the Northern Region.

With respect to the Volta Region, HBC utilization was not associated with living far from a CHPS or with low flexibility of CHPS for attending patients. The HBC strategy in the Volta Region was found to be coherent with the guidelines in terms of not treating children under 6 months, it is reaching the poorest in coherence with its intention of being a "pro-poor" intervention and it is more used when there is no health facility close to the house. It is worth noting that the 2007 Uganda study (127) concluded that HBC was less likely to reach the poorest than the least poor and the authors couldn't explain why. Three other studies in Uganda, Zambia and Burkina Faso found that proximity to a health facility was a barrier to HBC utilization (162, 167, 168) and another study found that HBC is not cost-effective in the context of proximity to a health facility (96). For future planning and considering only the therapeutic component of the HBC (which is the one evaluated in this Chapter), HBC should consider to target areas without a health facility (as was the strategy of the NMCP in the Volta Region).

With regards to CHPS utilization, proximity to a CHPS was found to be associated to CHPS utilization in the Northern Region (and not in the Volta Region, were carers seem to choose a provider based on different criteria not identified). Our results on CHPS utilization were higher than the results of the LQAS survey (between 6-10%). No other comparable studies on CHPS utilization were found in the literature to contrast these results.

Carers visiting a CBA in the Volta Region and visiting a CHPS in the Northern Region did it more promptly when compared with other providers. When diagnosed with malaria, children visiting a CBA also received ACT more promptly than when visiting any other provider in the Volta Region (22.4% versus 3.8%, p=0.05). Prompt treatment received from a CBA was reported in other studies conducted in Rwanda (169), Uganda (127, 170), Ghana (87, 88), Nigeria (87), Burkina Faso (88, 126), Tanzania (171), Ethiopia (88) and Malawi (88). Most of these studies looked at the performance of HBC at a point in time or in before-after cross-sectional studies. Only the two studies in Uganda (an RCT and a quasi-experimental study) were designed to test for a difference in prompt treatment seeking between HBC and standard treatment and their results were similar: 62% versus 37%, p=0.0001(170) and a significant difference at post intervention (12.3%, p=0.05) (127).

4.5.2. Appropriate treatment given for malaria, diarrhoea and suspected pneumonia

The target of treating 100% of eligible children with ACT, amoxicillin and/or ORS+ZINC was not met after visiting a CBA or a CHPS. This worrying fact should question the local health authorities particularly on the adequacy of the drug chain, as it will be described below. Acknowledging the difficulty of interpreting the HBC figures due to the low numbers of carers visiting a CBA in the Northern Region, it seems that HBC was more used and performed better in the Volta Region when compared with the Northern Region while CHPS in the Northern Region were more used and performed better than in the Volta Region.

More malaria cases were treated with quinine (reserved for complicated cases) than with ACT in the CHPS of Northern Region. As only between 0-11% of cases seen in health facilities in Ghana are complicated cases (172, 173) a possible explanation for the frequent use of quinine could be stock-outs of drugs.

The percentage of uncomplicated malaria cases treated with ACT in this study is lower than that found in other studies. A cross-sectional study in Ghana (84) showed that 100% of febrile children visiting a CBA received ACT according to CBA records. The source of information (CBA records versus carers' information) could contribute to the different results. As mentioned in section 2.3.5, it is important to note that neither CBA records nor carers' information are the gold standard for collecting this type of information, which is considered to be the direct observation of CBA work (90): CBA registers may suffer from inaccurate or incomplete reporting and household surveys may

suffer from recall bias and misunderstanding. However, two multi-country studies conducted in Africa used both sources of information (CBA records and carers' information) and found (i) better HBC performance than my study, and (ii) similarity of results obtained from the two sources: a multi-country study in Ghana-Nigeria and Uganda (87) showed 59% of febrile children receiving ACT from a CBA and in a multi-country cross-sectional study in Ghana, Burkina, Ethiopia and Malawi (88) 82% of febrile children received ACT from a CBA. As mentioned before, other factors that could explain those differences in performance are better supervision, better supply of drugs with the involvement of the research teams, as well as a shorter duration of the research projects when compared to programme implementation. Another study conducted in Burkina Faso (126) with less external supervision or antimalarial supply had similar results as this study (54% of the febrile children received ACT from a CBA).

With regards to diarrhoea management, a common finding among regions and strategies was the low percentage of cases correctly treated and children receiving either ORS or zinc, but not both at the same time. The LQAS survey in the Northern Region also found a low proportion of diarrhoea cases treated with ORS and zinc when visiting a CBA or a CHPS and authors suggested that it might be due to stock-outs of drugs. CBAs are provided with drugs during the monthly community welfare clinics conducted by CHPS' or health centres' nurses. However, the stock-outs of drugs suggests that this integration is not covering all drug needs. Results of the 2011 MICS and the 2014 DHS also showed a low proportion of diarrhoea cases correctly treated (2011MICS: 32% and 30.1% of diarrhoea cases received ORS and 0% and 0.2% received zinc from an appropriate provider excluding pharmacies in the Volta and Northern Regions respectively; 2014 DHS: 41.3% and 48.7% of diarrhoea cases received ORS and 0% and 5% received zinc from an appropriate provider excluding pharmacies in the Volta and Northern Regions). The low coverage of ORS and almost negligible use of zinc to treat diarrhoea cases was also reported by Gill *et al* 2013 (174). In their paper about bottlenecks, barriers and solutions to the low implementation of effective measures to reduce childhood pneumonia and diarrhoea deaths in low and middle-income countries, they stated that the main bottlenecks for diarrhoea appropriate treatment were concentrated in downstream areas related to provision of ORS and zinc in the community.

With regards to suspected pneumonia case management, the 2011 MICS and the 2014 DHS also showed low treatment coverage: 55.7% and 41% of suspected pneumonia cases received antibiotic in in the 2011 and 2014 surveys nationally, respectively. However, it is not possible to make a direct comparison with my results as all appropriate providers were considered together. Another 3 studies conducted in Uganda and Zambia on HBC (168, 175, 176) showed a better performance (between 63% to 98% of suspected cases received amoxicillin). However, 2 of them (168, 175) used a different methodology to diagnose suspected pneumonia cases (registries and direct

observation of CBA as opposed to carers' reports) and another one used carers reported symptoms but in the context of a cluster randomized trial.

Finally, there is the need to reflect on the fact that some cases received amoxicillin, ORS or zinc when visiting a CBA in the Volta Region (as the GFATM is only supporting ACT drugs). It seems feasible to believe that CBAs still had some of these drugs distributed in 2013 in stock, or CBAs bought these drugs to be distributed among sick children.

4.5.3. CBA follow up visits, CBA'referrals and second visit to health providers

Reported CBA follow up visits on the day after the first visit and adequate referrals were higher in the Volta than in the Northern Region (although interpretation must be done with caution due to the low numbers of HBC visits in the Northern Region). The best performance was on the follow up visits, 68.8% of under-fives that visited a CBA received a follow up visit in the Volta Region. Written referrals in the Volta Region (62.9%) were higher than in another study in Ghana where written referrals in case of fever decreased from 21.8% at the beginning of the project to 15.1% two years later (85). Giving artesunate suppository in case of CBA referrals of fever cases and one dose of amoxicillin in case of referrals of cough cases was not a common practice.

My study showed a higher proportion of carers that sought care elsewhere after visiting a CBA than the study in Dangme West district (84) (where only 3.9% of the carers sought care elsewhere). Since for the HBC strategy in the Volta Region CBAs were expected to refer diarrhoea and suspected pneumonia cases, one would expect a higher proportion of carers seeking care elsewhere in the Volta Region than in the Northern region. However, 42% and 63% of carers in the Volta and Northern Region sought care elsewhere after visiting a CBA because of unavailability of drugs and children not getting better. This is coherent with the LQAS survey where only 16% of the CBAs had ACT, ORS, Zinc and amoxicillin on the day of the survey in the Northern Region. With regards to HBC in the Volta Region, it is important that HBC coordinators emphasise the importance of referral with a form, as seeking care elsewhere can be seen as a failure of the programme while referral can be interpreted as appropriate management of cases.

The low coverage of appropriate treatment found should make policy makers and health partners in Ghana reflect upon the new "Integrated community case management guidelines" which will include pregnancy and neonatal care, nutrition in under 5 and the inclusion of RDT for the diagnosis of malaria. Before adding more components to the HBC strategy, adherence to protocol through ensuring availability of drugs, adequate supervision and continuous replacement of CBAs must be ensured.

4.5.4. Users' satisfaction

The present study included only 3 questions on satisfaction: "Were you satisfied with the service received when you seek care", "If not or absolutely not, why" and "If yes or absolutely yes, why". As mentioned in section 3.4, a study addressing satisfaction should consider different areas or dimensions of satisfaction to ensure the validity of the instrument (in that case, our survey). However, the 2 questions asking why yes or why not, including an open response, gave a possibility to see which of the areas described by Fitzpatrick (177) were more relevant to the carers which can be further analysed through a qualitative study. Most of the 'not satisfied' responses were due to availability and affordability of drugs, child not recovered and staff not professional, which relates to the organization of health care and technical competence.

Lack of availability and affordability of drugs were the main factors for carer dissatisfaction of services in both regions. Therefore, emphasis must be given to avoiding drug stock outs. Also, a reflexion must be undertaken about carers paying CBAs for drugs. Although paying CBAs' for their drugs could be a strategy to retain CBAs, carers valued free drugs as a positive element of the HBC strategy. Secondly, it is a contradiction with the NHIS which established free treatment for children under five. Thirdly, because this practice is not considered in the HBC guidelines, which only states "to ensure that cost of iCCM would not be a barrier to accessing treatment, drugs should be given to clients at no cost or the National Health Insurance Scheme (NHIS) may cover all drugs".

Limitations of the study

The response rate was very high for the survey with no refusals to participate. The variables described in the study represent only the population of sick children during the last two weeks prior the interview and not the whole population.

The study looked at programme implementation against guidelines and targets of the national programme. Comparison between north and south was done based on the understanding that regions are different from the cultural and epidemiological point of view and without directly comparing malaria HBC with integrated HBC. Different epidemiological burden would not be expected to influence results, as the target population was children with symptoms. As guidelines are the same, carers' seeking behaviour and the management of cases by providers are expected to be the same in both regions. However, finding these children when doing the data collection was easier in the Northern Region as the prevalence of the three diseases was higher. As this was a cross sectional study, no reference to causality can be made, only association among variables (for example when analysing predictors of HBC and CHPS utilization). In addition, cross sectional studies can deal with possible known confounders while they cannot deal with unknown confounders.

In section 3.7.1, I described the adequacy of using a cross sectional study, basing my results on responses of carers of children under-five. Although this study design has been used in many other studies, carer's responses may suffer from recall bias and may be influenced by their understanding of instructions and the identification of symptoms. To reduce recall bias particularly on the treatment received, study participants were limited to those with symptoms in the two weeks prior to the survey. In addition, each field worker carried to the households pictures of the antimalarial drugs, antibiotics, ORS and zinc available in the districts to help the identification of drugs during the interview, in case carers did not remember or had not kept the drug package.

Morbidity data collected is subjective as it is based on a mother's perception of illness and their understanding about their children's disease and the treatment given, with no validation of their responses (using CBAs/CHPS registers or observation). Therefore, interpreting results particularly related to suspected pneumonia must be done with caution as fast breathing, chest in drawing or noisy breathing can be perceived differently by the carers and the provider and therefore, treated differently. The same is the case with diagnostic procedures and treatment given and understood. A patient could have been given "artesunate-amodiaquine" but referred to have received "amodiaquine". Or the patient might not remember the name of the drug, even with the help of the drugs pictures that were taken to the field to conduct the survey. However, the use of carers' reports to classify malaria, diarrhoea and suspected pneumonia has been used in the MICS, DHS and other studies (176). In addition, two studies on antimalarial use and dosage using both sources of data (HBC records and carers's reports) showed similar results (87, 88). Finally, if some children were misclassified (for example being attributed with one symptom while they do not have it), this is not likely to have introduced a differential bias between HBC and CHPS.

Some of the results had large confidence intervals even though the formula used to calculate the sample size was adequate. The clustering of indicators by district was larger than expected and therefore a bigger design effect could have been more appropriate (DE=2 instead of 1.5). As a result, the sample size was small for some indicators.

4.6. Conclusions

Utilisation of HBC was higher in the Volta Region while CHPS utilisation was higher in the Northern Region. HBC utilization was almost non-existent in the Northern Region. Poorer children, children older than 6 months and those living far from a health facility were more likely to use HBC in the Volta Region. HBC contributed to prompt treatment of fevers in the Volta Region.

Appropriate treatment for the three diseases was low in the HBC and CHPS areas, in the Volta and Northern Regions. Carers were satisfied with the services received. Lack of availability and affordability of drugs were the factors most reported as a cause of dissatisfaction.

More efforts should be made in the provision of drugs, replacement of CBAs and in monitoring the CBA and CHPS performance, especially if more components are to be included in the HBC strategy. A well-functioning integration of services might help to improve provision of drugs and supervision. Sustainability of HBC needs to be addressed.

Chapter 5. Assessment of the HBC and CHPS preventive component

5.1. Introduction

In 1978, the Alma- Ata declaration called for urgent action from governments to improve health and reduce inequities by promoting primary health care and providing promotive and preventive services in addition to curative and rehabilitative services (178). In 2008 the director general of the World Health Organization (WHO) advocated for a return to the Alma- Ata values, principles and approaches for addressing priority health needs and the fundamental determinants of health (179).

In 1990s, the IMCI strategy was introduced with the aim of reducing the number of deaths among children under- five years of age (39). This strategy includes a preventive component with the aim of improving family and community health practices recognising that success in reducing childhood mortality requires more than the availability of adequate health services (40) (Section 1.3). IMCI emphasises inter-personal communication to improve family and community practices.

Both HBC and CHPS have an important preventive component, which is often not monitored or evaluated. However, the HBC guidelines stated that operational research regarding the effect of HBC on community health practices was needed (65).

CBAs of the HBC strategy in Ghana contribute to disease prevention by conducting IEC activities including the promotion of insecticide treated nets (ITN), malaria intermittent preventive treatment for pregnant women (IPTp), indoor residual spraying (IRS) and hygiene measures. When the HBC strategy was introduced in 2007 in the Northern Region with the support of UNICEF, it was called community- IMCI. CBAs delivered health messages to contribute to the IMCI aim of improving family and community health practices. In 2010 the name of the strategy changed to iCCM. According to policy, CBAs have a stock of IEC materials and conduct health education activities in the community on a monthly basis. Health education activities are supervised by health facility staff and CBAs include these activities in their monthly reports to health facilities. Health education sessions may include groups such as in churches, mosques or prayer camps or may target individuals. It was reported that 163,468 children under-five were checked for illness and 503,550 IEC activities were conducted in 2014 through the HBC strategy nationally (source: DHIMS2- District Health Information Management System 2. Chapter 1, Section 6, Figure 1).

CHPS implement the IMCI strategy (now called IMNCI which is Integrated Management of Neonatal and Childhood Illnesses (180)). Health promotion and disease prevention messages are

delivered by nurses to carers in the waiting area of health facilities (group education sessions), during consultation (individual sessions) and during outreach visits (individual or group sessions). Nurses from CHPS also include IEC activities in their monthly reports to the district.

Table 13 summarises the preventive component of HBC and IMCI strategies. The type of messages delivered by these two strategies are very similar, with the IMCI messages being more comprehensive, including child growth, vaccine promotion, appropriate care for children living with HIV and full antenatal care promotion.

After several years of national implementation, government and donors wish to assess the implementation of HBC and CHPS. In this chapter I assessed the preventive component of the HBC and CHPS strategies in terms of carers' disease knowledge and health behaviour (objective 2 of the thesis). As HBC can contribute to IMCI with respect to the family and community practices (as above), it is important to note that I am comparing the preventive component implemented through HBC and CHPS, and not HBC and IMCI *per se*. The utilization, appropriate treatment, and the users' satisfaction with the curative component (objective 1) and the cost analysis (objective 3) are reported in chapters 4 and 6, respectively.

Table 13. Preventive component of HBC and IMCI

HBC family and community objectives (65)	HBC family and community activities	IMCI family and community objectives (76, 181)	IMCI family and community component activities
		Promotion of growth and development	Promotion of best practices such as exclusive breastfeeding during first 6 months, adequate complementary feeding and providing a stimulating environment for the mental and social development.
Disease prevention	Promotion of hygiene measures including washing hands; Promotion of ITNs and retreatment of nets; Promotion of IPT for pregnant women; Promotion of IRS.	Disease prevention	The same as HBC. Less emphasis on promotion of IRS
Appropriate care at home	Continue to feed and increase fluids, including breast milk to children when they are sick; Counselling on how to take CBA drugs; Tepid sponging to reduce temperature; Promotion of appropriate clothing when the weather changes.	Appropriate care at home	The same as HBC. Less emphasis in promotion of appropriate clothing when the weather changes. **Counselling on how to take health facility drugs;** **Protect children from injury and accident and provide treatment when necessary.**
Care-seeking outside the home	Correct recognition of signs of malaria, diarrhoea and pneumonia; Recognition of sings of severe disease; Early care seeking; Full compliance with treatment, follow up and referral; Identification and referral of pregnant women for IPT Take children to complete a full course of immunization before their first birthday.	Care-seeking outside the home	The same as HBC. In addition, adequate care for pregnant women and promotion of spacing;

5.2. HBC, CHPS and Health Communication

Health Communication is defined by WHO as a key strategy to inform the public about health concerns and to maintain important health issues on the public agenda (182). The Community Guide (a website that houses the US official collection of all Community Preventive Services Task Force findings) defines Health Communication as the study and use of communication strategies to inform and influence individual and community decisions that enhance health. The scope of health communication includes disease prevention, health promotion, health care policy, and the business of health care as well as enhancement of the quality of life and health of individuals within the community (183).

Disease prevention refers to the prevention of the occurrence of disease, such as risk factor reduction, but also aims to stop its progress and reduce its consequences once established (182).
Health promotion is the process of enabling people to increase control over the determinants of health (which are the range of personal, social, economic and environmental factors which determine the health status of individuals or populations) and thereby improve their health (182).

Health communication strategies have evolved and improved since 1960 in recognising that transmitting information and improving knowledge (although an intermediary outcome) is not necessarily enough to change behaviour. Social and economic factors of a specific behaviour should also be considered in behaviour change (184-186). Therefore, health communication strategies have evolved to increase effectiveness and use a systematic process, are based on behavioural theories and use social marketing techniques to develop and carry out communication activities that promote and sustain healthy behaviour (187, 188). This strategic use of communication to promote positive health outcomes which are based on proven theories and models of behaviour change is also called Behaviour Change Communications (BCC). Health communication considers a variety of channels to deliver its targeted or tailored messages to the audience (189, 190). Those channels are: (i) Mass media (radio, tv, etc); (ii) Small media (brochures, posters, etc.); (iii) Social media (twitter, web logs, etc.); (iv) Interpersonal communication (one on one or group education) and (v) Events. The different activities conducted to implement the communication plan are called Information, Education and Communication (IEC) activities. The material developed (posters, flyers, leaflets, brochures, booklets, etc.) is referred as IEC materials (65, 76).

To address the family and community objectives described in Table 13, the HBC guidelines and the Community- IMCI guidelines (which are implemented by CHPS among other facilities) state that a

comprehensive health communication strategy is required for behaviour change (76), in coherence with what I just described above. These strategies consider the existing health practices and look for innovative approaches for behaviour change. They both include the development of IEC materials, training on communication strategies, partnerships with different channels to deliver messages and consider grouping and individual education sessions. When evaluating the effect of the IEC activities conducted by CBA and CHPS nurses, and understanding that transmitting information does not mean improving behaviour as already mentioned, efforts must be done exploring disease knowledge AND health behaviour. As defined in section 3.5, disease knowledge and health behaviour will be used as proxy indicators of the effectiveness of the preventive component.

5.3. Household survey

Data from the household survey as described in Chapter 3 was used to assess the effectiveness of HBC and CHPS preventive component. In brief, a stratified three stage cluster survey was conducted in the Volta and Northern Regions. In the Volta Region, only communities implementing HBC were included in the sampling. From the 24 districts in the Volta Region, only 8 were targeted for the implementation of HBC. From them, 6 districts with its communities were included in the sampling (Annex 1). In the Northern Region all districts and communities were included in the sampling, as HBC was implemented everywhere.

Carers of children under-five years of age presenting with fever, diarrhoea or cough in the previous two weeks were asked about their exposure to disease prevention and health promotion messages, the source of the messages, their knowledge about the causes of malaria, diarrhoea and acute respiratory infections, the identification of signs of severe disease, treatment seeking behaviour when the child was sick and adherence to the treatment prescribed. Those were considered to be standard questions and valid for both strategies.

Several closed-ended questions exploring carer's disease knowledge and health behaviour allowed multiple answers. Compared with open-ended questions, closed-ended questions are precise, allow uniformity in responses, are easy to recall and are easily quantifiable. However, they require researchers with good knowledge of the area/topic to ensure that the appropriate answers are included as responses. The option "other" in a closed-ended question however allows respondents to give their personal answer in case the different options offered were not adequate or did not translate respondent believes. On the contrary, open- ended questions are useful in qualitative studies particularly when the researcher wants to explore a new topic which he/she is not familiar with. Because the richness of the information, efforts involved in analysing this type of information are substantial, and therefore, they are used to study small groups or populations (191).

Similarly with my analysis of the appropriate treatment given (Chapter 3), in this chapter I compared knowledge and practices against national guidelines and standard definitions and not against control groups.

5.4. Study definitions

Table 2 describes the definitions used for the analysis. As described above, carers were asked about different knowledge and health practices, and multiple responses were allowed. If for example two responses were given by one carer, where one answer was correct and the other incorrect, the carer was included in the group of correct knowledge.

5.5. Data analysis

Assessing which factors or predictors were associated with disease knowledge and health behaviour may help to explore if IEC activities conducted by CBAs and CHPS nurses were associated with disease knowledge and health behaviour, and to identify enablers and barriers of disease knowledge and behaviour that can be useful for future planning of health communication strategies.

To explore the association between disease knowledge and health behaviour, and potential predictors, the crude OR was obtained using univariate logistic regression, and the adjusted OR using multivariate analysis. To do that, initial data examination and prevalence estimates were obtained using tabulations adjusted for survey design.

Potential predictors of disease knowledge were explored. Disease knowledge outcomes included were identification by carers of (i) mosquitos as vectors of malaria transmission, (ii) at least 2 signs of severe malaria, (iii) at least 2 practices that can cause diarrhoea, (iv) at least 2 signs of severe diarrhoea, (v) microorganisms as the cause of suspected pneumonia, (vi) not vaccinating children as a practice that can cause pneumonia and (vii) 2 signs of severe pneumonia. Potential predictors explored are described in Table 3. Pearson's design based chi-square was used to test for associations. Survey logistic regression was used to obtain adjusted estimates. To explore the potential association between disease knowledge and the factors described above, firstly, the association of each potential predictor (adjusted only for district) with the outcome was estimated. All factors whose association reached significance at $p<0.1$ were included in a multivariate analysis. All factors that remained significantly associated with the outcome ($p<0.05$) in this model were retained in the final model.

The same methodology was used to explore potential predictors of children sleeping under mosquito nets. Potential predictors (Table 14) were explored in the univariate analysis (adjusted only for districts). All factors whose association reached significance at $p<0.1$ were included in a multivariate analysis. All factors that remained significantly associated with the outcome ($p<0.05$) in this model were retained in the final model.

To analyse potential predictors of having an improved sanitation facility, potential predictors (Table 14) were explored in the univariate and multivariate analysis using the same methodology.

Table 14. Potential predictors explored by outcome

Potential predictors of disease knowledge
(i) Age of carers, (ii) education of carers, (iii) SES, (iv) receiving information and education messages (on malaria if questions were related malaria knowledge; on diarrhoea if questions related to diarrhoea disease knowledge; on respiratory infections if questions related to respiratory infection knowledge), and (v) source of the information and education messages.
Potential predictors of children sleeping under mosquito nets
(i) Age of child, (ii) age of respondent, (iii) sex of child, (iv) education of respondent, (v) SES, (vi) HBC and CHPS utilization, (vii) identifying mosquitos as malaria vectors, and (viii) receiving malaria education messages from different sources.
Potential predictors of improved sanitation facility
(i) Age of respondent, (ii) education of respondent, (iii) SES, (iv) identification of causes of diarrhoea and (v) receiving diarrhoea preventive messages from any source.

5.6. Results

The number of interviews conducted in the Volta and Northern Regions, the prevalence of fever, diarrhoea and cough among the children that were sick two weeks prior to the survey and the carers' health seeking behaviour can be found in Chapter 4, Tables 5 and 6.

When asked about the year preceding the survey, a higher proportion of carers in the Northern Region reported receiving health messages than those from the Volta Region (Table 15). A greater proportion of carers reported receiving messages relating to malaria than those relating to diarrhoea or respiratory infections across the two regions. The proportion of carers who reported receiving malaria education messages (including information on any of: how it is transmitted, how to avoid it, what are the symptoms and what to do when sick) was 83.8% (95%CI 57.3, 95.2) and 89.0% (95%CI 80.9, 93.6) in the Volta and Northern Region respectively. In the case of diarrhoea, 73.6% (95%CI 43.9, 90.8) and 79.7% (95%CI 69.3, 87.2) of carers in the Volta and Northern Region received health education and health promotion messages respectively and 57.1% (95%CI 32.8, 78.4) and 66.1% (95%CI 56.2,74.8) of carers in the Volta and the Northern Region received messages regarding respiratory infections.

The proportion of carers in the Volta Region receiving malaria information messages from CBAs and CHPS were 18.5% (95%CI 4.9, 50.0) and 31.2% (95%CI 11.5, 61.3) respectively, while in the Northern Region was 8.5% (95%CI 3.2, 20.4) and 26.8% (95%CI 14.9, 43.3) respectively (Table 14). Radio was a frequent source of information for malaria in both regions. Neighbours, family members and friends were much more important as a source of malaria information in the Northern Region while messages from health facilities were proportionately similar to or slightly less frequently a source of messages than in the Volta Region.

The main sources of malaria information in the Volta Region were (i) radio (201/576, 34.3%), (ii) CHPS (118/576, 31.2%) and (iii) hospital (142/576, 25.5%). In the Northern Region, the main sources of malaria information were (i) neighbours (242/575, 45.8%), (ii) radio (254/575, 44.5%) and (iii) family members (160/575, 33.2%). In the case of diarrhoea and respiratory infections messages, the sources of information followed the same ranking as for malaria with the exception of diarrhoea in the Volta Region were CHPS were the first rather than the second source of messages (Table 15).

Table 15. Sources of malaria, diarrhoea and respiratory information and education messages in the Volta and Northern Regions

Health education	Volta Region		Northern Region	
	N	% (95% CI)*	N	% (95% CI)*
Receiving messages on malaria	576/671	83.8	575/685	88.8
Sources of malaria messages				
- From CBAs	74	18.5 (4.9, 50.0)	43	8.5 (3.2, 20.4)
- From CHPs nurses	118	31.2 (11.5, 61.3)	182	26.8 (14.9, 43.3)
- From HC nurses	195	21.7 (15.7, 29.0)	131	22.3 (11.5, 38.7)
- From hospital nurses	142	25.5 (10.2, 50.7)	75	13.7 (7.2, 24.7)
- Outreach clinic	23	4.0 (0.6, 22.1)	0	0
- From radio	201	34.3 (23.6, 46.9)	254	44.5 (21.1, 70.6)
- From neighbours	47	12.8 (6.4, 23.8)	242	45.8 (40.5, 51.2)
- Family member	41	4.2 (1.3, 12.9)	160	33.2 (22.6, 45.9)
- Friends	23	3.8 (2.0, 7.1)	109	18.5 (13.0, 25.7)
- From TV	66	8.6 (2.0, 29.7)	24	2.0 (0.7, 5.4)
- From posters	11	1.0 (0.1, 8.7)	2	0.1 (0.007, 1.7)
Receiving messages on diarrhoea	496/671	73.65	491/685	79.6
Sources of diarrhoea messages				
- From CBAs	55	15.0 (4.7, 38.9)	33	7.4 (2.7, 18.8)
- From CHPs nurses	107	33.3 (12.5, 63.6)	153	28.8 (16.3, 45.6)
- From HC nurses	161	18.1 (9.1, 32.9)	105	20.7 (10.2, 37.3)
- From hospital nurses	106	19.0 (5.1, 50.6)	62	11.5 (5.4, 22.7)
- Outreach clinic	23	5.1 (0.7, 27.7)	0	0
- From neighbours	39	8.2 (2.3, 25.2)	208	46.4 (38.6, 54.3)
- Family member	39	4.4 (1.4, 13.2)	150	31.5 (20.8, 44.6)
- Friends	27	9.2 (3.0, 24.7)	116	20.8 (15.7, 27.0)
- From radio	180	32.3 (23.3, 42.7)	191	37.9 (18.0, 63.0)
- From TV	61	9.0 (1.7, 35.0)	19	4.1 (1.1, 13.3)
- From posters	9	0.9 (0.1, 7.7)	9	0.8 (0.05, 11.9)
Receiving messages on respiratory infections	345/669	57.1	400/683	66.1
Sources of respiratory infections messages				
- From CBAs	34	18.2 (3.3, 59.2)	21	4.6 (1.9, 10.5)
- From CHPs nurses	73	31.2 (12.3, 59.6)	99	21.7 (13.8. 32.5)
- From HC nurses	99	19.0 (12.6, 27.8)	91	21.4 (9.1, 42.3)
- From hospital nurses	78	19.6 (5.0, 53.1)	49	12.1 (3.7, 33.2)
- Outreach clinic	13	6.0 (0.7, 34.6)	0	0
- From neighbours	34	8.4 (2.0, 29.2)	162	41.1 (33.9, 49.2)
- Family member	40	8.0 (1.7, 30.1)	119	28.6 (20.7, 38..1)
- Friends	16	6.8 (2.6, 16.5)	98	21.8 (13.4, 33.4)
- From radio	127	30.5 (20.1, 43.4)	138	34.1 (19.8, 52.0)
- From TV	35	5.3 (1.2, 20.3)	10	0.8 (0.2, 3.5)
- From posters	2	0.0 (0.004, 0.4)	8	1.1 (0.0, 17.4)

*Weighted estimates

5.6.1. Carers' knowledge of malaria, diarrhoea and respiratory infections

Most of the carers identified mosquitoes as malaria vectors (more than 90% in both regions). However, those that identified severe signs of malaria were much fewer (approximately 22% and 29% in the Volta and Northern Region respectively) and with greater variation among clusters in the Northern Region (Table 16).

Only 35.8% and 52.6% of carers in the Volta and the Northern Regions identified at least 2 practices that can cause diarrhoea. Causes and practices that can cause respiratory infections were less known to carers than those of malaria and diarrhoea. Although the DHS 2014 reports that about 79% and 69% of children in the Volta and Northern Regions received all basic vaccinations (57),

only 0.2% and 12.0% of carers in the Volta and Northern Regions knew that vaccination prevents their children from having respiratory infections (and from other diseases).

Table 16. Carer's disease knowledge in the Volta and Northern Regions

	Volta Region		Northern Region	
Indicator	**N**	**% (95%CI)***	**N**	**% (95% CI)***
Identifying mosquito as malaria vector	645	96.8 (90.4, 98.9)	626	91.0 (84.5, 94.9)
Identifying at least 2 signs of severe malaria	135	21.9 (13.0, 34.3)	217	28.5 (13.6, 50.2)
Identifying at least 2 practices that can cause diarrhoea	229	35.8 (29.6, 42.5)	394	52.6 (41.2, 63.8)
Identifying at least 2 signs of severe diarrhoea	185	30.3 (21.4, 41.0)	336	47.4 (38.6, 56.3)
Identifying microorganism as cause of respiratory infection	92	21.1 (12.4, 33.6)	246	36.8 (23.4, 52.5)
Identifying vaccination as practice to prevent respiratory infections	5	0.2 (0.01, 3.8)	73	12.0 (9.1, 15.5)
Identifying 2 signs of severe pneumonia	52	8.7 (4.4, 16.5)	184	25.5 (19.7, 32.4)

*Weighted estimates

5.6.2. Predictors of carer's knowledge of malaria, diarrhoea and respiratory infections

In the univariate analysis, age, education and SES of carers were not found to be predictors of disease knowledge across the indicators assessed in any of the two regions. However, the univariate and multivariate analyses showed that receiving information and education messages and the source of information influenced the disease knowledge in both regions, and not always in a positive way as further described below for each of the regions separately.

Volta Region

The univariate analysis showed several associations between health messages and disease knowledge. Receiving malaria messages from any source was associated with the identification of mosquitoes as malaria vectors. Receiving respiratory illness and diarrhoea messages from hospitals and from leaflets were found to be associated with the identifications of microorganisms as cause of respiratory infections and at least two practices that cause diarrhoea. Receiving diarrhoea messages from neighbours, CHPS and posters were found to be associated with the identification of severe signs of diarrhoea. Receiving respiratory illness messages from TV was found to be associated with the identification of severe signs of pneumonia and malaria messages from friends and from health centres were found to be associated with the identification of severe signs of malaria.

The multivariate analysis showed that receiving malaria education messages (from any source) remained associated with the identification of mosquitos as malaria vectors. Compared with those that did not receive messages about malaria, those that did were more likely to identify mosquitos: adjusted OR 15.6 (3.2, 75.9), p=0.01 (Table 17). Receiving health education and health promotion messages from CBAs was not a predictor of disease knowledge across any of the indicators explored. However, carers receiving diarrhoea messages from CHPS compared with those that did not were more likely to identify at least two signs of severe diarrhoea: adjusted OR 3.6 (95% CI 1.4, 9.0); p=0.02. Diarrhoea messages from neighbours and from posters did not remain significantly

associated with severe signs of diarrhoea. Receiving health education messages from hospitals showed conflicting results. Compared with those that did not receive messages on respiratory illness from a hospital, those that received them were less likely to identify microorganism as cause of ARI: adjusted OR 0.2 (95% CI 0.1, 0.6), p=0.01. A possible explanation for these conflicting results could be that staff in hospitals do not focus their health messages on prevention but on how to take care of the child when sick. Malaria messages from friends also had negative association with disease knowledge. Compared with those that did not receive messages from friends, those that received them were less likely to correctly identify at least two signs of severe malaria: adjusted OR 0.01 (95%CI 0.001, 0.1); p=0.01. Malaria messages from health centres did not remain significantly associated with the identification of malaria severe signs.

Radio was one of the most prevalent sources of health information and promotion messages, but radio messages were not associated with a better disease knowledge in the Volta Region. On the contrary, TV and leaflets were a less common source of information but they were found to be a predictor of the identification of severe pneumonia signs: adjusted OR TV 9.4 (95%CI 1.9, 45.6), p=0.02; adjusted OR leaflets 19.4 (7.4, 50.7), p=0.002.

Northern Region

The univariate analysis showed that receiving diarrhoea messages (from any source) was associated with the identification of signs of severe diarrhoea while respiratory illness messages (from any source) was associated with the identification of signs of severe pneumonia. Messages from CBAs were found to be associated with the identification of practices that can cause diarrhoea and with the identification of signs of severe malaria and severe pneumonia. Receiving messages from CHPS was associated with the identification of mosquitos as malaria vectors and microorganisms as the cause of respiratory infections. Receiving messages from neighbours was found to be associated with the identification of mosquitoes as malaria vector, the identification of microorganisms as cause of respiratory infections, and the identification of signs of severe diarrhoea and severe pneumonia. Receiving messages from friends were associated with the identification of microorganisms as cause of respiratory infections, the identification of practices that cause diarrhoea, and the identification of signs of severe diarrhoea, severe pneumonia and severe malaria. Messages from family were associated with the identification of mosquitos as malaria vectors, microorganisms as cause of respiratory infections, practices that can cause diarrhoea and the identification of signs of severe diarrhoea and severe malaria. Receiving messages from posters was found to be associated with the identification of signs of severe malaria and with the identification of microorganisms as cause of respiratory infections. Finally, receiving messages from the radio was found to be associated with the identification of signs of severe malaria and with the identification of practices that can cause diarrhoea.

The multivariate analysis showed that carers receiving health messages from CBAs remained significantly associated with three indicators: compared with those that did not receive messages on malaria, diarrhoea and respiratory illness from CBAs, those that did were more likely (i) to identify at least two signs of severe malaria [adjusted OR 1.8 (95%CI 1.0, 3.3); p=0.04], (ii) to identify practices that can cause diarrhoea [adjusted OR 4.7 (1.4, 15.5); p=0.02] and (iii) to identify at least 2 signs of severe pneumonia [adjusted OR 7.7 (95%CI 2.2, 26.5); p=0.01] (Table 17). Receiving messages from CHPS, health centres or hospitals did not remain associated with disease knowledge in the multivariate analysis. Malaria and diarrhoea messages from neighbours remained associated with the identification of mosquitos as malaria vectors and with the identification of signs of severe diarrhoea: adjusted OR for identifying mosquitos as malaria vector 16.2 (95%CI 0.9, 268); p=0.05; adjusted OR for identifying at least two signs of severe diarrhoea 3.3 (0.9, 11.4); p=0.05. Malaria messages received from family members were negatively associated with the identification of signs of severe malaria: adjusted OR 0.4 (95%CI 0.2, 0.9); p=0.04 while diarrhoea and respiratory illness messages from friends were associated with (i) the identification of at least two practices that cause diarrhoea: adjusted OR 6.9 (95%CI 2.6, 18.3); p=0.008; (ii) the identification of microorganism as cause of ARI: adjusted OR 9.1 (95%CI 4.4, 18.6); p=0.05 and (iii) the identification of two signs of severe pneumonia: adjusted OR 5.3 (95%CI 2.4, 11.6); p=0.006. Finally, exposure to malaria and diarrhoea radio messages remained significantly associated with the identification of signs of severe malaria [adjusted OR 4.3 (05%CI 1.0, 17.6); p=0.04] and with the identification of practices that can cause diarrhoea [adjusted OR 4.5 (95%CI 2.0, 10.2); p=0.009]. In the case of identifying the vaccination of children as a practice to prevent acute respiratory infections, because of the low numbers (only 5 carers believed that not vaccinating their children can cause respiratory infections), the analysis was not conducted in the Volta Region. In the Northern Region no predictors were found.

Table 17. Predictors for disease knowledge in the Volta and Northern Regions

VOLTA REGION				NORTHERN REGION			
Predictors	**n/N (%)**	**Adjusted OR (95% CI)**	**P value**	**Predictors**	**n/N (%)**	**Adjusted OR (95% CI)**	**P value**
IDENTIFYING MOSQUITOS AS MALARIA VECTORS				**IDENTIFYING MOSQUITOS AS MALARIA VECTORS**			
Receiving malaria messages (any source)				**Receiving malaria messages from neighbours**			
No	79/95 (86.3)	1	0.01	No	292/333 (85.5)	1	0.05
Yes	566/576(98.8)	15.6 (3.2, 75.9)		Yes	238/242 (99.0)	16.2 (0.9, 268)	
IDENTIFYING AT LEAST 2 SIGNS OF SEVERE MALARIA				**IDENTIFYING AT LEAST 2 SIGNS OF SEVERE MALARIA**			
Receiving malaria messages from friends				**Receiving malaria messages from CBA**			
No	121/553 (21.2)	1	0.01	No	154/532 (25.5)	1.0	0.04
Yes	2/23 (0.5)	0.01 (0.001, 0.1)		Yes	22/43 (50.6)	1.8 (1.0, 3.3)	
				Receiving malaria messages from family			
				No	140/415 (32.9)	1.0	0.04
				Yes	36/160 (17.3)	0.4 (0.2, 0.9)	
				Receiving malaria messages from radio			
				No	52/321 (13.4)	1.0	0.04
				Yes	124/254 (45.5)	4.3 (1.0, 17.6)	
IDENTIFYING AT LEAST 2 CAUSES OF DIARRHOEA TRANSMISSION				**IDENTIFYING AT LEAST 2 CAUSES OF DIARRHOEA TRANSMISSION**			
				Receiving diarrhoea messages from CBA			
				No	262/458 (52.6)	1.0	0.02
				Yes	26/33 (76.5)	4.7 (1.4, 15.5)	
				Receiving diarrhoea messages from friends			
				No	189/375 (47.3)	1.0	0.008
				Yes	99/116 (81.6)	6.9 (2.6, 18.3)	
				Receiving diarrhoea messages from radio			
				No	145/300 (43.1)	1.0	0.009
				Yes	143/191 (72.9)	4.5 (2.0, 10.2)	
IDENTIFYING AT LEAST 2 SIGNS OF SEVERE DIARRHOEA				**IDENTIFYING AT LEAST 2 SIGNS OF SEVERE DIARRHOEA**			
Receiving diarhoea messages from CHPS				**Receiving diarrhoea messages from neighbours**			0.05
No	97/389 (25.7)	1	0.02	No	120/283 (35.5)	1.0	
Yes	56/107 (44.7)	3.6 (1.4, 9.0)		Yes	144/208 (69.8)	3.3 (0.9, 11.4)	
IDENTIFYING MICROORGANISM (INFECTIONS) AS ARI CAUSE				**IDENTIFYING MICROORGANISM (INFECTIONS) AS ARI CAUSE**			
Receiving ARI messages from hospital				**Receiving ARI messages from friends**			
No	64/269 (30.1)	1	0.01	No	75/303 (29.1)	1	0.05
Yes	12/78 (14.8)	0.2 (0.1, 0.6)		Yes	77/116 (58.5)	9.1 (4.4, 18.6)	
Receiving ARI messages from leaflets				**Receiving ARI messages from posters**			
No	74/344 (27.1)	1	0.002	No	147/393 (38.6)	1	0.05
Yes	2/3 (75.0)	19.4 (7.4, 50.7)		Yes	5/8 (70.8)	8.5 (0.9, 76.9)	
IDENTIFYING AT LEAST 2 SIGNS OF SEVERE PNEUMONIA				**IDENTIFYING AT LEAST 2 SIGNS OF SEVERE PNEUMONIA**			
Receiving ARI messages from TV				**Receiving ARI messages from CBA**			
No	35/312 (6.8)	1	0.02	No	127/380 (32.9)	1.0	0.01
Yes	5/35 (48.1)	9.4 (1.9, 45.6)		Yes	15/21 (69.3)	7.7 (2.2, 26.5)	
				Receiving ARI messages from friends			
				No	81/303 (26.8)	1.0	0.006
				Yes	61/98 (62.3)	5.3 (2.4, 11.6)	

5.6.3. Carers' health behaviour

The proportion of carers that reported to have a mosquito net hanging was 43.0%, (95%CI 35.0, 51.3) in the Volta Region and 70.1% (95%CI 45.2, 87) in the Northern Region. However, 80% of carers of both regions reported that their children under- five slept under mosquito net the night before the survey (80.4%, 95%CI 69.4, 88.1 and 79.2%, 95%CI 57.5, 91.5 in the Volta and Northern Region, respectively). Almost all carers interviewed in both regions reported that they would accept spraying the house if offered (Table 18).

Table 18. Carer's health behaviour in the Volta and Northern Regions

	Volta Region		Northern Region	
Indicator	**N**	**%***	**N**	**%**
At least 1 mosquito net hung	297/664	43.0	422/685	70.1
Children sleeping under mosquito net last night	535/670	80.4	482/684	79.2
Adult sleeping under mosquito net last night	516/665	77.7	469/683	77.8
Carers want to spray the house	642/666	98.0	675/683	98.3
Improved sanitation facilities	460/670	64.8	37/685	3.6
Promptness in seeking care if visiting a CBA	58/90	56.0**	6/8	79.9
Promptness in seeking care if visiting CHPS	22/61	36.3	163/228	76.9**
Promptness in seeking care if severe malaria signs are identified	55/132	38.2	110/190	64.0
Promptness in seeking care if severe diarrhoea signs are identified	83/179	42.2	212/315	67.4
Promptness in seeking care if severe pneumonia signs are identified	23/52	43.2	116/161	85.4**
Adherence to 3 days ACT treatment when visited CBA	16/18	93.2	0/0	0.0
Adherence to CBA ACT prescription	86/90	96.31	8/8	100
CHPS' staff did not inform about No of days to take ACT	53/61	90.1	201/228	93.5
Adherence to 3 days ACT treatment when visited CHPS	6/6	100	5/7	90.4
Adherence to CHPS ACT prescription	60/61	98.4	220/227	99.28

*Weighted estimates; **p<0.05

5.6.4. Predictors of carers' health behaviour

Predictors of children sleeping under mosquito nets were explored in the univariate and multivariate analysis. Age of child, age of respondent, sex of child, education of respondent, SES, HBC and CHPS utilization, identifying mosquitos as malaria vectors, and receiving malaria education messages from all different sources was not found to be associated with children under-five sleeping under mosquito nets in the Volta Region.

In the Northern Region, the multivariate analysis showed a borderline association between receiving malaria preventive messages from CBAs [adjusted OR= 4.4 (95%CI 0.6, 26), p=0.09] and from friends [adjusted OR= 0.4 (95%CI 0.1, 1.2), p=0.09] and sleeping under mosquito nets. No other predictors were found (Table 19).

Table 19. Predictors of children under- five sleeping under mosquito nets in the Northern Region

Predictors	**n/N**	**%***	**Adjusted OR (95%CI)**	**P**
Receiving malaria messages from CBAs				
No	375/529	79.5	1	0.08
Yes	38/43	93.8	4.3 (0.7, 27.0)	
Receiving malaria messages from friends				
No	342/463	82.8	1	
Yes	71/109	71.6	0.4 (0.1, 1.2)	0.09

*Weighted estimates

Only 64.8% and 3.6% of carers in the Volta and the Northern Region reported to have an improved sanitation facility. The association between having an improved sanitation facility and age of respondent, education of respondent, SES, identification of causes of diarrhoea and receiving diarrhoea messages from any source was explored in the Volta Region (there were insufficient numbers to do the analysis on the Northern Region data). Socioeconomic status was found to be associated with having an improved sanitation facility [adjusted OR lower middle SES 5.0 (95%CI 2.0, 12.0), p=0.01; adjusted OR middle SES 3.1 (95%CI 1.0, 9.7), p=0.04; adjusted OR upper middle 7.9 (95%CI 1.8, 34.1), p=0.02; adjusted OR upper 23.8(95%CI 5.0, 112), p=0.007]. Receiving malaria preventive messages from CBAs and from friends each had a borderline association with having an improved sanitation facility [adjusted OR messages from CBAs 1.9 (95%CI 0.8, 4.5), p=0.07, adjusted OR messages from family 0.4 (95%CI 0.2, 1.1), p=0.07] (Table 20).

Table 20. Predictors of having an improved sanitation facility in the Volta Region

Predictors	n/N	%	Adjusted OR (95%CI)	P
Socioeconomic status				
Lower	27/133	30.2	5.0 (2.0, 12.0)	0.01
Lower middle	93/132	68.6	3.1 (1.0, 9.7)	0.04
Middle	95/132	64.2	7.9 (1.8, 34.1)	0.02
Upper Middle	114/132	79.0	23.8(5.0, 112)	0.007
Upper	124/132	92.9		
Receiving diarrhoea messages from CBAs			1	0.07
No	304/441	66.0	1.9 (0.8, 4.5)	
yes	45/55	69.0		
Receiving diarrhoea messages from family			1	0.07
No	322/457	65.3	0.4 (0.2, 1.1)	
yes	27/39	91.7		

Promptness in seeking care is vital to reduce child mortality and morbidity. In the Volta Region, iCCM had a positive association with care seeking in the first 24 hours of onset of symptoms: 56.0% of carers visiting a CBA did so on the same day or the day after of the onset of symptoms while only 36.3% of carers that visited a CHPS did this. When comparing iCCM versus all other appropriate providers, this difference was significant (56.0%, 95% CI 48.7, 63.08 *versus* 39.4%, 95% CI 29.2, 50.5, p=0.03). When comparing promptness in seeking care when visiting a CHPS versus other appropriate providers together, the differences were not significant (36.3%, 95%CI 17.1, 61.3 *versus* 43.5%, 95%CI 36.8, 50.5, p=0.4). In the Northern Region, 79.9% and 76.9% of the carers that visited a CBA and a CHPS did it in the first 24hours of onset of symptoms. In the case of visiting a CHPS versus the other appropriate providers, the differences were significant (77.0%, 95%CI 70.2, 82.7 *versus* 63.6%, 95%CI 50.2, 75.2, p=0.02). Due to the low number of carers visiting a CBA in the Northern Region, this analysis was not done.

Identifying signs of severe pneumonia was associated with promptness in care seeking in the Northern Region. Eighty five percent of the carers that identified chest in-drawing and noisy breathing as severe signs of pneumonia sought care in the first 24 hours of onset of symptoms (p=0.04). No other association was found in the Northern Region or in the Volta Region regarding the identification of severe signs and promptness in seeking care.

Adherence to treatment, following the instructions received from providers, is an important step to obtain optimal treatment outcome. A high proportion of carers reported not being told for how many days they should take ACT treatment. In Volta Region, 45.4% and 90.1% of carers visiting a CBA and a CPHS respectively, and in the Northern Region, 87.1% and 93.5% of carers visiting a CBA and a CHPS reported not being told about the duration of the treatment. A possible reason for this lack of explanation is because a full treatment is packed in one box or envelope. Then, providers often ask users to take the treatment "until it is finished" rather than saying the number of days for which the treatment has to be taken. Of the few carers that were told to take the ACT treatment for 3 days, more than 90% of carers reported having adhered to these 3 days treatment in the Volta and Northern Region when visiting a CBA or a CHPS. Also, when carers were asked if they took the treatment as told, more than 90% of carers in both regions reported to have followed the instructions received in both regions.

5.7. Discussion

HBC and CHPS service delivery strategies at community level have an important health promotion and disease prevention component in terms of programme costs and potential health outcomes. In this chapter I assessed the effectiveness of the HBC and CHPS health education messages in terms of disease knowledge and healthy behaviour of carers of children under- five years old.

Few studies assessing the effectiveness or efficacy of HBC considered the preventive component. Three studies in Mali (192), Uganda (193) and Ethiopia (194) and one multi-country study conducted in Ghana, Burkina Faso, Ethiopia and Malawi (88) assessed, among other outcomes, the improvement of care's disease knowledge. Although not much detail on the communication strategy used was given by the authors, it seems that interpersonal communication was the communication channel reported as the one to which carers of children under-five were more exposed. Interpersonal communication was also the main source of health information found in my study (80.5% and 93.0% of carers in the Volta and Northern Region received any malaria message from interpersonal communications). Interpersonal communication was considered the source that gave the highest success rate in a study conducted in Ghana analysing four health campaigns (Stop TB, malaria HBC, integrated child health and life choices-family planning campaigns) although it is

not clear how the author evaluated this success (195). Community health workers (CHW) in Mali (192) used visual aids for explaining to carers symptoms such as convulsions and difficulty breathing which require immediate referral. In the study in Uganda (193), CHWs advised carers of children on how to continue treatment at home and on danger signs that will require referral to a health facility. In Ethiopia (194), communities were first trained to identify general childhood danger signs just before the deployment of CHW and were further educated by the CHW using IEC materials. The multi-country study (88) described that CHW in Malawi provided vaccinations and growth monitoring for children younger than 5 year-olds, supervision of sanitation, water source protection and treatment and nutrition advice among other things. No other details were given on how health education was delivered in Malawi or in the other 3 countries.

The multi-country evaluation of IMCI (49) conducted in Bangladesh, Brazil, Peru, Tanzania and Uganda evaluated the preventive component. These studies also reported that the main channel used to deliver health education messages were interpersonal communications, in groups or individually. The study in Tanzania did not report on prevention activities because health education messages as part of community IMCI had not been implemented at the time of the study (52). In Bangladesh, approximately 33% of carers in the IMCI areas received health messages through community theatres, about 33% received feeding advice from individual counselling, 12% of men received health education messages from the imam in the mosque and only 3% of carers attended health community meetings (196). The study in Uganda and Tanzania only reported that carers were educated during consultation (197). Interestingly, Peru and Brazil trained CHWs to implement community- IMCI (or the promotion of community and family practices) (50, 198).

My study showed that a high percentage of carer's received health education messages regarding malaria, diarrhoea and respiratory infections. More carers reported to have received messages in the Northern Region when compared with the Volta Region and malaria messages were more common than messages on diarrhoea and respiratory infections. These results are similar to the 2008 Ghana Demographic and Health Survey (DHS): 83.8% of carers in my study received malaria messages versus 89.8% in the 2008DHS in the Volta Region and 89% versus 83.3% in the Northern Region (145). The source of messages followed a similar pattern as the 2008DHS: radio was a predominant source of health information, higher than health workers and community volunteers (145). More carers in the Volta Region reported to have received malaria, diarrhoea and respiratory illness messages from CBAs and CHPS than the Northern Region. These results are coherent with the lower IEC activity reported on the DHIMS2 in 2014 by the HBC programme in the Northern Region compared with the Volta Region: less than 1 IEC activity in a population of 1000 children under five was conducted in the Northern Region *versus* 390 IEC activities per 1000 children under five in the Volta Region (199).

Health messages sent by different sources had an association with different disease knowledge and health behaviour outcomes explored. However, carer's education level or their SES was not associated with any of the outcomes explored. Health education messages from CBAs, even though they were not the predominant source of health information (between 15% to 18.5% and 4.6% to 8.5% of carers in the Volta and Northern Region received health education messages on malaria, diarrhoea and respiratory infections), were associated with several health knowledge and healthy behaviour outcomes, particularly in the Northern Region. A possible explanation for this higher effect in the Northern Region when compared with the Volta Region could be that, even though the proportion of carers exposed to CBA messages were lower than in the Volta Region, carers might have been exposed more times to CBA messages (this evaluation came 2 years and 8 years after the implementation in the Volta and Northern Region). Improving knowledge and changing behaviour takes time (200-202).

Health messages from CBAs was the predictor explored that had more positive associations with the disease knowledge and health behaviour outcomes explored, particularly in the Northern Region: receiving messages from CBAs were found to be associated in the Northern Region with the identification of at least 2 signs of severe malaria, 2 practices that can cause diarrhoea, 2 signs of severe pneumonia, and a borderline association with children sleeping under mosquito nets. Although the association between HBC utilization and prompt care seeking behaviour could not be explored due to low numbers (Chapter 3), identifying 2 signs of severe pneumonia was found to be associated with prompt care seeking behaviour in the Northern Region. However, these positive results found in the Northern Region could decrease in the next few years if the low number of IEC activities conducted in 2014 continue to be the same for several years. In the Volta Region, receiving diarrhoea messages from CBAs had a borderline association with having an improved sanitation facility and HBC utilization was associated with prompt care seeking behaviour.

The MICS, the DHS and the LQAs surveys reported on the carers' knowledge of the cause of malaria, signs of severe pneumonia, the use of mosquito nets and the prevalence of improved sanitation facilities in Ghana (145, 153, 203). However, the association between those outcomes and receiving health messages or treatment from CBA or CHPS was not assessed. Studies reporting on the efficacy or effectiveness of HBC in Ghana do not report on the preventive component: they focus on the therapeutic component of the HBC strategy. The only study found in Ghana that reported on IEC activity of the HBC strategy, did not assess the association between the knowledge and behaviour and the source of messages received (153). This study, conducted in the three northern regions of Ghana, reported on the correct content of the message sent by CBAs and nurses from CHPS, particularly on hand washing, breastfeeding practices and caring of a sick child. It concluded that CBAs had similar knowledge to nurses from CHPS on washing hand practices but

less knowledge on breastfeeding practices and caring of a sick child which I did not assess in this current study. With regards to adherence to treatment, my study showed a similar and high adherence to ACT treatment when visiting both, a CBA or a CHPS. When compared with other appropriate providers, HBC in the Volta Region contributed to prompt treatment seeking behaviour as was also found in other studies (84, 127, 170) (Chapter 3). Other HBC studies that reported on carers' disease knowledge in Mali (192), Uganda (193), Ghana (88), Burkina Faso (88), Ethiopia (88, 194) and Malawi (88) also found positive results. Carers' in Mali in the HBC intervention arm were significantly more likely to recognise fever lasting more than one day after treatment and convulsions as danger signs than carers in the control group. In Uganda, more carers in the intervention arm significantly recognised convulsions as a sign to seek care immediately (45 %) compared to the non-intervention districts (22 %). Carers in Kumasi (Ghana), Lilongwe (Malawi) and Ougadougou (Burkina Faso) improved their knowledge on signs of severe malaria but not those in Bolgatanga (Ghana) and Jimma (Ethiopia) (88). Finally, a longer study (9 years) conducted in Ethiopia showed an increase in the recognition of fast and difficulty in breathing as signs of suspected pneumonia and other childhood danger signs (194).

My study also suggests that CHPS had some influence on disease knowledge and behaviour but less than the HBC strategy: receiving messages from CHPS was associated with the identification of at least 2 signs of severe diarrhoea in the Volta Region and with promptness in seeking care in the Northern Region. The Multi-Country Evaluation of the IMCI conducted in Tanzania and Bangladesh reported on knowledge of severity of signs and care seeking behaviour (52, 204). These 2 studies (a non-randomised controlled trial in Tanzania and a cluster randomised controlled trial in Bangladesh) showed that, when compared with areas without IMCI, carers in the IMCI areas that perceived severity of signs (fast or difficulty in breathing, convulsions, extreme sleepiness, excessive vomiting or inability to drink/breastfeed) were more likely to seek care for their children ($p<0.05$). Other outcomes reported in studies evaluating the community component of IMCI, were advice given on (i) fluids and feeding given when child is sick (50, 52, 196, 197, 205), (ii) breastfeeding and complementary feeding (52), (iii) how to take the prescribed medicines (196, 197, 205), (iv) when to return when child is sick (50, 196, 197, 205) and (v) caring for children with very low weigh(196). However, my study did not report on these outcomes: Focusing on the preventive messages of the 3 diseases and on seeking prompt treatment when symptomatic better addresses my study objectives.

Globally, the community component of the IMCI strategy (community-IMCI) started later than the other 2 IMCI components (the case management and health system) and it has been more neglected (204, 206). As presented in Table 14, the objectives of community-IMCI are similar to those of the preventive component of HBC. Evaluations of HBC normally do not report on the preventive

component but this study suggests that the preventive component is actually being implemented and is associated with disease knowledge and behaviour. Evaluations of community –IMCI gave more emphasis on family health practices to be implemented when the child is already sick (such as increasing fluids if child is sick or when to return for care seeking immediately), with less emphasis on disease prevention practices with the exception of the promotion of vaccination. The manuals of community-IMCI state that for the implementation of community- IMCI, health facilities need to (i) partner with the community, (ii) increase appropriate and accessible health care and information from community-based providers, and (iii) integrate promotion of key family practices critical for child health and nutrition (181, 206, 207). Based on these points, it seems that HBC could be an ideal strategy for implementing community-IMCI as the Ghana case study shows and the studies in Peru and Brazil suggested (50, 198). Actually, iCCM in Burkina Faso, Malawi, Niger, and Mozambique is also called community-IMCI (208-211) although iCCM adds a curative component which community-IMCI does not have. This interchange of names shows integration and complementarity within strategies which is beneficial for both, iCCM and IMCI. Under this integrated approach, CHPS not only supervise CBAs but also partner with them on the implementation of the Community- IMCI. However, policy documents in Ghana unfortunately no longer reflect this integration or complementarity between iCCM and IMCI and their coordination is placed in different programmes (iCCM in the National Malaria Control Programme and IMCI in the Reproductive and Child Health Department of the Ghana Health Service).

Limitations of the study

This study assessed the effectiveness of the preventive component of the HBC and CHPS strategy based on the responses of carers of children who were sick in the two weeks preceding the survey. Therefore, the results are not representative of the entire population. In the case of the Volta Region, these results represent the population that had sick children in the previous two weeks in the areas where HBC and CHPS were implemented (which are rural communities with less access to health facilities).

Effectiveness was measured based on the association found between the source of message and the desired outcome. Therefore, I cannot say that HBC was more effective than other strategies. I can only say that HBC was a predictor or was associated to better disease knowledge and healthy behaviours.

Carers were asked about health education messages received during the last year on malaria, diarrhoea and respiratory infections. One year was considered good timing to allow a communication strategy to be implemented and to avoid problems in recall. However, recall bias should still be considered, as carers can forget some sources, or remember others that were received

more than one year ago. However, it is likely that the carers remember the messages that had a higher impact on them. The MICS limit the period of receiving health education to the previous 6 month before the survey (203). The DHS did not mention the timing where carers needed to recall health education messages (145). The other studies reporting on HBC and CHPS preventive component did not report on sources of health education messages or on the timing receiving the messages to avoid recall bias: they only report on the improvement of disease knowledge or practice (50, 52, 88, 192, 193, 197, 198, 204, 205).

I mentioned in section 5.4 that, when carers were asked about knowledge and practices, multiple answers were allowed. If one correct and one incorrect answered was given, the carer was included in the group of correct knowledge. Even though I believed this was the best approach, this could have resulted in an overestimation in adequate knowledge.

Some of the results had large confidence intervals. A bigger sample size would have been desirable, particularly considering a design effect of 2 instead of 1.5.

4.8. Conclusions

HBC and CHPS were effective in improving family and community practices. Health messages delivered by CBAs were not the most common source of health information, but they were associated with disease knowledge and appropriate health behaviour outcomes, particularly in the Northern Region. This association was more important (in terms of number of outcomes found to be associated with the health message) than that found with CHPS or other health information sources explored. HBC should continue to be considered as the strategy through which community-IMCI is implemented. This could boost the effectiveness of both strategies, both in terms of performance and more efficient use of available resources. However, emphasis must be done in increasing the IEC activities in the Northern Region to maintain these positive results.

Chapter 6. HBC and CHPS cost analysis

6.1. Introduction

In December 2014 a new global coalition of more than 500 leading health and development organizations worldwide was launched to urge governments to accelerate reforms that ensure everyone, everywhere, can access quality health services without being forced into poverty (22). This global coalition, called the Universal Health Coverage (UHC), comprises two main components: quality essential health service coverage and financial coverage – both extended to the whole population (24).

With UHC on the global health agenda, governments of many low and middle-income countries are under pressure to scale up essential health services to meet the needs of their people. This means that governments need to prioritise effective interventions to scale up. Health technology assessments (HTAs) have been recognised as a tool for priority setting particularly useful in this UHC context (212). HTA examines the cost-effectiveness of an intervention as well as the organizational implications and social consequences, bridging the gap between the evidence and policy making (213). HTA can be used to prioritise an intervention in a particular context as mentioned before (ex-ante HTA) or it can be used as a monitoring tool, providing information to governments and funders to continue or discontinue certain interventions, helping to address sustainability (ex-post HTA) (212, 213).

As mentioned in section 1.6, Ghana has developed two main community based strategies that aim to reduce barriers to physical access to quality treatment: the HBC and CHPS.

When assessing these two strategies, financial sustainability, particularly of HBC should be considered. In sub-Saharan African countries, HBC current funding is primarily reliant on external multilateral and bilateral donors. Case studies conducted in Malawi, Niger, Kenya, Mozambique, Burkina Faso and Mali showed that external funding is a common denominator and all these countries are struggling in finding a sustainable solution (93, 210, 211, 214-216). Like these countries, the long term financial plan for HBC in Ghana is not clear. In contrast, the CHPS strategy, it is being financed through government money.

When addressing financial sustainability of an intervention, one needs to question the affordability of the intervention and the appropriate financing strategies. This question can be answered with a cost-analysis followed by an assessment of financing options. Therefore, I decided to analyse the cost per malaria, diarrhoea and suspected pneumonia case appropriately diagnosed and treated in

children under-five under the HBC and CHPS strategies. This study is an approach to ex-post HTA which considers the real costs and effectiveness of both interventions which is key to policy decisions. This information may be used to improve performance and to guide decisions on sustainable financing strategies particularly regarding HBC.

6.2. Brief note on economic evaluations

Economic evaluation is *the comparative analysis of alternative courses of action in terms of both their cost and consequences (108)*. Economic evaluation is one of the tools available to help choose wisely from a range of alternatives and to implement efficiently the resources available. It addresses one criteria of health care programme decisions. There are other criteria that need to be addressed also when deciding to finance or not an intervention. Those are the affordability, acceptability and feasibility of the intervention and health equity (108).

Four types of economic evaluations have been described: cost- minimisation analysis, cost- benefit analysis, cost- effectiveness analysis and cost- utility analysis. Cost- minimisation analysis compares different strategies that have shown identical effect but different costs. Therefore, cost-minimisation analysis is only a comparison of costs (217), and some authors do not consider this modality as a full economic evaluation (108).

Cost- benefit analysis measures cost and benefits, all in monetary terms. There are three main approaches to value the economic benefits of an intervention: the human capital approach (to value improved health, using for example the value of the increased productivity of individuals through fewer work-loss days), revealed preferences (the value of what an individual would have to give up to obtain something-for example, lower risk job at a lower wage rate) and contingent valuation (which uses survey methods to elicit willingness to pay values for goods in a hypothetical market) (108, 218). This type of economic evaluation receives "ethical" critiques due to the fact of translating health benefits into monetary terms (health benefits are more than just money).

According to Drummond (108), in cost- effectiveness analysis benefits are measured in the most obvious units of effects, depending on the field being studied, such as years of life gained. Even though intermediate outcomes and intermediate outputs are admissible, in general one should choose an effectiveness measure related to a final output. However, the most important issue to consider is whether the measure is relevant given the objectives of the decision- maker concerned (108). When several benefits are measured at the same time (for example years of life gained, reduction in anaemia and reduction in hypertension) the analysis is called cost-consequences analysis. This type of economic evaluation has some challenges: results can be only compared with studies using the same benefit measure and often they cannot be compared with different diseases.

In addition, the trade-offs where one can consider if an intervention is most cost-effective that another is not explicit. To address this point, a new form of cost-effectiveness analysis was developed: cost- utility analysis. Cost- utility analyses uses utility measures (DALYs and QALYs) to measure the benefits, and allow comparison across different diseases and interventions.

Because my effectiveness measure was an intermediate outcome in addition to the importance of having information about affordability of HBC to guide long term financing of HBC, I decided to conduct a cost analysis.

To ensure that the methodology used to conduct the cost analysis was appropriate and that the results were valid, I applied a recognised check list (Table 21) which can also be used when conducting critical assessment of cost analysis (108).

Table 21. Check list to ensure quality of reporting of results of cost analysis

Elements of a sound cost analysis	Comments
1. Well defined question posed in an answerable form 1.1. The study involves a comparison of alternatives 1.2. It is stated the view point for the analysis and the study is placed in any particular decision-making context.	Addressed in Chapter 1, Section 8; Chapter 2, Section 8 and Chapter 6, Section 1
2. There is a comprehensive description of the competing alternatives	Addressed in Chapter 1, Section 6
3. All the important relevant costs for each alternative are identified	Addressed in Chapter 6, Section 4
4. All costs are measured accurately in appropriate physical units 4.1. Sources of resource utilization are described and justified 4.2. If identified items are omitted, adequate measures are taking place in the analysis 4.3 If there are special circumstances that made the measurement difficult, these are handled appropriately	Addressed in Chapter 6, Section 4
5. Costs are valued credibly 5.1. Sources of all values are clearly identified	Addressed in Chapter 6, Section 4
6. Costs are adjusted for differential timing 6.1. Costs that occur in the future are discounted to their present values 6.2. There is a justification for the discount rate used	Addressed in Chapter 6, Section 4
7. There is an incremental analysis of costs conducted	Addressed in Chapter 6, Section 4
8. Uncertainty of cost is considered 8.1. If patient level data, appropriate statistical analysis is performed 8.2. If sensitivity analysis is performed, a justification is provided for ranges or distribution of values and for the form of sensitivity analysis performed 8.3. Results include the sensitivity analysis	Addressed in Chapter 3, Section 8.2 and Chapter 6, Section 6.4
9. The presentation and discussion of the study results include all issues of concern to users 9.1. Results are compared with those of others 9.2. The generalizability of the results to other settings is discussed 9.3. The study takes into consideration other important factors in the choice or decision under consideration 9.4 The study discusses issues on implementation, such as feasibility of adopting "preferred" programmes given financial or other constraints	Addressed in Chapter 6, Section 7

6.3. Unit of the cost analysis

The unit cost was defined as total cost incurred in diagnosing and treating one case of malaria, diarrhoea or suspected pneumonia.

The measure of the cost analysis was the cost of a_malaria, diarrhoea or suspected pneumonia case **appropriately** diagnosed and treated. This refers to a malaria, diarrhoea or suspected pneumonia case that received treatment according to guidelines or a child without malaria, diarrhoea or suspected pneumonia that was not prescribed the recommended drugs to treat malaria, diarrhoea or pneumonia (Section 3.6). Definitions of a malaria, diarrhoea and suspected pneumonia case can be found in Table 1 (Chapter 3).

6.4. Measurement of costs

Economic costing was done from the **societal** perspective, which considers costs from the perspective of households and the health system. This approach is the broadest compared with the health system or government budget perspective (219), and allows comparison with previous studies. Considering household costs is important because they can be significant, they may deter caregivers from using a service and they might be a cause of poverty (catastrophic cost). Data on cost was collected from the household survey, from the Health Administration and Support Services division (HASS) of the Ghana Health Service, from the National Malaria Control Programme, from CHPS and from the NGO, Plan International, which supports HBC in the Volta Region.

Two activities were used to calculate the cost per case diagnosed and treated: (i) estimation of unit cost for treating a malaria, diarrhoea and suspected pneumonia case from CHPS, HBC and households and (ii) combination of unit cost for treating malaria, diarrhoea and suspected pneumonia case under the HBC and CHPS strategies with the household costs to obtain unit cost from the societal perspective.

6.4.1 Estimation of unit costs for diagnosing and treating a malaria, diarrhoea and suspected pneumonia case from HBC, CHPS and household

HBC costs

Costs per diagnosing and treating a malaria, diarrhoea and suspected pneumonia case under the HBC strategy were divided into direct and indirect costs (Table 22). Direct costs refer to those involved directly in the service being analysed. Indirect costs refer to productivity loses due to the time CBA spent away from their usual activities (attending a sick child). Direct recurrent costs

included training of CBAs (according to policy it happens every two years), training of supervisors (according to policy it happens every two years), supervision (every year), training material for supervisors and CBAs and IEC material for CBAs (last several years), registers (every year) and cost of drugs (every year). Direct capital costs included ARI timers (to measure the breathing rate to diagnose suspected pneumonia cases), box to keep CBA items and the incentive package (includes bicycles, raincoats, boots, torchlights and t-shirts) which, according to policy, is given once at the beginning of the intervention to motivate CBAs.

With regards to the Volta Region, Plan International provided information on cost for training CBAs and supervisors. Training expenditures were annualised using the expected life time of two years and the recommended discount rate of 3% (220). Annualising capital costs means that even though a good has been purchased at a specific point in time, one needs to consider that its benefits will be enjoyed over several years, and therefore, its costs will be spread over these years. The directorate of the Volta Region provided information on the quantities of training material, registers, boxes and incentive package received from the national level, while the national level provided information about the cost per item sent to the regions. A10% of freight costs were added to the unit costs. The training and IEC materials, the boxes and the incentive package are supposed to last several years, and therefore, they were annualised using the expected life time of 8 years and the discount rate of 3% (220). The NMCP reported no ARI timers in the Volta Region. The number of drugs used in 2014 was obtained from the DHIMS2. The cost of drugs used was the median price from a list of suppliers obtained from the International Drug Price Indicator Guide (221) with an addition of 10% freight costs as when calculating CHPS costs.

The regional directorate of the Northern Region provided information about costs of training CBAs and supervisors. Training expenditures were annualised using the expected life time of two years and the recommended discount rate of 3% (220) considering that, according to policy, these trainings happen every two years. The directorate of the Northern Region provided information on the quantities of training material, registers, boxes and incentive package received from the national level, while the national level provided information about the cost per item sent to the regions. To these item cost, a 10% of freight costs were added. The training materials, the boxes and the incentive package were annualised using the expected life time of 8 years and the recommended discount rate of 3% as I did for the Volta Region. The unit cost of ARI timers used was US$3.5 plus a 10% of freight costs as recommended by UNICEF. The number of drugs used in 2014 was obtained from the DHIMS2. The cost of drugs used was the median price from a list of suppliers obtained from the International Drug Price Indicator Guide (244) with an addition of 10% freight costs as when calculating CHPS costs and HBC costs in the Volta Region.

As indirect cost, the time of the CBAs attending a sick child was included. The opportunity cost to their time was estimated from interviews with four CBAs, two in each region. CBA time was assigned a monetary value based on the agricultural labour wage which was 0.41 GHC/hour (222, 223) which is the main occupation of the population, particularly in rural areas (224).

All costs were estimated for 2014 and were converted to US dollars. If the source of a cost belonged to a year different than 2014 with a different currency, I first estimated the cost for the year 2014, taking into account the inflation (225). To do this, I multiplied the cost by the annual inflation rate. Secondly, I converted the currency to US dollars based on the change rate at December 2014 (226). Direct and indirect cost were then allocated to malaria, diarrhoea and suspected pneumonia case management based on the percentage of HBC activity reported in 2014 through the DHIMS-II.

CHPS costs

Two CHPS compounds were visited in each region to collect information during the 5th to 16th April 2014 in the Volta Region and during the 23rd June to 3rd July 2014 in the Northern Region. The criteria used to select these facilities was average performing facilities based on their activity (outpatient visit per nurse). This information was provided by the person responsible for health information at the regional directorates. In addition, and as cost information was collected during the household survey, the criteria of feasibility was also considered. This means that to select two CHPS among average CHPS, I considered those that were closer to the communities being surveyed. The CHPS compounds selected in the Volta Region were Fodome Woe and Likpe Agbozome in the Hohoe district. In the Northern region, Mankpang (Central Gonja district) and Gbulahagu (Tolon-Kumbugu district).

Direct costs were considered from the CHPS perspective, including recurrent and capital costs (Table 22). As recurrent cost, salaries of personnel including any allowances received, medicines, disposables, stationary, utilities and maintenance costs were considered. 2014 recurrent expenditures were obtained from the financial officer at the respective health districts. Capital cost included the building, vehicles, furniture and equipment that were annualised using the expected life time of 30, 8, 10 and 8 years respectively and the recommended discount rate of 3% (220). The size of the CHPS facilities was estimated based on plans of standard CHPS facilities available from the HASS division. The information on construction cost per m^2 for such buildings was obtained from the same division. An inventory of equipment and furniture was developed during the field visits at the two CHPS in each region. These items were valued using a price list from the HASS division. If the cost of an existing equipment or furniture was not in the list provided by the HASS division, market surveys were conducted to value these items. To do this, the average of a sample of at least 3 different prices were considered for one equipment or furniture as suggested in the

guidelines for cost data collection in the field in ACT consortium projects (227). These sample prices were mainly obtained online in the case of equipment and in Ghanaian shops in the case of furniture. All costs were estimated for 2014 (taking into account the inflation rates when needed) and were converted to US dollars.

The allocation of recurrent and capital costs to outpatient visits was performed using the standard step down costing methodology (108). First, all resources were allocated to all cost centres using different allocation criteria suggested in the guidelines of ACT consortium projects (227) (step 1). Cost centres refer to groups of activities serving a similar purpose. Three groups of cost centres can be defined in a CHPS facility: overhead cost centres (which include administration, accounting, health information, cleaning, security and stores services), support centres (diagnosis and pharmacy services) and final services cost centres (outpatient visits, antenatal, postnatal, maternity, vaccination, outreach services and health education). To allocate salaries and training costs to the different cost centres, I considered the value of staff time involved in the different activities and the annual activities reported in the health information system. To allocate stationaries costs, 10% of these costs were allocated to administration, accounting, health information and pharmacy cost centres while the 60% remaining was allocated to final services based on the annual activity produced. Utilities and cleaning costs were allocated to cost centres based on the percentage of the floor area used by each cost centre. All medicine's costs were allocated to pharmacy services, disposables' costs to diagnostic services and maintenance cost to administration cost centre.

Then, the overhead costs were allocated to support and final centres also using relevant allocation criteria (step 2). Administration, accounting, security and stores costs were allocated to support and final services using the same proportion of costs allocated to support and final services at the end of step 1 (227). Health information costs were distributed among final cost centres based on the percentage of the annual activity reported. Cleaning costs were distributed among support and final centres based on the proportion of floor used in by each cost centre. Finally, support centres costs were allocated to outpatient visits (step 3). To do so, pharmacy costs were distributed among final services based on the total annual activity produced by each final service adjusted by a weight (1 for outpatient and antenatal visits, 3 for deliveries and 0.5 for vaccines and postnatal). Diagnostic services costs were distributed among final services based on the reported diagnosis activity by the staff interviewed. The main diagnostics services were rapid diagnostics test (RDT) for malaria and pregnancy test in antenatal services.

To differentiate cost per malaria, diarrhoea and suspected pneumonia diagnosis and treatment in children under- five from the rest of the outpatient visits, a bottom up costing method was done to supplement the standard step-down costing methodology. Interviews with staff captured self-reported time for doing an RDT and treating a case of malaria, diarrhoea and suspected pneumonia

in children under- five years of age. The average cost of an RDT was taken from two market surveys done by the Global Fund and the Program for Appropriate Technology in Health (PATH) (228, 229) which gave an average cost of US$0.35 plus a 10% of freight costs. Details of the drugs given were taken from a sample of patients (between 6-12 cases per disease in each CHPS). The cost of drugs used was the median price from a list of suppliers obtained from the International Drug Price Indicator Guide (221) with an addition of 10% freight costs as recommended by the guide.

Household costs

Household costs incurred when visiting a CBA or a CHPS facility were also divided into direct and indirect cost. Direct costs included cost per transport to provider and any other direct cost involved at the provider. Indirect costs relate to productivity loses and refer to time travelling to CBA/CHPS and time spent at/with the provider. Cost of carers time was calculated based on the agricultural wage labour.

These household costs were obtained from the household survey conducted in 2014. Carers seeking care when their child was sick, were asked about the different cost involved based on the different providers they visited. Therefore, household costs when visiting a CBA or a CHPS (or any other provider) were different and were included in the analysis

Table 22. Direct and indirect costs involved for diagnosing and treating a malaria, diarrhoea and suspected pneumonia case, considered by HBC, CHPS and households

HBC			CHPS		
Costs	**Sources**	**Value ***	**Costs**	**Sources**	**Value***
PROVIDER PERSPECIVE			**PROVIDER PERSPECIVE**		
1) **Direct cost**			**1) Direct cost**		
Recurrent			**Recurrent**		
-Training CBAs	NMCP and Plan International	Reported expenditures annualized using 2 years at 3% discount rate	**Salaries, including allowances**	District financial officer	2014 expenditures
-Training supervisors and supervision	NMCP and Plan International	Reported expenditures	**-Medicines**	District financial officer	2014 expenditures
-Training materials and educational material	NMCP	Reported expenditures annualized using 8 years	**-Disposables**	District financial officer	2014 expenditures
-ACT, ORS, zinc and paracetamol plus transport	DIMS, List of drugs price	Median price for 2014	**-Stationary**	District financial officer	2014 expenditures
			-Utilities	District financial officer	2014 expenditures
			-Maintenance cost	District financial officer	2014 expenditures
Capital costs			**Capital costs**		
-ARI timers	NMCP, UNICEF	Reported expenditures annualized using 8 years at 3% discount rate	**-Building**	Plans of standard CHPS facility and cost for m2 from the MoH	2014 expenditures annualized using 30 years at 3% discount rate
-Drugs Box	NMCP	Reported expenditures annualized using 8 years at 3% discount rate	**-Vehicles**	Inventory from the field visits, prices from MoH and survey market	2014 expenditures annualized using 8 years at 3% discount rate
-Incentive package	NMCP	Reported expenditures annualized using 8 years at 3% discount rate	**-Furniture**	Inventory from the field visits, prices from MoH and survey market	2014 expenditures annualized using 10 years at 3% discount rate
			-Equipment	Inventory from the field visits, prices from MoH and survey market	2014 expenditures annualized using 8 years at 3% discount rate
Indirect cost			**Indirect cost**		
-CBAs productivity loses	CBA interviews	Reported time spent equivalent to agricultural labor wage			
HOUSEHOLD PERSPECIVE			**HOUSEHOLD PERSPECIVE**		
-Time to provider	HH survey	Reported time spent equivalent to agricultural labor wage	**-Time to provider**	HH survey	Reported time spent equivalent to agricultural labor wage
-Travel cost	HH survey	Reported cost spent	**-Travel cost**	HH survey	Reported cost spent
-Time in provider	HH survey	Reported time spent equivalent to agricultural labor wage	**-Time in provider**	HH survey	Reported time spent equivalent to agricultural labor wage
-Food in provider	HH survey	Reported cost spent	**-Food in provider**	HH survey	Reported cost spent
-RDT payment	HH survey	Reported cost spent	**-RDT payment**	HH survey	Reported cost spent
-Cost of drugs if out of pocket money	HH survey	Reported cost spent	**-Cost of drugs if out pocket money**	HH survey	Reported cost spent

*All costs were estimated for 2014 and converted to USD.

6.4.2. Estimation of unit costs for diagnosing and treating a malaria, diarrhoea and suspected pneumonia case under the HBC and CHPS strategy from the societal perspective

Facility and programme costs were added to the household costs to obtain costs from the societal perspective under the HBC and CHPS strategies.

Data from the survey showed no reported deaths after visiting a CBA or a CHPS in the Volta and Northern Regions. Reported referrals after visiting a CBA were 14.1% and 20.1% in the Volta and Northern Region, respectively, and 5.9% and 4.3% after visiting a CHPS compound. However, 42% and 63% of carers sought care elsewhere after using HBC and 28% and 7.9% after using CHPS in the Volta and Northern Regions, respectively. This high proportion of carers visiting a second provider (particularly for the HBC strategy) is important as it represents an extra cost to diagnose and treat a case. Therefore, costs due to this second visit to a provider were also taken into consideration and added to the unit cost for the diagnosis and management of malaria, diarrhoea and suspected pneumonia. To do this, I multiplied the proportion of carers that sought care elsewhere after visiting a CBA or a CHPS facility because of malaria, diarrhoea or suspected pneumonia with the cost of the second visit. The cost of the second visit was calculated by adding programme/facility costs to household costs (as I did for the first visit). This included, (i) the average iCCM cost for diagnosing and treating a malaria, diarrhoea and suspected pneumonia case (if second provider was a licensed chemical seller or a drug peddler), or average CHPS cost (if second provider was a health facility); (ii) the average cost for traveling to the second provider and (iii) the average money spent at the second provider visited. Taking into account that CHPS were the health facility more often used in this second visit, and that expenditures from other health facilities, from licensed chemical sellers or from drug peddlers were not available, it was believed that using CHPS and CBA cost was the best approach to calculate the cost for diagnosis and treating a case in the second visit (Figure 8).

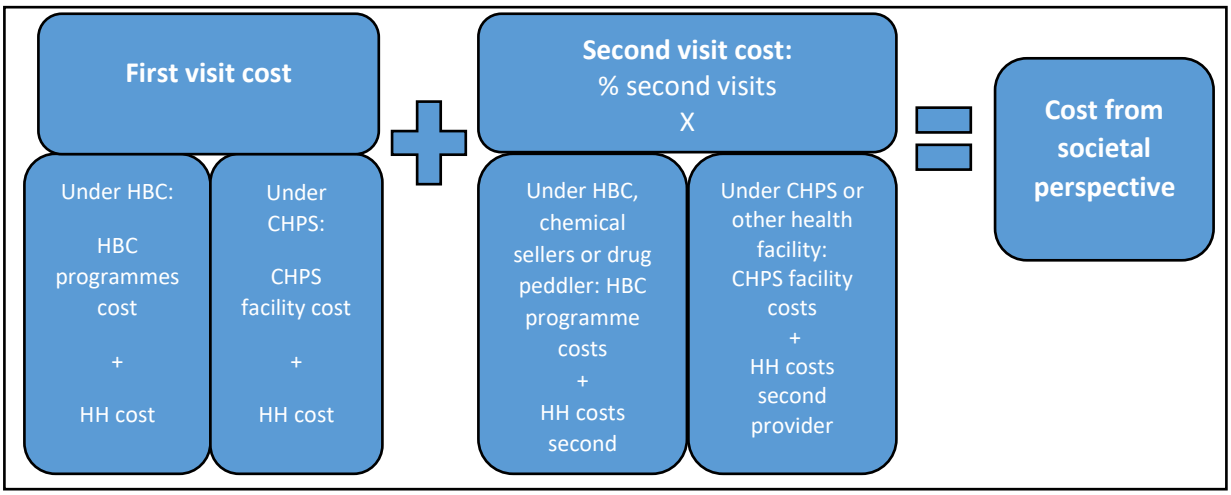

Figure 8. Scheme on how costs from societal perspective were calculated

6.5. Cost-analysis

The cost analysis was done based on a sample of 100 eligible children for treatment, using the data obtained from the household survey. This analysis gave information about how much it costs to appropriately diagnose and treat a malaria, diarrhoea and suspected pneumonia case under HBC and CHPS, which may be useful for planning purposes.

6.6. Results

This results section will firstly describe the unit cost for diagnosing and treating a malaria, diarrhoea and suspected pneumonia case in children under-five years of age from the health system, household and societal perspective. This will follow with the cost analysis and the sensitivity analysis.

6.6.1. Unit cost for diagnosing and treating a malaria, diarrhoea and suspected pneumonia case from HBC, CHPS and household perspective

Unit costs per diagnosing and treating a malaria, diarrhoea and suspected pneumonia case under the HBC strategy in the Volta and the Northern Region are described in Table 23, Figure 9. Average HBC programme costs in the Volta Region were lower when compared with those of the Northern Region: diagnosing and treating a malaria case costs US$1.54 and US$7.77, a diarrhoea case costs US0.38 and US$6.72 and a suspected pneumonia case costs US$1.12 and US$7.80 in the Volta and Northern Region, respectively. The much higher HBC costs in the Northern Region when compared with those of the Volta Region (particularly in the case of diarrhoea and suspected pneumonia cases) was mainly due to (i) higher costs for training and for the incentive package in the Northern Region (due to a higher number of CBAs); (ii) a lower number of visits to sick children in the Northern Region (30,830 and 17,898 visits in the Volta and the Northern Region) and (iii) a much lower number of IEC activities (177,484 and 99 IEC activities conducted in the Volta Region and the Northern Region). If we look at the contribution to HBC costs by the different cost drivers, drugs cost in the Volta Region represent the higher percentage, while in the Northern Region and because of the low activity and the high number of CBAs, training and incentive package cost represent the highest contribution to HBC cost.

Table 23. Cost per diagnosing and treating a malaria, diarrhoea and suspected pneumonia case under the HBC strategy in the Volta and Northern Region in 2014 (US$)

	Volta Region			Northern Region		
	Malaria	**Diarrhoea**	**Pneumonia**	**Malaria**	**Diarrhoea**	**Pneumonia**
Program costs	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)
Training CBAs	881.43 (2.2)	125.57 (8.4)	40.73 (2.7)	18,756.66 (27.0)	25,024.98 (31.2)	9,579.92 (26.9)
Training supervisors	446.84 (1.1)	63.66 (4.3)	20.65 (1.4)	7,062.53 (10.1)	9,422.77 (11.7)	3,607.17 (10.1)
Supervision	-	-	-	1,473.76 (2.1)	1,966.28 (2.4)	752.72 (2.1)
Training and IEC materials	60.93 (0.1)	8.68 (0.5)	2.82 (0.2)	1,069.25 (1.5)	1,426.58 (1,7)	546.11 (1.5)
CBA drugs	36,088.88 (88.9)	837.48 (56.3)	1,266.76 (85.7)	12,698.00 (18.2)	4,343.24 (5.4)	5,966.96 (16.7)
ARI timers			-			658.15 (1.8)
Registers	430.25 (1.0)	61.29 (4.1)	19.88 (1.3)	5,961.00 (8.5)	7,953.11 (9.9)	3,044.57 (8.55)
Time of CBAs	1,426.16 (3.5)	210.89 (14.2)	68.40 (4.6)	484.11 (0.7)	645.90 (0.8)	247.26 (0.6)
Drugs Box	86.39 (0.2)	12.31 (0.8)	3.99 (0.2)	1,448.60 (2.1)	1,932.72 (2.4)	739.87 (2.0)
Incentive package	1,167.01 (2.8)	166.25 (11.2)	53.92 (3.6)	20,478.34 (29.5)	27,322.03 (34.1)	10,459.27 (29.3)
Total programme costs	40,587.89 (100)	1,486.12 (100)	1,477.14 (100)	69,432.25 (100)	80,037.61 (100)	35,602.01 (100)
Average cost per case	1.54	0.38	1.12	7.77	6.72	7.80

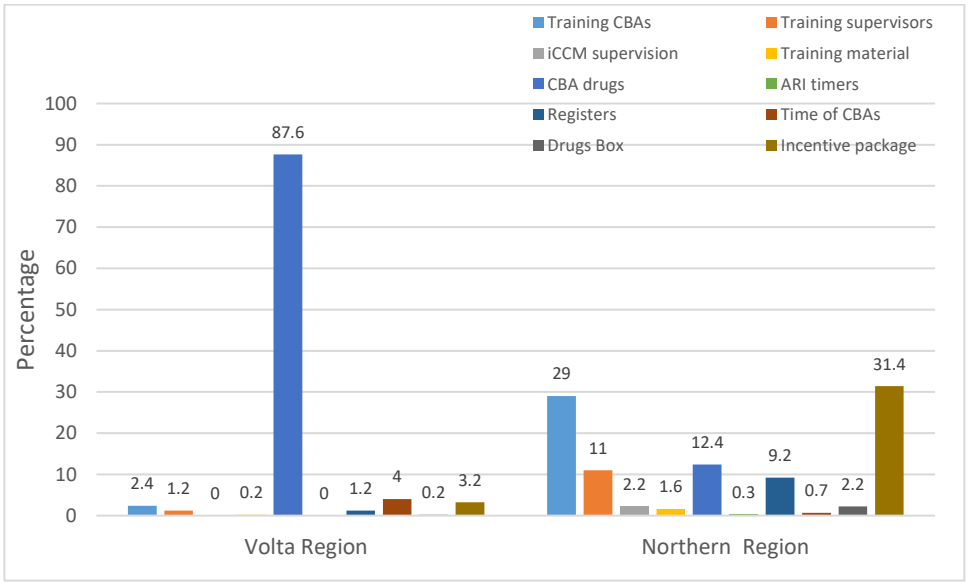

Figure 9. Percentage of contribution to HBC costs to diagnose and treat a malaria, diarrhoea and pneumonia case by the different cost drivers in the Volta and the Northern Region in 2014

Unit cost per diagnosing and treating a malaria, diarrhoea and suspected pneumonia case in the four CHPS visited from the health system perspective are presented in Table 24, Figure 10. Across the Volta and the Northern Regions, the cost per diagnosing and treating a malaria case varied from US$4.65 to US$9.95; the cost per treating a diarrhoea case varied from US$3.05 to US$8.16 and the cost per treating a suspected pneumonia cased varied from US$3.11 to US$8.79. Results from the Volta Region had the lower and higher costs per malaria, diarrhoea and suspected pneumonia case

diagnosed and treated across both regions. These differences in the Volta Region were mainly due to the existence of a bigger facility with smaller reported activity compared to a smaller facility with higher reported activity. In the Northern Region, the micro-costing exercise showed that the large differences observed in diagnosing and treating a malaria case in the two CHPS analysed were mainly due to the use of ACT in syrup in Mankpan CHPS (which costs US$ 0.1/ml) instead of ACT tablets in Gbulahu CHPS (which costs US$ 0.01/tablet).

Diagnosing and treating malaria was found to be more costly than treating diarrhoea or suspected pneumonia in 3 out of 4 CHPS facilities. All three diseases needed similar resources in terms of building, furniture and equipment. However, in the case of malaria the cost increased because of the time invested in doing the RDT and the laboratory costs. In addition, and as mentioned above, the cost of ACT in syrup was higher than the cost of ACT in tablets and higher than ORS (0.07/sachet), zinc (0.02/tablet) or amoxicillin (0.004/ml). Major contribution to costs among all CHPS were salaries (ranges between 34% and 55%), dispensary (ranges between 12% and 40%) and diagnostic services (ranges between 5% and 17%).

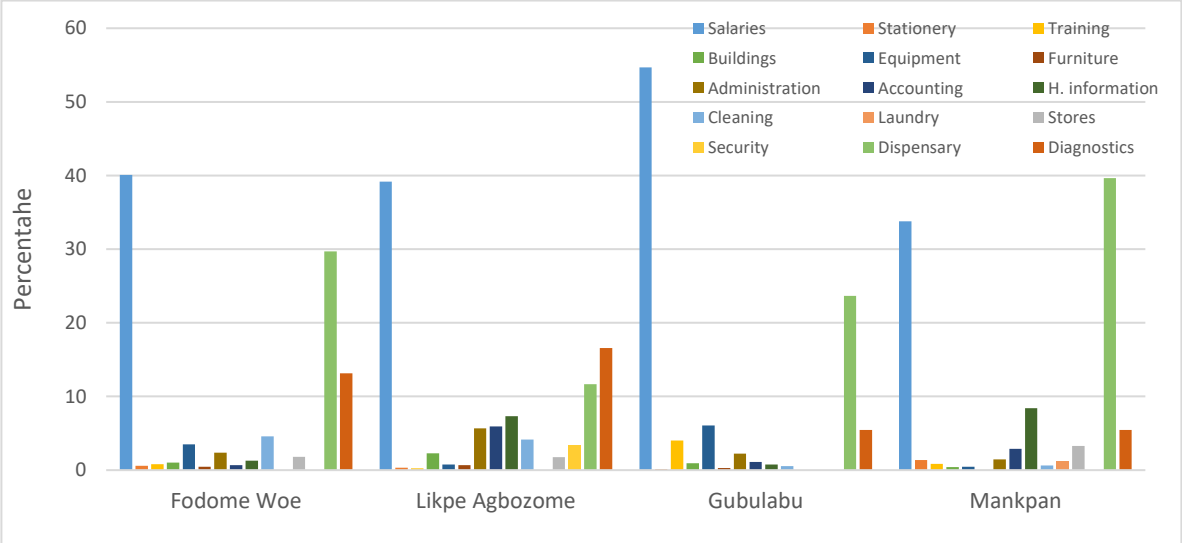

Figure 10. Percentage of contribution to CHPS costs by the different cost drivers in the Volta and the Northern Region in 2014

Table 24. Cost per diagnosing and treating a malaria, diarrhoea and suspected pneumonia case in four CHPS facilities in the Volta and Northern Region in 2014 (US$)

	VOLTA REGION						NORTHERN REGION					
	Fodome Woe			Likpe Agbozome			Gubulahu			Mankpan		
	Malaria	Diarrhoea	Pneumonia	Malaria	Diarrhoea	Pneumonia	Malaria	Diarrhoea	Pneumonia	Malaria	Diarrhoea	Pneumonia
Recurrent expenditures	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Salaries	625.15 (34.9)	338.48 (53.1)	43.72 (52.1)	582.09 (37.5)	119.4 (45.8)	104.48 (42.4)	745.52(51.7)	342.01 (62.7)	9.84 (48.8)	1386.98(31.7)	290.05(48.8)	7.91 (44.5)
Stationery	9.15 (0.5)	4.96 (0.8)	0.64 (0.8)	4.84 (0.3)	0.99 (0.4)	0.87 (0.4)	2.16 (0.1)	0.99 (0.2)	0.03 (0.1)	56.08 (1.3)	11.73 (2.0)	0.32 (1.8)
Utilities	0 (0)	0 (0)	0 (0)	2.04 (0.1)	0.42 (0.2)	0.37 (0.2)	0 (0)	0 (0)	0 (0)	2.24 (0.1)	0.47 (0.1)	0.01 (0.1)
Training	12.46(0.7)	6.75 (1.1)	0.87 (1.0)	3.02 (0.2)	0.62 (0.2)	0.54 (0.2)	54.83(3.8)	25.15 (4.6)	0.72 (3.6)	35.33 (0.8)	7.39 (1.2)	0.2 (1.1)
Capital expenditures												
Buildings	15.73(0.9)	8.52 (1.3)	1.1 (1.3)	34.81 (2.2)	7.14 (2.7)	6.25 (2.5)	12.86(0.9)	5.9 (1.1)	0.17 (0.8)	17.55 (0.4)	3.67 (0.6)	0.1 (0.6)
Equipment	54.3 (3.0)	29.4 (4.6)	3.8 (4.5)	9.41 (0.6)	1.93 (0.7)	1.69 (0.7)	82.78(5.7)	37.97 (7.0)	1.09 (5.4)	18.06 (0.4)	3.78 (0.6)	0.1 (0.6)
Furniture	7.32 (0.4)	3.96 (0.6)	0.51 (0.6)	10.43(0.7)	2.14 (0.8)	1.87 (0.8)	4.15 (0.3)	1.9 (0.3)	0.05 (0.2)	1.82 (0.0)	0.38 (0.1)	0.01 (0.1)
Overhead												
Administration	37.32(2.1)	20.21 (3.2)	2.61 (3.1)	86.54(5.6)	17.75 (6.8)	15.53 (6.3)	30.75(2.1)	14.11 (2.6)	0.41 (2.0)	60.82 (1.4)	12.72 (2.1)	0.35 (2.0)
Accounting	10.41(0.6)	5.64 (0.9)	0.73 (0.9)	92.1 (5.9)	18.89 (7.2)	16.53 (6.7)	15.41(1.1)	7.07 (1.3)	0.2 (1.0)	118.9 (2.7)	24.86 (4.2)	0.68 (3.8)
Health information	20.38(1.1)	11.04 (1.7)	1.43 (1.7)	113.58 (7.3)	23.3 (8.9)	20.39 (8.3)	10.36(0.7)	4.75 (0.9)	0.14 (0.7)	345.8 (7.9)	72.32 (12.2)	1.97 (11.1)
Cleaning	71.27 (4.0)	38.59 (6.1)	4.99 (5.9)	61.16(3.9)	12.55 (4.8)	10.98 (4.5)	7.48 (0.5)	3.43 (0.6)	0.1 (0.5)	26.9 (0.6)	5.63 (0.9)	0.15 (0.8)
Laundry	0	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	47.4 (1.1)	9.91 (1.7)	0.27 (1.5)
Stores	28.22(1.6)	15.28 (2.4)	1.97 (2.3)	26.38(1.7)	5.41 (2.1)	4.73 (1.9)	0 (0)	0 (0)	0 (0)	134.51 (3.1)	28.13 (4.7)	0.77 (4.3)
Security	0 (0)	0 (0)	0 (0)	52.08(3.4)	10.68 (4.1)	9.35 (3.8)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Support centres												
Dispensary drugs	499.06 (27.8)	115.27 (18.1)	16.52 (19.7)	33.07(2.1)	19.91 (7.6)	35.23 (14.3)	365.31 (25.3)	102.18 (18.7)	7.42 (36.8)	1739.20 (39.7)	99.70 (16.8)	4.30 (24.2)
Dispensary overhead	71.98 (4.0)	38.97 (6.1)	5.03 (6.0)	96.7 (6.2)	19.84 (7.6)	17.36 (7.1)	0 (0)	0 (0)	0 (0)	111.46 (2.5)	23.31 (3.9)	0.64 (3.6)
Diagnostics	330.36 (18.4)	0 (0)	0 (0)	344.65 (22.2)	0 (0)	0 (0)	109.81 (7.6)	0 (0)	0 (0)	273.11 (6.2)	0 (0)	0 (0)
Total	1793.12 (100)	637.06 (100)	83.93 (100)	1552.9 (100)	260.97 (100)	246.16 (100)	1441.42 (100)	545.47 (100)	20.17 (100)	4376.15 (100)	594.04 (100)	17.79 (100)
Average cost per case	4.65	3.05	3.11	9.95	8.16	8.79	4.76	3.92	5.04	8.32	5.4	5.93

Household costs for diagnosing and treating a malaria, diarrhoea and suspected pneumonia case are described in Table 25, Figure 11. Household costs represent the cost of time used to travel to provider, the money spent on travel, the cost of time spent with the provider and the money spent at the provider in terms of food. Other costs involved such as paying for the service or for drugs were also considered to show the burden of out of pocket money spent when visiting a CBA or a CHPS facility. As expected, household costs were higher when visiting a CHPS facility than when visiting a CBA, particularly because of longer distances from household to a CHPS facility than to a CBA, higher cost of transport and longer time at a CHPS facility than with a CBA. Household costs ranged from US$0.04 when visiting a CBA in the Northern Region (corresponding to a 0.4% of the total cost per case) to US$1.54 when visiting a CHPS in the Volta Region (corresponding to 20.6% of the total cost per case).

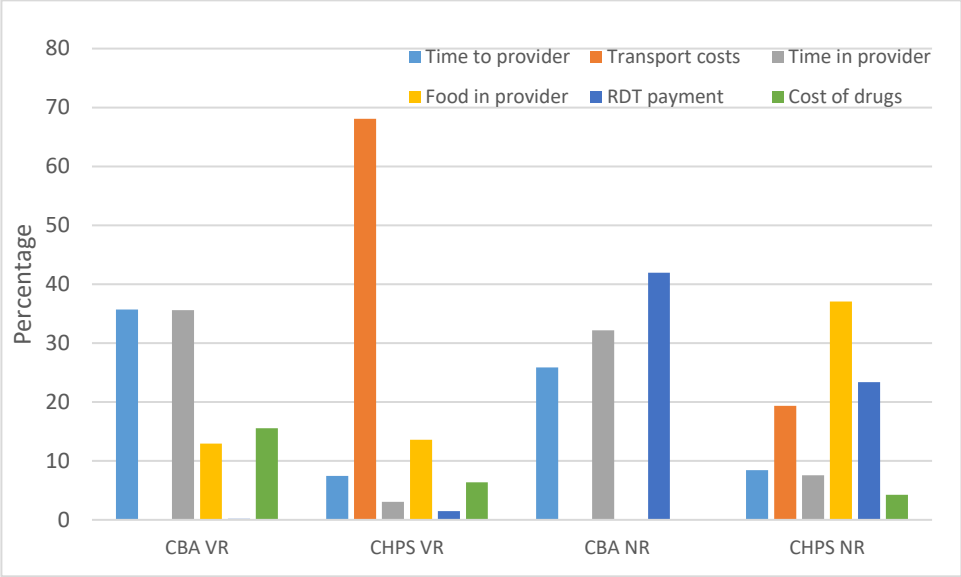

Figure 11. Percentage of contribution to household costs to diagnose and treat a malaria, diarrhoea and pneumonia case by the different cost drivers in the Volta and the Northern Region in 2014

Table 25. Cost per diagnosing and treating a malaria, diarrhoea and suspected pneumonia cases from the household perspective under the HBC and CHPS strategy in the Volta and Northern Region in 2014 (US$)

	VOLTA REGION						NORTHERN REGION					
	CBA			CHPS			CBA			CHPS		
Variables	**Malaria**	**Diarrhoea**	**Pneumonia**	**Malaria**	**Diarrhoea**	**Pneumonia**	**Malaria**	**Diarrhoea**	**Pneumonia**	**Malaria**	**Diarrhoea**	**Pneumonia**
	N (%)	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**
Value of time lost to provider (1)	0.03(36.5)	0.03 (30.3)	0.0(42.4)	0.12 (6.6)	0.12 (7.8)	0.12 (8.1)	0.02 (44.5)	0.02 (14.1)	0.02 (44.5)	0.08 (8.8)	0.08 (11.2)	0.08 (6.50)
Travel cost (2)	0 (0)	0 (0)	0 (0)	1.10 (60.6)	1.10 (71.3)	1.09 (73.8)	0 (0)	0 (0)	0 (0)	0.18 (20.2)	0.18 (25.8)	0.18 (15.0)
Value of time lost at provider (3)	0.03(36.4)	0.03 (30.2)	0.03 (42.2)	0.05 (2.7)	0.05 (3.2)	0.05 (3.3)	0.02 (55.5)	0.02 (17.5)	0.02 (55.5)	0.07 (7.9)	0.07 (10.1)	0.07 (5.8)
Food in provider (4)	0.01(13.2)	0.01 (11.0)	0.01 (15.4)	0.22 (12.1)	0.22 (14.3)	0.22 (14.8)	0 (0)	0 (0)	0 (0)	0.35 (38.7)	0.35 (49.4)	0.35 (28.6)
RDT cost (5)	0.00 (0.6)	0 (0)	0 (0)	0.07 (3.9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (10.9)	0 (0)	0 (0)
Drug cost (6)	0.01(13.4)	0.03 (28.5)	0 (0)	0.25 (14.1)	0.05 (3.4)	0 (0)	0 (0)	0.08 (68.4)	0 (0)	0.12 (13.4)	0.03 (3.6))	0.54 (44.0)
Average cost per case	0.07 (100)	0.09 (100)	0.06 (100)	1.81 (100)	1.54 (100)	1.49 (100)	0.04 (100)	0.11 (100)	0.04 (100)	0.91 (100)	0.72 (100)	1.24 (100)

(1) Refers to the value of time carers spent travelling to provider to sick care for their children; (2) Money spent on transport to provider by carers when seeking care; (3) Value of time spent at provider by carers when seeking care; (4) Money spent by carers buying food at provider when seeking care for their children; (5) Money spent paying for RDT; (6) Money spent paying for drugs.

6.6.2. Unit cost for diagnosing and treating a malaria, diarrhoea and suspected pneumonia case from the societal perspective

To obtain unit costs from the societal perspective, household costs were added to programme costs of the HBC and CHPS strategies (Table 26, Figure 12).

Costs involved due a second visit to a provider after visiting a CBA or a CHPS facility were added to programme/facility costs. These costs were higher under the HBC strategy when compared to CHPS, as more carers sought care after the first visit to a CBA than to a CHPS. In the Volta Region, average costs for this second visit correspond to US$3.34 and US$0.41 per a malaria case diagnosed and treated under the HBC and CHPS strategy respectively; US$0.41 and US$0.11 per diarrhoea case diagnosed and treated under the HBC and CHPS strategy and US$0.14 and US$0.02 per suspected pneumonia case diagnosed and treated under the HBC and CHPS strategy respectively. In the Northern Region, average costs for the second visit to a provider was US$1.56 and US$0.61 per malaria case diagnosed and treated under the HBC and CHPS strategy respectively; US$1.53 and US$0.16 per diarrhoea case diagnosed and treated under the HBC and CHPS strategy and US$0.66 and US$0.001 per suspected pneumonia case diagnosed and treated under the HBC and CHPS strategy respectively.

After adding household costs and those of the second visit to a provider, to the cost per diagnosing and treating a malaria case under the HBC strategy was US$4.96 and US$9.37 in the Volta and Northern Regions and US$9.52 and US$8.07 in a CHPS in the Volta and the Northern Regions; to diagnose and treat a diarrhoea case costs US$0.88 and US$8.36 under the HBC in the Volta and Northern Regions and US$7.25 and US$5.54 in a CHPS in the Volta and the Northern Regions. Finally, diagnosing and treating a suspected pneumonia case costs US$1.33 and US$8.50 under the HBC strategy in the Volta and the Northern Regions and US$7.45 and US$6.73 in a CHPS in the Volta and the Northern Regions respectively. Therefore, diagnosing and treating a malaria case was the most expensive, followed by a suspected pneumonia case and a diarrhoea case, mainly because of laboratory costs and drugs costs (as mentioned in section 6.6.1) in both, HBC and CHPS.

Looking at the contribution to these costs by the different drivers (Figure 11), programme and facility cost are the main contributors (costs ranging from 43% to 85%), with the exception of the HBC in the Volta Region. HBC costs in the Volta Region are comparatively lower than other facility and programme costs. In addition, costs related to the second provider visit, after visiting a CBA in the Volta Region, were higher than in the Northern Region. Even though a higher percentage sought care after visiting a CBA in the Northern Region than in the Volta Region, average CHPS costs and household costs were higher in the Volta Region than in the Northern Region. Finally, and as mentioned above, household costs were higher when visiting a CHPS than a

CBA due to longer distances and more time spent at the provider (corresponding to 20% and 14% of the total cost under CHPS in the Volta and the Northern Region, respectively).

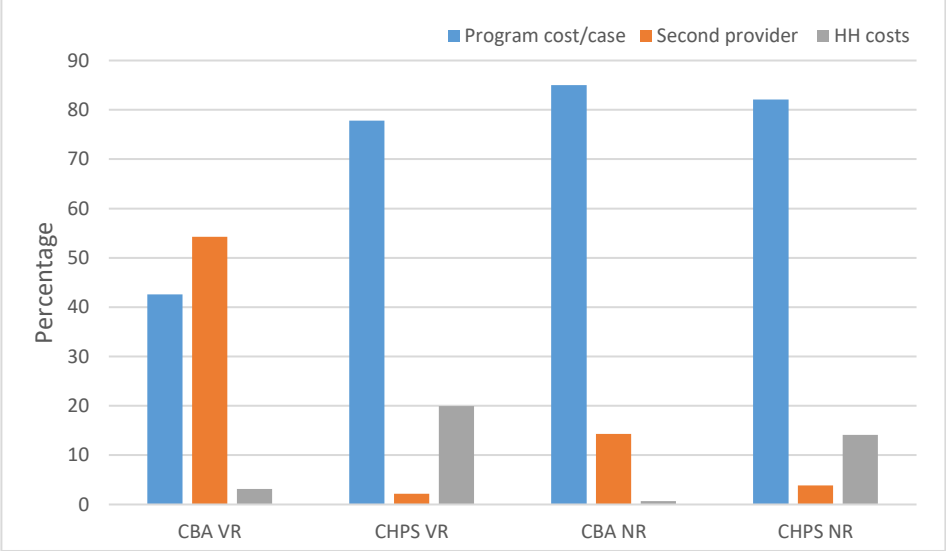

Figure 12. Percentage of contribution to societal costs to diagnose and treat a malaria, diarrhoea and pneumonia case by the different cost drivers in the Volta and the Northern Region in 2014. VR: Volta Region; NR: Northern Region

Table 26. Cost per diagnosing and treating a malaria, diarrhoea and suspected pneumonia case from the societal perspective under the HBC and CHPS strategy in the Volta and Northern Region in 2014 (US$)

	VOLTA REGION						NORTHERN REGION					
	CBA			CHPS			CBA			CHPS		
	Malaria	**Diarrhoea**	**Pneumonia**	**Malaria**	**Diarrhoea**	**Pneumonia**	**Malaria**	**Diarrhoea**	**Pneumonia**	**Malaria**	**Diarrhoea**	**Pneumonia**
PROVIDER PERSPECTIVE	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**
Programme cost per case	1.54(31.1)	0.38 (43.6)	1.12 (84.8)	7.30(76.7)	5.60 (77.3)	5.95 (79.8)	7.77 (83.0)	6.72 (80.4)	7.80 (91.8)	6.54(81.1)	4.66(84.2)	5.49 (81.6)
If second provider was sought	3.34 (67.4)	0.41 (46.3)	0.14 (10.4)	0.41 (4.3)	0.11 (1.5)	0.02 (0.2)	1.56 (16.7)	1.53 (18.3)	0.66 (7.7)	0.61(7.6)	0.16 (2.9)	0.00 (0.1)
Total Facility/programme cost per case	4.88 (98.5)	0.79 (89.9)	1.26 (95.2)	7.71(81.0)	5.71 (78.8)	5.97 (80.1)	9.33 (99.6)	8.24 (98.6)	8.46 (99.6)	7.15(88.7)	4.82(87.1)	5.49 (81.6)
HOUSEHOLD PERSPECTIVE												
Value of travel time lost to provider	0.03 (0.5)	0.03 (3.1)	0.03 (2.0)	0.12 (1.3)	0.12 (1.7)	0.12 (1.6)	0.02 (0.2)	0.02 (0.2)	0.02 (0.2)	0.08 (1.0)	0.08 (1.5)	0.08 (1.2)
Cost to provider	0.00 (0)	0.00 (0)	0.00 (0)	1.10(11.5)	1.10 (15.1)	1.10 (14.7)	0.00 (0)	0.00 (0)	0.00 (0)	0.18 (2.3)	0.18 (3.3)	0.18 (2.7)
Value of time lost at provider	0.023 (0.5)	0.03 (3.0)	0.03 (2.0)	0.05 (0.5)	0.05 (0.7)	0.05 (0.7)	0.02 (0.2)	0.02 (0.2)	0.02 (0.2)	0.07 (0.9)	0.07 (1.3)	0.07 (1.1)
Food in provider	0.01 (0.2)	0.01 (1.1)	0.01 (0.7)	0.22 (2.3)	0.22 (3.0)	0.22 (2.9)	0.00 (0)	0.00 (0)	0.00 (0)	0.35 (4.4)	0.35 (6.4)	0.35 (5.3)
RDT	0.00 (0)	0.00 (0)	0.00 (0)	0.07 (0.7)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.10 (1.2)	0.00 (0)	0.00 (0)
Drugs	0.01 (0.2)	0.03 (2.9)	0.00 (0)	0.25 (2.7)	0.05 (0.7)	0 (0)	0.00 (0)	0.08 (0.9)	0.00 (0)	0.12 (1.5)	0.03 (0.5)	0.54 (8.1)
Total household cost per case	0.07 (1.5)	0.09 (10.1)	0.06 (4.8)	1.81(19.0)	1.54 (21.2)	1.49 (19.9)	0.04 (0.4)	0.11 (1.4)	0.04 (0.4)	0.91(11.3)	0.72(12.9)	1.24 (18.4)
Average cost per case	4.96 (100)	0.88 (100)	1.33 (100)	9.52 (100)	7.25 (100)	7.45 (100)	9.37 (100)	8.36 (100)	8.5 (100)	8.07(100)	5.54 (100)	6.73 (100)

6.6.3. Cost-analysis

Tables 27, 28 and 29 presents the average cost per case appropriately treated (average cost per malaria, diarrhoea and suspected pneumonia cases appropriately diagnosed and treated according to protocol in a group of 100 eligible children, meaning that those that need the treatment received it, and those that do not need it do not receive it). Due to the low numbers of carers visiting a CBA in the Northern Region (Chapter 3), I excluded the HBC data of the Northern Region from this analysis.

In the Volta Region, HBC was less costly than CHPS not only for the appropriate diagnosis and treatment of malaria, but also for the appropriate diagnosis and treatment of diarrhoea and suspected pneumonia (Tables 27, 28, 29 and Figure 13). Note that even though the GFATM only provides ACT drugs for the HBC strategy in the Volta Region, CBAs received training for the management of the three diseases (Chapter 4). If no drugs were available to treat a diarrhoea and pneumonia case (CBAs were provided with ORS, zinc and amoxicillin in 2013), CBAs were supposed to refer cases for further management, and this referral was also considered as appropriate treatment.

The average cost per case appropriately diagnosed and treated was lower under the HBC than under the CHPS strategy. HBC had lower costs than CHPS to diagnose and treat malaria, diarrhoea and suspected pneumonia cases while the number of children appropriately diagnosed and treated was similar or slightly higher under the HBC strategy (Tables 27, 28 and 29). The cost per case appropriately diagnosed and treated was lower for the management of malaria (US$4.25 versus US$6.12), for the prompt management of malaria (US$5.58 versus 12.24), for the management of diarrhoea with ORS or referred (US$0.12 versus US$1.45) for the management of diarrhoea with ORS and zinc (US$0.18 versus US$1.12), and for the management of suspected pneumonia (US$0.27 versus 1.69) under the HBC strategy when compared with CHPS.

Table 27. Cost-analysis for appropriately diagnose and treat a malaria per 100 eligible children from de societal perspective in 2014 (US$)

	Volta Region		Northern Region	
Variables	**HBC**	**CHPS**	**HBC**	**CHPS**
Number of eligible children for treatment	**100**	100		**100**
Number treated with ACT or quinine*	24	19		30
Number treated with prompt ACT or quinine	17	4		23
Number treated according to protocol (ACT or quinine)	28	30		35
Number treated according to protocol (prompt ACT or quinine)	21	15		27
Cost per 100 children (ACT or quinine)	US$119.04	US$182.30		US$244.57
Cost per child treated according to protocol (ACT or quinine)	US$4.25	US$6.12		US$7.09
Cost per child treated according to protocol (prompt ACT or quinine)	US$5.58	US$12.24		US$8.92

*Source: Annex 2

Table 28. Cost analysis for appropriately diagnose and treat a diarrhoea per 100 eligible children from de societal perspective in 2014 (US$)

	Volta Region**		Northern Region	
Variables	**HBC**	**CHPS**	**HBC**	**CHPS**
Number of eligible children for treatment	100	100		100
Number treated with ORS (or referred)*	8	11		7
Number treated with ORS and zinc (or referred)	11	7		4
Number treated according to protocol (ORS or referred)	59	57		62
Number treated according to protocol (ORS and zinc)	54	43		59
Cost per 100 children (ORS)	US$6.84	US$83.20		US$38.88
Cost per 100 children (ORS and zinc)	US$9.78	US$47.54		US$19.44
Cost per child treated according to protocol (ORS or referred)	US$0.12	US$1.45		US$0.62
Cost per child treated according to protocol (ORS and zinc)	US$0.18	US$1.12		US$0.33

* Source: Annex 3; **Appropriate treatment for diarrhoea under the HBC strategy in the Volta Region includes those treated with ORS and zinc or referred for further management. The cost per treatment of those referred is included to allow comparison with CHPS.

Table 29. Cost analysis for appropriately diagnose and treat a suspected pneumonia per 100 eligible children from de societal perspective in 2014 (US$)

	Volta Region**		Northern Region	
Variables	**HBC**	**CHPS**	**HBC**	**CHPS**
Number of eligible children for treatment	100	100		100
Number treated with amoxicillin or co-trimoxazole*	15	16		23
Number treated according to protocol	72	72		73
Cost per 100 children	US$19.87	US$122.13		US$156.44
Cost per child treated according to protocol	US$0.27	US$1.69		US$2.13

* Source: Annex 3; **Appropriate treatment for diarrhoea under the HBC strategy in the Volta Region includes those treated with ORS and zinc or referred for further management**.** The cost per treatment of those referred is included to allow comparison with CHPS.

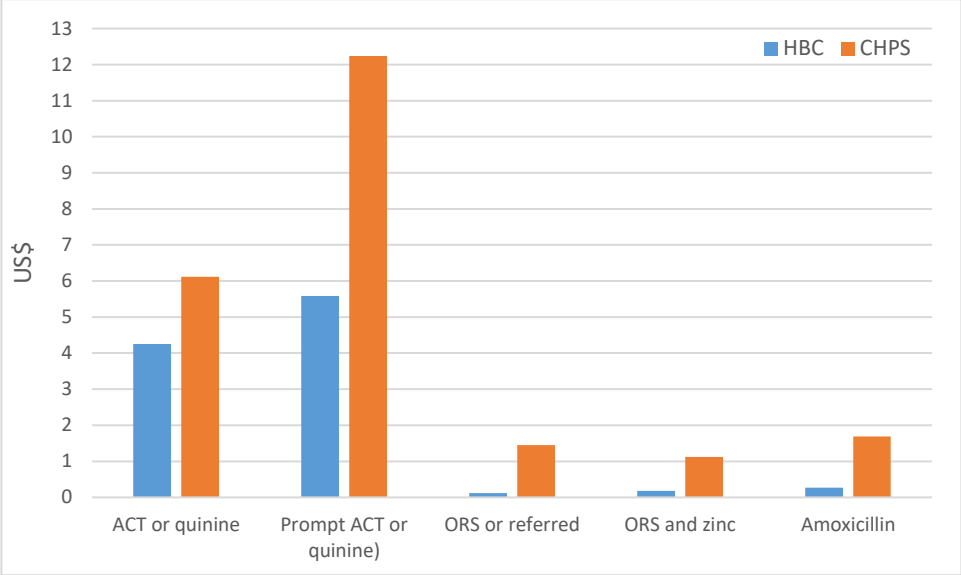

Figure 13. Average cost per malaria, diarrhoea and suspected pneumonia case appropriately diagnosed and treated under the HBC and CHPS in the Volta Region in 2014

6.6.4. Sensitivity analysis

The one way sensitivity analysis explored how varying specific values influenced the average cost per case appropriately diagnosed and treated from the societal perspective in both strategies For simplicity in presenting the data, I only included one cost per disease. HBC in the Volta Region remained less costly than CHPS for the appropriate diagnosis and treatment of malaria, diarrhoea and suspected pneumonia cases when using different facility costs, different discount rates, different HBC and CHPS utilization and different HBC effectiveness (Table 30). However, when the HBC effectiveness is reduced by 50%, the number of children appropriately diagnosed and treated was lower for the management of malaria (11 versus 15 children appropriately diagnosed and treated in a sample of 100 children) and suspected pneumonia (65 versus 72 children appropriately diagnosed and treated) than CHPS (data not shown in Table).

Modifying the HBC effectiveness and the HBC and CHPS utilization had the highest effect on the cost per case appropriately diagnosed and treated. When increasing, and reducing, by 50% the number of cases appropriately diagnosed and treated, the cost for the management of malaria ranged from US$2.75 to US$6.03 and from US$0.12 to US$0.29 in the case of the management of diarrhoea. With respect to suspected pneumonia, the cost varied from US$0.20 to US$0.50 when increasing and reducing by 50% HBC and CHPS utilization.

Table 30. Sensitivity analysis to selected parameters of the cost per malaria, diarrhoea and suspected pneumonia case appropriately diagnosed and treated in children under-five under HBC and CHPS in the Volta Region (cost in US$)

Indicators	HBC	CHPS	HBC	CHPS	HBC	CHPS
	Average facility cost		**More costly facility**		**Less costly facility**	
Costs per 1 child (ACT or quinine)	4.25	6.12	5.04	7.86	3.46	4.38
Cost per 1 child (ORS and zinc)	0.18	1.12	0.21	1.51	0.15	0.71
Costs per 1 child (amoxicillin)	0.27	1.69	0.28	2.30	0.26	1.05
	3% discount rate		**5% discount rate**		**7% discount rate**	
Costs per 1 child (ACT or quinine)	4.25	6.12	4.33	6.30	5.56	6.8
Cost per 1 child (ORS and zinc)	0.18	1.12	0.18	1.14	0.18	1.17
Costs per 1 child (amoxicillin)	0.27	1.69	0.27	1.73	0.27	1.77
	Average utilization		**Higher utilization**		**Lower utilization**	
Costs per 1 child (ACT or quinine)	4.25	6.12	3.94	5.58	5.14	7.62
Cost per 1 child (ORS and zinc)	0.18	1.12	0.16	1.02	0.23	1.18
Costs per 1 child (amoxicillin)	0.27	1.69	0.20	1.55	0.50	1.79
	Average effectiveness		**Higher effectiveness**		**Lower effectiveness**	
Costs per 1 child (ACT or quinine)	4.25	6.12	2.75	5.99	6.03	6.25
Cost per 1 child (ORS and zinc)	0.18	1.12	0.12	1.11	0.29	1.12
Costs per 1 child (amoxicillin)	0.27	1.69	0.24	1.69	0.31	1.70

6.6.5. Affordability

Table 31 shows the HBC average budgetary requirements from the provider perspective that should be consider for planning purposes at the actual performance level in the Volta Region. This cost could be lower if HBC utilization and the appropriate diagnostic and treatment given increases. To get an estimate of total HBC cost in the whole country per year (understanding that costs varies between regions as we observed regarding the Northern Region) similar exercise could be done using data from the other regions reported in the DHMDII and taking into consideration the lowest and highest cost obtained in the sensibility analysis.

Table 31. HBC average budgetary requirements from the provider perspective in the Volta Region in 2014 (US$)

	Malaria	Diarrhoea	Suspected pneumonia	Total
Average cost per case appropriately diagnosed and treated	4.19	0.16	0.26	
Number of cases treated in 2014	25,788.68	3,813.47	1,236.85	
Total in 2014	108,054.57	610.15	321.58	**108,986.31**

6.7. Discussion

Before the adoption of the HBC and CHPS strategies in the Ghana Health System, RCT were conducted to assess their efficacy in Ghana (86, 230). In addition, another study was conducted to assess the cost-effectiveness of two strategies of HBC (ACT alone *versus* ACT and amoxicillin) (95), although without presenting the cost per fever treated under the standard care. My study used data from an observational study to analyse the cost per a malaria, diarrhoea and suspected pneumonia case appropriately diagnosed and treated in children under- five under the HBC and CHPS strategies after 2 and 8 years of HBC implementation in the Volta and the Northern Region respectively, and 10 years of CHPS implementation in both regions. Results from this evaluation might be used to improve HBC and CHPS implementation and to guide policy makers in the discussion about long term financing of HBC in Ghana.

My results showed that HBC in the Volta Region was less costly than CHPS for the management of malaria, diarrhoea and suspected pneumonia, even after the sensitivity analysis modifying health facility costs, discount rates, HBC and CHPS utilization and HBC effectiveness. However, if the HBC effectiveness is reduced by 50% (understood as the number of children appropriately diagnosed and treated), HBC remains less costly but fewer cases were appropriately treated when compared with CHPS. Different HBC effectiveness and different HBC and CHPS utilization were the factors explored that most affected the cost.

Although these results are country specific and cannot be generalised to other countries, they are coherent with the study conducted in Zambia (98) which concluded that the cost per case appropriately diagnosed and treated was US$4.22 in 2009 which was less than the cost at a health facility in the same year (US$6.61). Some differences however can be seen between the Zambia study and my study: the Zambia analysis was done from the provider perspective, used registries instead of survey data to assess the effectiveness, and RDTs were used within the HBC strategy. Excluding household costs could bias results in favour of CHPS (my study showed that household costs were higher when visiting a CHPS than a CBA). Using registries instead of surveys to collect effectiveness data could also introduce differences as discussed in Chapter 3: registers might suffer from uncompleted reporting and survey data might suffer from recall bias and misinterpretation of symptoms. Using RDT for the malaria HBC could increase HBC cost (due to staff time and laboratory costs) but drug costs might be reduced (if CHW adhere to RDT results).

The cost per case appropriately diagnosed and treated was not conducted in the Northern Region due to the low numbers of carers visiting a CBA. However, the assessment of the curative component, the preventive component and the cost analysis showed differences in the HBC management, implementation and strategy between the Northern and Volta Region worth

mentioning. HBC programme costs in the Northern Region were higher than in the Volta Region, particularly due to the higher number of CBAs registered doing few preventive and curative activities (chapter 4, chapter 5 and DIMS II). In Chapter 4, I described the low HBC utilization in the Northern Region with about 41% of carers reporting that they do not know or they do not have a CBA in the community. In addition, I also mentioned that stock out of drugs could be a reason for the low HBC utilization and the low HBC and CHPS effectiveness. In Chapter 5, I showed that a lower proportion of carers in the Northern Region received health education messages from CBAs than carers in the Volta Region, in coherence with the annual activity reported in 2014 in the DHIMS2. Another difference with the Volta Region is the strategy of the HBC: HBC in the Volta Region targets only the most remote areas, while in the Northern Region all communities are targeted for HBC. As described in Chapter 4, carers having a health facility close to the house were less likely to visit a CBA, reducing HBC utilization and therefore increasing the cost per case appropriately diagnosed and treated. The Markov Model conducted in the study in Uganda also concluded that malaria HBC is attractive in areas with no access to standard care (96). These points determined the higher average costs per diagnosing and treating a malaria, diarrhoea and suspected pneumonia case under the HBC strategy in the Northern Region compared to the Volta Region, which were similar to those of the CHPS strategy in the Northern Region. If we consider the scale of the project, without considering the incentive package as this only happens at the beginning of the intervention, HBC in the Northern region remains more costly than HBC in the Volta Region.

To reduce HBC cost in the Northern Region a focus must be done on improving the level of activity of CBAs by replacing inactive CBAs, increasing IEC activities and ensuring availability of drugs (as utilization of HBC or CHPS is a carers decision). In addition, targeting the rural areas to implement HBC in the Northern Region could be an option to reduce costs and to increase HBC utilization. However, the positive results of the preventive component particularly in the Northern Region (Chapter 5) should also be considered before deciding to target only remote areas.

Long term financing is a cornerstone of HBC, often financed by health partners without a clear sustainability strategy. However, if HBC is affordable and its benefits worth it, other financial plans must be considered. In Ghana, the NHIS pays health providers for services included in the insurance benefit package. A criteria to include a service or strategy into the NHIS benefit package is its affordability and its potential value in paying these costs. My study provides information about how much it costs to appropriately diagnose and treat a malaria, diarrhoea and pneumonia case under the HBC and CHPS strategy in the Volta Region. These costs can be extrapolated to the whole Volta Region and to the rest of the country. Then, based on the available money and the potential value of paying these costs, a decision could be made on the long term financial plan. In Chapter 4 and 6 I showed that the curative component of the HBC strategy in the Volta Region

provided appropriate treatment to more people in need than CHPS (although still at unacceptable levels). In addition, HBC was able to reach the poorest, contributing to health equity. In Chapter 5 I described the association between the HBC preventive component and disease knowledge and healthy behaviours, such as identifying signs of severe pneumonia, children sleeping under mosquito nets, prompt seeking care and having safe faeces disposal in the Northern Region. In this Chapter I showed that household costs were lower under the HBC when compared to CHPS in both the Volta and the Northern Region. All these points should make the HBC strategy "attractive" to be included in the NHIS benefit package. However, the NHIS must have the money to finance this strategy without increasing too much the already high expenditure. I mentioned in Section 1.5 that in 2009-2013 the NHIS expenditures exceeded revenues (61-63). The 2014 and 2015 reports are not available on the website. Revising the whole NHIS benefit package as planned in 2014 (*Concept Note for Stakeholder Dialogue on NHIS Benefits Package)* and considering the HBC among the possible benefits based on the results of this study could be the right approach. From the point of view of implementation, it is important to reflect on how the NHIS could reimburse HBC activities. CHPS are facilities registered under the NHIS. CBAs curative activities reported to CHPS could be reimbursed by the NHIS as activities related to CHPS, which is informally happening already in some districts. If we also consider the preventive component of HBC (which is likely to be cost-effective when compare to CHPS, although we only have data on its effectiveness), some IEC activities, particularly those done in partnership with CHPS under the Community- IMCI could also be reimbursed by the NHIS. This could help the sustainability of HBC, retain CBAs and improve the quality of the intervention. However, control measures must be put in place to avoid reporting false activity. Another issue to be considered is the acceptability, particularly of the CHPS and the NHIS. An acceptability study should be conducted to see how different actors see that approach.

Limitations of the study

The number of cases appropriately diagnosed and treated was obtained from a cross sectional study. Effectiveness data in economic evaluations are often recommended to be from RCT although there are limitations such as the comprehensiveness (only one source of data) and the short time horizons. To overcome these limitations, there is now a tendency to use data from systematic reviews or even better, from decision analytic modelling (108). This is true if one wants to prove the efficacy and efficiency of a new intervention. But if one wants to evaluate the effectiveness and cost-effectiveness of a proven intervention in a real life, meaning evaluating its actual implementation like an ex-post HTA does, then data from a observational studies is more relevant (108, 212, 213) and it has been used in several studies in the UK, Asia and Africa (98, 231-235).

In chapter 2 I explained that I am conducting a cost analysis instead of a cost-effectiveness analysis for two reasons. First, because I needed to answer the question about how much it cost to assess the affordability of the programme for the NHIS. Secondly, because the effectiveness measure available is an intermediate outcome which might not be accepted to all economists (108). Using appropriate diagnosis and treatment as the effectiveness measure might bring some difficulties when summarizing results from each of the three diseases evaluated. In addition, this intermediate outcome doesn't have a threshold to say that an intervention is cost-effective. Ideally, the government should be questioned about their willingness to pay per extra case appropriately treated. Case appropriately diagnosed and treated measures the quality of care given as it refers to adherence to guidelines. However, it doesn't consider the outcome of death or disability (although I considered the cost of visiting a second provider in case the child didn't recover). Even though I don't expect that not considering death and disability might influence my results- no deaths or disability were reported-, using DALYs or QALYs might have solved the issue of the different end points of treatment. In addition, the use of DALYs/QALYs might allow comparison of my results with other diseases and studies.

Case appropriately diagnosed in this study refers to adherence to guidelines and not to adherence to microscopy results (which cannot be performed at this community level). This means that the appropriate diagnosis of malaria under the HBC strategy refers to a child with fever, while in the CHPS refers to a child with a positive RDT or a child with fever if an RDT was not performed. Although some fever cases might be misclassified as malaria cases, this is something to consider when revising the HBC guidelines but not in this current study (which objective is to assess the HBC and CHPS implementation and the adherence to guidelines).

Data from the cross-sectional study brought relevance to the evaluation but also brought limitations. Carers of sick children chose their providers based on different criteria (such as proximity, trust, availability or perceived severity of disease), reflecting the actual utilization of the services. This self-selection also affected the cost analysis: few carers of sick children chose to visit a CBA in the Northern Region. Due to these low numbers of carers visiting a CBA in the Northern Region it was not possible to conduct the cost per case appropriately diagnosed and treated. Self-selection is a factor to be considered when addressing cost analysis. Children with signs of more severe disease could have reached CHPS more often than HBC and received a more expensive treatment, reducing the cost per case appropriately diagnosed and treated of CHPS compared to HBC. However, this study aimed to conduct the cost analysis in the routine system, and therefore, this self-selection should be considered as part of the system and not as a source of bias.

Sources of facility costs came from data of 2 CHPS in the Volta Region and 2 in the Northern Region. Although the analysis took into consideration average costs, and higher and lower facility

cost for the sensitivity analysis, it would have been better to have at least one more CHPS in each region to have a better representation of CHPS costs. Unfortunately, it was not possible to add another CHPS to the cost analysis. Finally, I mentioned in section 5.4.1 that the selection criteria for the CHPS facilities was average CHPS based on the activity reported and the number of personnel. In addition, being close to the communities being surveyed was also considered for logistic reasons. Considering that districts and communities were selected using probability proportional to size, I believed that the CHPS selected represent average CHPS facilities without introducing selection bias.

6.8. Conclusions

This study brought more light to the scarce evidence on the cost of appropriately diagnosing and treating a case under the HBC strategy. Diagnosing and treating a malaria, diarrhoea and suspected pneumonia case in children under-five was less costly than under CHPS in the Volta Region. High programme costs in addition to low curative and preventive activities made the HBC strategy in the Northern Region more costly than in the Volta Region. A revision of the HBC strategy in the Northern Region is needed to reduce HBC costs. This study brings necessary information to consider the inclusion of HBC in the NHIS benefit package as a long-term financing strategy. However, a revision of the NHIS benefit package and an acceptability study must be conducted before making such a decision.

Chapter 7. Discussion

This study aimed to assess the programme implementation of two community- based interventions in Ghana (HBC and CHPS) to (i) improve national performance, (ii) guide discussions on the long-term financing of HBC and (iii) contribute to the global evidence on community based interventions.

In Chapter 2 I revised the current evidence about HBC for the prevention and management of malaria, diarrhoea and pneumonia, as well as methods and frameworks to evaluate health interventions. This review of evidence showed that there is extensive literature assessing the effect of HBC in Africa, mainly addressing the curative component of malaria HBC, under controlled circumstances and reaching few districts. The preventive component has been less explored and its cost-effectiveness has been barely addressed. There are limited but promising results on the effect of malaria HBC in reducing child mortality, but no evidence regarding diarrhoea and pneumonia HBC and child mortality in Africa. HBC can contribute to increasing appropriate treatment and prompt treatment even when diarrhoea and suspected pneumonia cases are integrated in the strategy. The few studies looking at the preventive component and the cost-effectiveness showed positive results regarding disease knowledge, adequate administration of drugs and on its cost-effectiveness when compared with the standard care. Based on this evidence, I believed that assessing HBC under programme conditions, in large areas and after several years of implementation to be the appropriate next step, understanding that implementation issues may decrease the expected outcomes of the strategy. This should be a comprehensive evaluation, without focusing on only one aspect of the intervention and considering its continuity and coordination with other interventions. As HBC (and CHPS) are implemented throughout Ghana, the design of the study should ensure the attribution of results to the intervention. Therefore, I conducted an observational study, post implementation and without controls in two regions of Ghana to assess service utilization, appropriate treatment given, users' satisfaction, carers' disease knowledge, carers' health behaviour and cost analysis. To attribute the outcomes to the delivery strategies under study, the questionnaire included question such us "where did you seek care", "from where did you receive the drug", "from where did you receive health promotion and preventive messages", Chapter 3 describes in detail the methods used.

In Chapter 4, 5 and 6 I presented the results of the study. Chapter 4 analysed the HBC and CHPS utilization, appropriate treatment given and user's satisfaction with the services. Chapter 5 assessed

the association between health education messages from CBAs and CHPS' nurses and carer's disease knowledge and health behaviour. Chapter 6 presented the cost analysis for the appropriate diagnosis and treatment of a malaria, diarrhoea and suspected pneumonia case in children under-five under the HBC and CHPS strategies in Ghana. The summary of these results can be found in Table 32.

Table 32. Summary of results of HBC and CHPS strategies by outcomes explored

Indicators	HBC	CHPS
Utilization of HBC/CHPS strategies associated with children from the poorest households	In the Northern Region	
Strategy that provided appropriate treatment for malaria to the highest percentage of children that visited a CBA or a CHPS	In the Volta Region	
Strategy that provided appropriate treatment for diarrhoea to the highest percentage of children that visited a CBA or a CHPS	In the Volta Region	
Strategy that provided appropriate treatment for suspected pneumonia to the highest percentage of children that visited a CBA or a CHPS		In the Northern Region
Strategy associated to the highest number of disease knowledge and health behaviour indicators explored	In the Northern Region	
Strategy with the lowest household costs per malaria, diarrhoea and suspected pneumonia case diagnosed and treated	In the Volta and the Northern Region	
Strategy with the lowest total costs per malaria, diarrhoea and suspected pneumonia case diagnosed and treated	In the Volta Region	
Strategy with the lowest total cost per case appropriately diagnosed and treated (analysis only conducted in the Volta Region)	In the Volta Region	

7.1. HBC and CHPS utilization

This study showed (i) an increased trend in care seeking behaviour in Ghana when compared with previous surveys, (ii) an important use of community health interventions, with 30% of carers using HBC or CHPS (iii) a surprising low HBC utilization in the Northern Region and (iv) the capacity of HBC in the Volta Region to reach the poorest, improving equity on health care utilization.

Care seeking behaviour for children presenting with fever, diarrhoea or cough in the two weeks prior to the survey was high, (about 93% in both regions). If only seeking care from formal health facilities (public or private) is considered, 52.2% and 72.7% of cares in the Volta and Northern Regions sought care. If CBAs and licensed chemical sellers are also considered appropriate providers, about 89% of carers in both regions sought care from an appropriate provider. This study found a higher care seeking behaviour than the 2011MICS and 2014DHS (57, 203) while being coherent with the increased trend in care seeking behaviour in Ghana. It also had a higher care seeking behaviour when compared with other studies conducted about 15 years ago in Africa that showed that fewer than 20% of febrile episodes and deaths arrive at any formal health system, and

more than 70% of malaria episodes in rural areas and more than 50% in urban areas are self-treated in Africa (236-239).

About 30% of carers went to a community health provider when their child was sick in both regions, contributing to the increase in care seeking behaviour in Ghana. However, important differences can be seen between HBC and CHPS utilization in the Northern and the Volta Region. HBC was reasonably used in the Volta Region although with large variations between districts (17.3% of carers of sick children went to a CBA) while CHPS was slightly less used (11.8%). HBC utilization in the Northern Region was surprisingly low (1%) although HBC was implemented for a longer time than in the Volta Region, while CHPS compounds were the provider more utilised (31.3%). A qualitative study to identify barriers and enablers of HBC utilization could help to explain why HBC utilization is low in the Northern Region, but unfortunately, this study was not possible to conduct. This low HBC utilization in the Northern Region was also found in the LQAS survey conducted in the 3 northern regions of Ghana (153). Recent HBC evaluations conducted in Ethiopia, Burkina Faso and Malawi also showed low HBC utilization, ranging from 2 to 11.5% (240, 241). Authors of these studies believe that the reason for this HBC low utilization was low implementation coverage (in terms of deployment of community health workers and drugs) and weak strategy on community entry and sensitization on HBC. Other studies conducted in Africa showed a higher malaria HBC utilization, ranging from 21% to 76% (87, 88, 193, 242), probably due to shorter time implementing the strategy and a focus on few districts instead of the whole region. In terms of CHPS utilization in the Northern Region, the LQAS survey showed a lower utilization than my study (between 6-10% of carers visited a CHPS when the child was sick) (153), probably due to differences in the sampling (the LQAS survey purposely selected some districts while our study included all districts in the Northern Region).

HBC was able to reach the poorest in coherence with its pro- poor intervention. In addition, carers of children older than 6 months more often visited a CBA than carers of children younger than 6 months as the national guideline states. Lastly, carers that lived far from any type of health facility were more likely to use HBC, which has implications for HBC planning. In the Northern Region, proximity to a CHPS was found to be associated to CHPS utilization. Based on the utilization of these community strategies and on the predictors of HBC and CHPS utilization, one would wonder if both HBC and CHPS are needed in the Northern Region. The effect of the curative and preventive component of both strategies and the cost analysis will help to answer this question.

7.2. Appropriate treatment given and carers' satisfaction

Appropriate treatment given for fever, diarrhoea and suspected pneumonia was low in both, HBC and CHPS, in the Volta and Northern Regions. The effectiveness of HBC and CHPS implementation in the programme context, with less supervision and at a larger scale can be lower than expected.

The proportion of children that received appropriate treatment was highest for the management of non-complicated malaria cases for those visiting a CBA in the Volta Region and a CHPS compound in the Northern Region, where 36.7% and 35.9% of cases receive ACT or quinine respectively. This was followed by the management of suspected pneumonia cases under the CHPS strategy in the Northern Region where 33% of cases received amoxicillin or co-trimoxazole. When other antibiotics with an effect on the respiratory tract infections are considered, then 50% of cases received an antibiotic. Prescribing both ORS and zinc, for the treatment of malaria was almost non-existent.

The low appropriate treatment found in my study contrasts with results of many studies described in Annex 1 showing that malaria HBC has the potential to provide appropriate treatment at community level. Most of these studies however were well supervised being in the context of RCTs (84, 167, 170, 243-245), had shorter implementation periods, or had been implemented in small areas (87, 88, 98, 246, 247). However, my results suggest that the effectiveness of HBC implementation in the programme context, with less supervision and at a larger scale can be lower than expected. Another study conducted in Burkina Faso (126) with less supervision had similar results (54% of febrile children received ACT from a CBA). With regards to diarrhoea treatment, my results were similar to those of the LQAS survey (153), 2011 MICS (203) and 2014 DHS (57). With regards to the management of suspected pneumonia, two studies conducted in Kenya (post studies without control of 1 year and 5 years of duration) showed similar low results as my study (248, 249) while other studies, (4 RCT and one post study without control of 1 year) showed better results (167, 175, 244, 245, 250). Although methods and data collection tools might influence results (household surveys *versus* CMD distributers registers and observation), studies with stronger supervision often have better results as mentioned above.

Recognising that 30% of the population used these community interventions which are actually reaching the poorest (particularly the HBC), it is imperative to increase the appropriate treatment given in both interventions if a reduction in mortality and morbidity of children under- five is desired. This means that a focus on quality of care is key. Some recommendations can be made based on the results described above to improve HBC performance. It seems that there is a problem with the availability and recognition of CBAs in the Northern Region. Districts should make more

efforts in monitoring CBAs and in replacing them if they are not actively working. The CBAs monthly reports and the district quarterly monitoring visits planned according to policy, might help to monitor HBC utilization and CBA performance. Ensuring the availability of drugs for the HBC and CHPS is another critical problem that must be addressed. Training and supervision will not be effective if drugs are not available. Once availability of CBAs and drugs are addressed, integrated supervision should always be promoted and coordinated (251).

7.3. Carers' disease knowledge and health behaviour

This study showed that exposure to both ice and CHPS health education messages were associated with disease knowledge and health behaviour, with health messages from CBAs being the predictor associated with a higher number of outcomes, particularly in the Northern Region.

Exposure to health messages from CBAs in the Northern Region were associated with the identification of at least 2 signs of severe malaria and pneumonia, the latter was also found to be associated with prompt care-seeking, and 2 practices that can cause diarrhoea. HBC utilization was associated with prompt care seeking behaviour in the Volta Region. CHPS were associated with the identification of at least 2 signs of severe diarrhoea in the Volta Region and with prompt care seeking behaviour in the Northern Region. Regarding other healthy behaviours, CBA messages had a borderline association with children under- five sleeping under mosquito nets in the Northern Region and with having an improved sanitation facility in the Volta Region. Even though, there are other study designs to better assess the effect of an intervention (such as RCT, quasi experimental studies and cohort studies), the numerous associations found between CBAs messages and disease knowledge and health behaviour after adjusting for known potential confounders suggest the plausibility of this findings.

HBC studies tend to focus more on the curative component than on the preventive component. However, the few studies that have reported on carers' disease knowledge also found increased carers' knowledge of signs of severe disease (88, 192-194). Studies evaluating the IMCI strategy considered the 3 components of the strategy, which are case management, supply chain and family practices. On the family practices component, carer's disease knowledge was also assessed in Bangladesh and Tanzania, concluding that carers in IMCI areas that perceived signs of severe disease were more likely to seek prompt treatment (52, 204). The preventive component of HBC and the family practices component (also called Community-IMCI) have many aspects in common. Actually, HBC in Burkina Faso, Malawi, Niger and Mozambique is also called community- IMCI. Peru and Brazil used community health workers to implement the community-IMCI in the same

way that HBC is implemented by community health workers. In the case of Ghana, HBC in its origins in the Northern Region was also called community- IMCI.

Results from this study contribute to evidence of the importance and the benefits of health communication. It also highlights the importance of including the preventive component in HBC evaluations which also contributes to its costs and to the impact on health outcomes. Integration of interventions could be beneficial: HBC is the ideal partner or delivery strategy for community-IMCI. HBC could help the facilities implementing IMCI to promote the household and family practices. This partnership could also benefit HBC as the communication between both (CBAs and nurses) might increase, bringing an opportunity for CBAs to be more recognised and to find more spaces to address the difficulties encountered implementing HBC, such us supply chain, availability of IEC materials or any challenge in case management or in reporting. Finally, and to increase integration and coordination of both community interventions, the Ghana Health Service could revise its organisation and consider one programme to be in charge of both iCCM and IMCI strategies.

7.4. HBC and CHPS cost analysis

This cost analysis has the same approach as the ex-post HTA that aim to assess an ongoing intervention to help policy makers decide to continue or discontinue it. Knowing the cost per case appropriately diagnosed and treated under programme conditions is critical when discussing about affordability and the long-term financing of HBC.

HBC in the Volta Region was found to be less costly than CHPS for the management of non-complicated malaria, diarrhoea and suspected pneumonia cases even after adjusting for different discount rates, different facility cost, different HBC and CHPS utilization and different HBC effectiveness (understood as number of children appropriately diagnosed and treated). Different HBC and CHPS utilization and different HBC effectiveness were the factors explored that most affected the cost, reducing or increasing it. Therefore, and as mentioned above, ensuring that CBAs are active and have a supply of drugs is a priority if one wants to ensure the affordability and sustainability of HBC.

Due to the low number of carers visiting a CBA in the Northern Region it was not possible to conduct the cost per case appropriately diagnosed and treated. However, the unit cost per case diagnosed and treated showed that a higher number of CBA combined with lower curative and preventive activity made the intervention more costly than the HBC in the Volta Region and than CHPS. However, household costs were lower under HBC than under CHPS in both regions, reducing the burden of health care cost on families.

7.5. Conclusions

The community was an important source of treatment for children with fever, diarrhoea and cough, contributing to an increased trend in care seeking behaviour when compared with previous surveys. However, the utilisation of HBC was almost non-existent in the Northern Region. HBC in the Volta Region was more used by the poorest and when households were far from a health facility. Appropriate treatment was low in both strategies and less than 50% of the sick children received appropriate treatment for malaria, diarrhoea and suspected pneumonia. Both HBC and CHPS had a positive influence in improving disease knowledge and healthy behaviour. However, this influence was higher for the HBC strategy, and higher in the Northern Region. The cost per case appropriately diagnosed and treated was lower under the HBC when compared with CHPS in the Volta Region. HBC unit costs to diagnose and treat a case in the Northern Region were higher than those in the Volta Region (and higher than CHPS), mainly due to higher number of CBA performing less preventive and curative activities. However, household costs were lower under HBC than under CHPS in both regions, reducing the burden of health care cost on families.

These findings have different programme and policy implications. From a programme perspective, several actions should be undertaken to improve HBC and CHPS performance. Availability of drugs and availability of CBAs (particularly in the Northern Region) seem to be the main challenges that need to be urgently addressed. Secondly, the low HBC preventive activity found in the Northern Region should be addressed and increased to maintain the positive effect of the preventive component.

From a policy perspective and with regards to the long- term financing of HBC, it seems that there are reasons to justify the financial support of the HBC strategy- even if it is more costly than CHPS- based on the different benefits that I already mentioned. The contribution of HBC to equity, reduced household costs, disease knowledge and healthy behaviours may justify the inclusion of HBC (preventive and curative services) in the NHIS benefit package. A revision of the NHIS benefit package to assess the affordability of HBC and an acceptability study of including HBC in the NHIS should be the next steps to evaluate.

Finally, it is important to be aware that the utilization of HBC to obtain treatment might be reduced with the improvement in CHPS coverage or with carers' preference for CHPS services. In this scenario, and acknowledging the results of the preventive component, HBC could focus on the

preventive component, becoming a strategy to promote healthy community and family practices without providing treatment. In other words, HBC would remain as implementer of the community -IMCI. The close relationship between HBC and community-IMCI and the need for coordination made obvious the next recommendation: a revision of the Ghana Health Service organogram, assigning the HBC and CHPS strategies under the same umbrella.

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Annex 1. Summary of studies showing Malaria Home- based Care effect on under- five morbidity and mortality.

Systematic review 2007. Studies with presumptive treatment with chloroquine. Inclusion criteria: (i) antimalarial treatment administered presumptively; (ii) administered by local community members; (iii) outcomes measures were specific health indicators; (iv) Africa.

Country/ Year/ Study design and duration/ Data collection	Epidemiology	Drug distribution	Incentive	Outcomes measured	Results
Kenya, 1987 (252) Before and after study with control (1 year): Health demographic surveillance and parasitemia/antibodies surveys	• Rural • Hyper- to holo-endemic	Community Health Workers (CHWs) provided presumptive chloroquine (CQ) treatment for free	Volunteer CHWs supported by the village	•Overall and malaria-specific mortality • Birth and fertility rates • Parasite rates	No obvious effect of providing CQ for treatment of malaria on mortality, fertility, or parasite rates
The Gambia, 1988(69); Before and after study with control (5 years): Health demographic surveillance and parasitemia/hemogram surveys	• Rural • Seasonal Transmission	CHWs sold CQ alone versus CQ with chemoprophylaxis for presumptive Treatment	Volunteer CHWs supported by the village	• Overall and malaria-related mortality • Frequency of clinical malaria • Packed cell volume, parasite rates, splenomegaly	Treatment alone had no significant effect on morbidity and mortality from malaria
Zaire (DRC), 1996 (253) Before and after study with control (2 years): Health demographic surveillance and parasitemia surveys	• Rural • Meso-endemic • Continuous transmission with seasonal fluctuations	CHWs sold CQ at cost for presumptive treatment	CHWs received "symbolic monetary reward"	• Malaria mortality • Malaria incidence and prevalence • Proportion of fever episodes receiving antimalarial treatment	• No impact on malaria mortality, but two-fold reduction in malaria prevalence and incidence. • Number of malaria episodes that remained untreated decreased significantly by 7% points.
Burkina Faso, 1997 (242) Before and after study without control (2 years): HHsurveys, Health Facility registers	• Rural • Seasonal transmission	• CHWs sold pre-packaged CQ for presumptive treatment	CHWs kept US$0.6 for each package sold	• HBC utilization •% of under-5 severe malaria cases recorded in health facilities. • Availability of drugs at peripheral level	• 76% went to CHW. • The % of severe cases decreased in the first year of the program; in the second year, the proportion decreased only in health facilities with drug coverage ≥50%. • 51.2% health facility drug coverage.
Ethiopia, 2000 (254). RCT (2 years): health demographic surveillance	• Rural • Seasonal transmission	Mother coordinators provided presumptive CQ treatment for free	None mentioned	Malaria-related mortality in children under 5 years old	Intervention associated with 40.6% reduction in overall under-5 mortality (95%CI 29.2–50.6, $p < 0.003$).
Burkina Faso, 2003 (126) Post study without control (2 years): HHsurveys	• Rural • Hyperendemic • Seasonal transmission	• Mothers trained to recognize illness and make decision to treat • CHWs sold CQ for presumptive treatment	• Drugs sold with 10% incentive margin for CHW. • Incentive provided to some drug store managers.	• Proportion of malaria cases progressing to severe • Prompt treatment •Appropriate dose	• Risk of progression to severe malaria was lower in children treated promptly with pre-packaged CQ (5%) than not treated (11%); (RR 0.47, 95%CI: 0.37– 0.60, $p < 0.0001$) • 56% prompt treatment • 52% appropriate dose

Systematic review 2013. Studies with presumptive treatment with chloroquine, SP, ACT or after a positive RDT. Inclusion criteria: RCT and non-RCT (controlled before-after studies and interrupted –time-series) that evaluated the effects of HBC.					
Kenya, 1987. Before and after study with control	Included in the first systematic review				
Zaire (DRC), 1996 Before and after study with control	Included in the first systematic review				
Ethiopia, 2000. RCT	Included in the first systematic review				
Burkina Faso, 2008 (243) RCT (2 years): Community drug distributers (CDD) registers and HH surveys	• Rural • Holoendemic • Seasonal transmission	Women leaders sold CQ	Not mentioned	• Anaemia prevalence • Appropriate treatment	• No effect on anaemia prevalence. • Increase in treatment from 36.9% to 86% (p=0.002) in intervention group. P=0.71 in control group.
Uganda, 2007 (127). Before and after study with control (2 years); HHsurvey	Rural Malaria transmission from holoendemic to hyperendemic	CHWs giving pre-packaged CQ/Sulphadoxine-Pyrimethamine (SP) for free	Not mentioned	• Appropriate treatment • Prompt treatment. • Proportion of fevers treated with adequate dosage of antimalarials • Proportion of fevers treated with adequate duration of antimalarials	• Improvement in the proportion of patients completing all steps: treated, treated within 24 h of illness onset, treated with the recommended antimalarials, treated at an adequate dosage and treated for the correct duration. In global, 10.4% improvement in the community effectiveness of malaria treatment
Uganda, 2009 (170) Cluster RCT (2 years): HHsurveys	Urban Meso endemic, perennial	Caregivers giving ACT	Not mentioned	• Proportion of fevers receiving any antimalarial • Proportion of fevers that received prompt and effective treatment. • Prevalence of parasitemia • Prevalence of anaemia • Mortality	• 97% versus 42% in the intervention and control (p<0.0001) received any antimalarial. • 58% versus 8% % in the intervention and control (p<0.0001) received prompt and effective treatment. • 2% versus 10% parasitemia prevalence in the intervention and control (p<0.006). • No differences in anaemia • Not possible to assess mortality
Tanzania, 2010 (255) Cluster RCT (1 year): HH surveys	• Rural • Holoendemic • Seasonal transmission	CHWs and women leaders giving SP for free	Women leaders were paid US$20 per month	Anaemia prevalence	Decrease in anaemia prevalence slightly more in the intervention (from 43.9% to 0.8%) than in the control (30.8% to 0.17%) group (p=0.038).
Tanzania, 2011(171) Cluster RCT (6 months): CDD	• Rural • High malaria	CHWs with RDT and ACT for free versus	US$15 per month	• Proportion of fever treated (using RDT or	• ACT was provided to 53.2% patients during RDT weeks and to

registers with lab test.	endemicity • Seasonal transmission	ACT for clinical diagnosis (CD)		clinical diagnosis) with ACT •Mortality	96.5% patients during CD weeks (OR 0.039, 95%CI 0.029–0.053). 99.3% of positive cases received appropriate treatment. •No mortality observed due to negative RDT
Zambia, 2010 (167). Cluster RCT (1 year): CDD registers, HH surveys.	Rural Hyper endemic Seasonal transmission	CHWs doing RDT and giving ACT and amoxicillin for free compared to CHWs giving ACT with CD and amoxicillin	Not mentioned	• Appropriate treatment • Mortality	• 27.5% and 99.1% of children with fever received appropriate treatment in the intervention and control arm (RR 0.23, 95%CI 0.14–0.38). 68.2% and 13.3% of children classified with non-severe pneumonia received early appropriate treatment in the intervention and control arm (RR 5.32, 95%CI 2.19–8.94). • No power to detect effect on mortality.
Kenya, 2011(34) Cluster RCT (1.5year) HH surveys.	• Rural • High malaria endemicity	Retail outlet staff giving subsidized ACT	Same salary they were having	• % of children with fever that received AL • % of children with fever that receive AL within 24 hours	• Difference of 26.4% points between arms receiving AL ($p<0.05$). • Difference of 25% points between arms receiving AL in the first 24h ($p<0.05$).
Systematic review 2014. Studies were included if they involved evaluation of an intervention to introduce or improve community-based management. Inclusion criteria: (i) studies conducted in sub-Saharan Africa; (ii) From 2000; (iii) randomized controlled trials (RCT), clustered RCTs, pre-post studies with or without control, interrupted time series designs, qualitative and cost effectiveness studies. Only studies reporting performance are included in this table.					
Ethiopia, 2000 RCT	Included in the first and second systematic review				
Kenya, 2001(248). Post study without control (3 years): observation.	Rural	CHW provided cotrimoxazole, SP and ORS		Appropriate treatment	% of children receiving an antibiotic, antimalarial or oral rehydration solution, depending on the child's disease classifications) were 57.8%, 35.5%, and 38.9%, respectively, for children with a severe classification
Burkina Faso, 2003	Included in first systematic review				
Mali, 2003 (192) Cluster RCT (1 year): additional training and IEC materials to improve performance. HHsurvey and CDD registries.	Rural	CHW distribute CQ		•Disease knowledge •Counselling •Appropriate treatment •Compliance with	• Fever more than 1 day and convulsions more often recognised as severe signs in the intervention group ($p<0.001$). • 82% and 57% of carers knew how to administer the drug in the intervention and control group. • 59% and 48% ($p<0.05$) gave

				referrals	appropriate treatment in the intervention and control group. • 64% and 86% complied with referrals in the intervention and control group.
Uganda, 2004(193) Before- after with control (1 year): household survey, health facility survey and CDD registers.	Rural High malaria endemicity	CHW distribute CQ/SP	Not mentioned	•Disease knowledge. •Use of ITN •Prevalence of malaria •Prevalence of anaemia •HBC utilization •Prompt care seeking •Counselling received •Appropriate treatment	• 45% versus 22% (p<0.5) recognise convulsions as sign to seek care immediately in intervention and control arm. • Increase in used of ITN in intervention areas from 2002 to 2003 (p < 0.01). • 10% point reduction in malaria prevalence (p>0.05) in intervention group. • Decline in severe anaemia levels in the interventions areas (p<0.01) • 21% HBC utilization in intervention areas • No differences between groups • No differences between groups • 37% and 7% of sick children received treatment in the intervention and control group
Ghana, 2006(84) Before-after without control (less than 1 year): FGD, survey, CMD registers.	Rural High malaria endemicity	CHW distribute ACT	Not mentioned	•Promptness in seeking care •Appropriate treatment •Seeking care elsewhere after HBC	• 89.5% sought care after 1 day of symptoms. •92% of sick children visiting HBC received appropriate dose. • 3.9% sought care elsewhere.
Uganda, 2006(256) Post study without control (5 months): CDD registers and carers interview, health facility records.	Rural	CHW distribute CQ/SP	Not mentioned	• Promptness in seeking care • % referrals • Compliance with referrals	• 68% sought care promptly • 8% were referred • 87% complete referral
Uganda, 2007	Included in second systematic review				
Four African sites (Ghana, Nigeria and Uganda), 2008(87) Post study without control (1 year): survey, CDD registers, focus group discussions (FGD) and interviews.	Rural and urban High malaria endemicity	CHW distribute ACT	Between US$4.5-8 every quarter.	• HBC utilization • Appropriate treatment • Prompt treatment	Average results from the 4 sites: • 59% of carers with sick children used HBC • 85% of those receiving ACT from HBC received correct dose and duration.

					• 90% of those receiving ACT from HBC were promptly treated.
Burkina Faso, 2008(243)	Included in the second systematic review				
Rwanda, 2008(246) Post study without control (1 year): CDD survey, FGD, observation, exit interviews, simulation clients, interviews.	Rural Endemic and non-endemic areas	CHW distribute ACT	Revenues from sales	•Referrals with form •Appropriate treatment •Carers advice •Carers satisfaction	• 70% • 92% received appropriate dose • High in how to take the drug, lower in when to come back • 7% dis-satisfied
Sudan, 2008(257) Before- after study without control (8 months): household survey, FGD, interviews and CDD registers.	Rural Hypo to meso-endemic malaria prevalence	CHW distribute ACT with RDT	Consultation fee of US$0.5	•Treatment seeking behaviour. •Appropriate treatment •Use of preventive measures	• 83.3% and 100% of the mothers sought treatment for their febrile child at the beginning and at the end of the study (p=0.099) • 70% treated accordingly to RDT results • 65% of CHW carried out awareness activities.
Zambia, 2008(258) Post study with control (different type of RDT instructions) (3h): observation.	Rural Endemic malaria prevalence	CHW distribute ACT with RDT	Not mentioned	•RDT performance •RDT interpretation	• 57%, 80% and 90% of CHW that received only instruction, job-aid and job-aid plus training respectively performed the 16 steps correctly (p<0.05). • 54%, 82% and 93% of CHW that received only instruction, job-aid and job-aid plus training respectively read RDT results correctly (p<0.05).
Cameroon, Nigeria and Uganda, 2008(259). Post study with control (3 years): Quantitative and qualitative methods including surveys.	Rural High endemicity	ACT in Cameroon and Nigeria and CQ-SP in Uganda		•Prompt appropriate treatment •Having ITN and sleeping under ITN • Children receiving Vit A •Population receiving ivermectin •DOTS completion rate	• 69% and 16.4% of sick children received prompt treatment in the intervention and control group (p<0.05). • 33.4% and 16% of children under 5 slept under mosquito nets in the intervention and control group (p<0.05). • 90% and 81% Vit A coverage in the intervention and control group (p=0.01). • 73.7% and 63.8%of population receiving ivermectin in the intervention and control group (p<0.5). • No significant differences: 87.6%

					and 90% DOTS completion rate in the intervention and control group.
Rwanda, 2009(247). Post study without control (3 months): CDD registers, observation, interviews.	Rural	CHW distribute ACT, ORS and Amoxicillin		•Appropriate treatment	• 84.8%, 72.1% and 79% of children with fever, diarrhoea and pneumonia received appropriate treatment.
DR Congo, 2009(260). Post study without control (1 week): test and observation.	Rural High malaria endemicity	CHW distribute ACT with RDT	% profit of activities	•RDT performance •RDT cost effectiveness	• Median of 100% performed and interpreted correctly the test. • Because malaria prevalence was high (87% with RDT and 88% with microscopy), RDT were not cost-effective.
Uganda, 2009	Included in second systematic review				
Tanzania, 2010. Cluster RCT	Included in the second systematic review				
Ethiopia, 2010(91) Before- after with control group (2 years): CDD registers, health facility registers and HH survey.	Hypoendemic Rural and urban	CHW distribute ACT with RDT and without RDT	Not mentioned	• Malaria prevalence • All-cause mortality • Malaria mortality	• Lower malaria prevalence in intervention group (7.4% (95% CI: 6.1–8.9%) versus 20.8% (95% CI: 18.7–23.0%) in the control group. • No difference in both groups (RR= 1.03, 95%CI 0.87–1.21, P = 0.751). • Lower mortality in intervention (RR 0.60, 95%CI 0.40–0.90, P = 0.013).
Zambia, 2010(167) Cluster RCT	Included in second systematic review				
Five African sites (Ghana, Burkina Faso, Ethiopia and Malawi), 2011(88) Before- after without control (1 year): Survey, CDD registers, FGD and interviews	Urban High malaria endemicity	CHW distribute ACT, 2 sites with RDT	Not mentioned	•Malaria signs knowledge •HBC utilization •Appropriate treatment •Prompt treatment	Average results from the 5 sites: • 3/5 sites improved in disease knowledge • 40% of carers with sick children used HBC • 82% of sick children visiting HBC received ACT • 69% of those receiving ACT from HBC were promptly treated
Zambia, 2011(98) Cost effective analysis, HBC versus health facility-based (1 year): CDD and facility registers	Rural Moderate malaria transmission	CHW distribute ACT with RDT	Not mentioned	•Appropriate treatment (ICER reported in table 2)	•100% in HBC and 43% in health facility-based
Tanzania, 2011(261) Post study without controls (1	Rural High malaria	CHW distribute ACT with RDT	Not mentioned	• Parasite cure rate (using PCR)	• PCR corrected parasitological cure rate by day 42 was 93.0% (95%CI

year): CDD registers and parasitological cure rate	endemicity			• AL blood levels	88.3%-95.9%). • Median AL concentration was statistically significantly lower in patients with recrudescence (97 ng/mL [IQR 0-234]; n = 10) compared with reinfections (205 ng/mL [114-390]; n = 92), or no parasite reappearance (217 [121-374] ng/mL; n = 70; p ≤ 0.046).
Tanzania, 2011(262) Post study, no control (children visiting CHW, 4.5 years) and HH survey (3 years)	Rural	CHW distribute ACT with RDT		•RDT sensitivity and specificity •Pre and post RDT appropriate treatment	• 88.6% and 88.2% sensitivity and specificity of RDTs in the cohort study. 63.4% and 94.3% in the HH survey. • 98.6% and 96.6% of children received appropriate treatment.
Tanzania, 2011.	Included in second systematic review				
Sierra Leone, 2011(263) Post study without control (2 years): CDD and HF registers	Rural High malaria endemicity	CHW distribute ACT with RDT	Not clear	•Compliance with referrals	•1.5% referral completion rate
Zambia, 2012(264) Post study without controls (1 year): observation	Rural	CHW distribute ACT with RDT		• RDT performance • RDT interpretation	• 88% performed correctly the 8 steps at 3-month post training and 100% at 6 and 12 months. • 96.5% of positive tests were correctly identified at 3 months, 98.3% at 6 months and 90.5% at 12 months.
Senegal, 2012(92) Before after with controls (1 year): CDD registers and routine data	Rural High malaria endemicity	CHW distribute ACT with RDT	Non-monetary incentives	• Appropriate treatment •All cause child mortality • Malaria mortality	• 96.6% of + tests were treated and cured. • Significant decrease in intervention area (-5.4%, 95%CI -25.4, -5.4). • Significant decrease in intervention area (-62.5%, 95%CI −81.2, -43.8).
Ghana, 2012(86) Cluster RCT (3 years): health demographic surveillance, parasitemia surveys	Rural Moderate malaria prevalence	CHW distribute ACT or ACT+Amoxicillin	Non-monetary incentives	•Child mortality	• Mortality reduced significantly by 30% (RR = 0.70, 95% CI 0.53–0.92, P = 0.01) in AAQ clusters and by 44% (RR = 0.56, 95% CI 0.41–0.76, P = 0.01) in AAQ+AMX. Differences in mortality between AAQ and AAQ+AMX not significant: RR = 0.79, 95% CI = 0.56–1.12, P = 0.195.

Malawi, 2012(265) Post study without control (18months): observation, gold standard re-assessment and exit interviews.	Rural	CHW distribute ACT, ORS and Amoxicillin		•Appropriate classification •Appropriate treatment •Referrals •Stock out of drugs •Supervision received •Adequate counselling	• 92.5% correctly assessed and classified as malaria and 79.3% correctly treated; 51.7% correctly A &C as pneumonia and correctly treated; 90.3% correctly A&C as diarrhoea and 68.8% correctly treated. • 55% with danger signs were referred. • 69% had all essential drugs. • 38% received supervision in previous 3 months. • 81% of carers knew how to take drugs.
Uganda, 2012(244) Cluster RCT (2 years): survey, CDD registers, observation, follow up children and FGD.	Rural	CHW distribute ACT or ACT+ Amoxicillin	Not mentioned	• Appropriate treatment •Equity	• 100% of febrile children received AL in the AL only group and 98.5% in the AL+AMX group. 81.7%of children with fast breathing received AMX. 12% of children without fast breathing received AMX. • Poorest quintiles used more HBC than least poor.
Burkina Faso, Ghana, and Uganda, 2012(245). Cluster RCT, intervention arm: RDT and ARI timers; control arm: clinical diagnosis (1 year). CDD registers.	Rural High malaria endemicity with (minimal) seasonal malaria transmission	CHW (and community nurses in Ghana) distribute ACT with RDT and Amoxicillin or cotrimoxazole with ARI timers.	Community nurses in Ghana have salary.	• Appropriate treatment •Fever clearance	• Compliance with RDT results was high across the three countries. Only 4.9% RDT-negative children received an ACT. Antibiotic overuse was more common: 0.9% in Uganda, 38.5% in Burkina Faso, and 44.6% in Ghana. • Fever clearance was high in both arms (97.8% versus 96.9%, P = 0.17 in day 3).

Annex 2. Summary of studies on Malaria Home- based Care Cost- effectiveness

Country/ Year/ Study design	Epidemiology	Drug distribution/ intervention	Outcomes measured	Results
Kenya, 2006 (97) Before-after study	Rural Stable and endemic malaria transmission	Training of shopkeepers on the use of CQ versus no training	• Cost per additional febrile episode treated • Cost per DALY averted	• ICER: US$4 • ICER <US$18.38
Uganda, 2010 (96) Markov model	Adjustment for different transmission	CHW versus standard care (mid-size hospital). Adjustment for different drugs; CQ+SP, AQ+AS, AL and DP	• Cost per DALY averted	Cost effective in: • High transmission areas. • Medium transmission areas if access to care is low. • Low transmission areas only if no access to care.
Zambia, 2011 (98) Before-after study	Rural Moderate transmission	CHW using RDT and ACT versus standard care (low-size health facility)	• Cost per additional febrile episode treated •	• ICER: US$4.18
Ghana, 2012 (95) Cluster RCT	Rural Endemic	CHW using ACT alone or in combination with Amoxicillin versus standard care (low/mid-size health facility). Cost of treating a malaria case at the primary care was not measured.	• Cost per DALY averted	• ICER using ACT alone: US$90.25 • ICER using ACT +Amoxicillin: US$114.21

Annex 3. Summary of studies showing Diarrhoea and Pneumonia Home- based Care effect on under- five morbidity and mortality

Country/ Year/ Study design and duration/ Data collection	Drug distribution/ intervention	Outcomes measured	Results
Systematic review 1992. Inclusion criteria: (i) intervention studies on community case management of pneumonia; (ii) studies reporting on under- five mortality.			
Tanzania, 1986 (266) Cluster RCT (2 years. In the second year the control group became Intervention): HH surveys	CHW provide co-trimoxazole	• Child Mortality • Pneumonia specific child mortality	• Overall mortality rate reduced from 40/1000 to 35/1000 and from 32.4/1000 to 29.2/1000 in the control and in the intervention group (no statistical significance). • Pneumonia specific child mortality reduced by 30.1% (p value not given).
India, 1987 (267) Post study with controls (study duration not specified- from birth to first year of age): Demographic surveillance and verbal autopsy	**Primary health care staff provided oral penicillin for pneumonia** in low-birth-weight infants. CHW sensitized the community and collected information.	• Seeking care • Infant Mortality • Pneumonia specific infant mortality • Case fatality rate	• 15.1% and 13% of carers of low-birth weight infants in the control and intervention group did not seek care when child had mild symptoms. • Overall Infant Mortality was 210/1000 and 275/1000 in the intervention and control group (95%CI and P value not given). • Pneumonia specific infant mortality was 30/1000 and 71/1000 in the intervention and control group. (95%CI and P value not given). • Pneumonia case fatality rate was 8.7% and 24.6% in the intervention and control group ($p<0.05$).
Nepal, 1989 (268) Before-after without control (baseline and 3 years after): Demographic surveillance and verbal autopsy.	CHW provide ampicillin (first line) and chloramphenicol (second line). CHW provide ORS for diarrhoea	• Child Mortality	• Pneumonia specific mortality reduced by 59% in year 1 and a further reduction of 25% between year 1 and 2 ($p<0.01$ if intervention years 1 and 2 are combined).
Pakistan, 1990 (269) Before-after with control (baseline and 3 years after). Control group became intervention in last year. Demographic surveillance and verbal autopsy	CHW provide IM procaine Penicillin or co-trimoxazole	• Child Mortality • Pneumonia specific child/infant mortality	• Difference in overall mortality at the end of the intervention between the intervention and control group was 26% ($p<0.01$). (However, baselines were different). • Reduction in pneumonia related child mortality by 55% ($p=0.06$) in control group when became intervention group. • Reduction in pneumonia related infant mortality by 47% ($p=0.12$) in control group when became intervention group.
India, 1990 (270) Before- after with control (baseline and 1 year after). Demographic surveillance, verbal autopsy and HH survey,	CHW provide co-trimoxazole	• Appropriate treatment • Child Mortality • Pneumonia specific child mortality	• Overtreatment in under one years- or cases misclassified- (146% cases treated) and 53% of cases between 1-4 years treated. • Difference in overall infant and child mortality at the end of the study between the intervention and control group was 27% and 30% respectively ($p<0.001$), (for the period 1987-1989?). • Difference in child mortality at the end of the study between the intervention and control group was 54% ($p<0.001$), (for the period 1987-1989?).

Bangladesh, 1992 (271) Before-after with controls (2 years before and 2 years after). Demographic surveillance and verbal autopsy	CHW provide IM procaine penicillin	• Child Mortality • Pneumonia specific child mortality	• Pneumonia specific child mortality reduced by 32% ($p<0.05$) in the intervention area and by 6% ($p>0.05$) in the control area.
Systematic review 2003. Inclusion criteria: (i) intervention studies on community case management of pneumonia; (ii) studies reporting on under- five mortality and (iii) Having a control group.			
India, 1978 (272) Before-after with control (1 year before and 3.5 years after). Longitudinal HH surveys	**Family health workers (not specified if nurse or CHW**) provides vaccine, treatment (not specified) and nutrition services	• Infant mortality • Child mortality	• Differences in infant mortality rate between the intervention were lower than in the control group for the period 1970-1973 ($p=0.005$). • Differences in mortality rate in the 2nd and 3rd year of life was lower in the intervention group than in the control group for the period 1970-1973 ($p=0.025$).
Tanzania, 1986	Included in first systematic review		
Pakistan, 1990	Included in first systematic review		
Philippines, 1998 (273) Before-after study with control: Demographic surveillance and verbal autopsy	**Midwife provide treatment**	• Child Mortality	• Overall child mortality rate reduced by 13% and 10% and overall infant mortality rate reduced by 20% and 0% from baseline to end of project in the intervention and in the control group (p value not available). • Pneumonia specific mortality rate in under-5 reduced by 28% and 10% ($p=0.07$) and Pneumonia specific infant mortality reduced by 30% and 1% from baseline to end of project in the intervention and in the control group (p value not available).
India, 1990	Included in first systematic review		
Nepal, 1991 (274) Before- After study (3 Years). Control group became intervention in 2nd year. Demographic surveillance and verbal autopsy. HH survey	CHW provide co-trimoxazole as first line and chloramphenicol as second line.	• Appropriate diagnosis and treatment. • Child Mortality	• 80% of children were appropriately diagnosed and treated. • Overall child mortality rate reduction between baseline and third year: RR= 0.72 (95% CI 0.63, 0.82, $p=0.02$).
Bangladesh, 1992	Included in first systematic review		
Nepal, 1989	Included in first systematic review. Not included in the meta-analysis (no control)		
Indonesia, 1998 (275) Before-after **without control** (baseline and 2 years after). Demographic surveillance and verbal autopsy. HH survey	CHW provide ARI treatment (not specified)	• Care seeking behaviour. • Child Mortality • Pneumonia specific infant mortality	• Reduction in seeking care from traditional healers from 52.3% to 39.5%. • Child Mortality reduced by 67% after 2 years of intervention. • Pneumonia specific infant mortality reduced by 60% after 2 years of intervention.
Systematic review 2010. Inclusion criteria: (i) RCTs, Cluster RCT, quasi-experimental studies and observational studies; (ii) pneumonia mortality and other pneumonia related outcomes; (iii) control arm; (iv) clear definition of pneumonia.			
Tanzania, 1986	Included in first and second systematic review		

Nepal, 1989	Included in first systematic review		
India, 1990	Included in first and second systematic review		
Pakistan, 1990	Included in first and second systematic review		
India, 1991(276) Before-after with controls (baseline and 2 years after). Demographic surveillance and verbal autopsy.	CHW provide amoxicillin or co-trimoxazole (plus vaccination and education).	• Appropriate treatment • Child Mortality • Pneumonia specific infant mortality	• Appropriate treatment was 57% and 23% for moderate and severe pneumonia. • Child Mortality was higher in the intervention group than in the control group at the beginning of the study ($p<0.05$) and were similar at the end of the study ($p>0.05$). **Possibly due to measles vaccine** • No statistical differences in Pneumonia specific child mortality
Nepal, 1991	Included in second systematic review		
Bangladesh, 1992	Included in first and second systematic review		
India, 1993 (277) Before- after without control. 3 years. Demographic surveillance and verbal autopsy.	CHW and medical officer were trained to provide Ampicillin and sulphametoxazol	• Pneumonia specific child mortality	• Reductions in pneumonia specific child mortality: RR=0.78, 95%CI 0.38, 1.59.
Philippines, 1998	Included in second systematic review		
Systematic review 2013. Inclusion criteria: (i) RCTs, Cluster RCT, quasi-experimental studies and observational studies; (ii) care seeking, uptake of treatment and pneumonia/diarrhoea and all cause of child mortality; (iii) clear definition of pneumonia and diarrhoea.			
On Pneumonia			
India, 1978	Included in second review		
Tanzania, 1986	Included in all previous reviews		
India, 1987	Included in first review		
Nepal, 1989	Included in first and third reviews		
India, 1993	Included in 3rd systematic review		
China and Fiji, 1995 (278) Post study without controls. Demographic surveillance and records. 3 years	Training of doctors and education of mothers	• Prompt care seeking behaviour if pneumonia symptoms • Use of antibiotics if pneumonia • Pneumonia specific child mortality	• Increased by 75% • Almost 100% • Reductions in infant and child mortality rate ($p<0.05$)
Malaysia, 1996 (279) RCT, HH surveys, 1 year	Mothers trained in identifying signs of disease and seeking care (and health workers received training on management as well)	• Incidence of severe pneumonia. • Pneumonia specific child mortality	• Higher reductions on incidence of severe pneumonia in the intervention group ($p<0.05$)

Bangladesh, 2001 (280) Before-after with control. Demographic surveillance, GIS. 5 years	CHW were trained to provide treatment (not specified which one)	• Under 2 years old pneumonia related mortality	• Under 2 mortality was 54% lower in the interventions area (although characteristics between intervention and control area were different).
Bangladesh, 2009 (196) CRT, 7 years (2 before and 5 after). HH census and periodic HH surveys	**IMCI strategy: CHW provide IEC messages and health facility staff provided treatment**	• Child Mortality • Child pneumonia related mortality	• Reductions in child mortality by 13.4% (95%CI -14.2, 34.3) in the intervention group. • Increase in pneumonia related child mortality: RR 1.26 (95%CI 0.28 1.94) in the intervention group
India, 1990	Included in all previous reviews		
Nepal, 1991	Included in all previous reviews		
India, 1991	Included in third review		
Bangladesh, 1992	Included in all previous reviews		
Pakistan, 1990	Included in all previous reviews		
Philippines, 1998	Included in 2nd and 3rd review		
Zambia, 2010	Included in Annex 1. 68.2% of children classified with non-severe pneumonia in the intervention arm (using ARI timers) and 13.3% in the control arm (without ARI timers) received early and appropriate treatment (RR 5.32, 95%CI 2.19–8.94). No enough power to detect an effect on mortality.		
Pakistan, 2012 (281) Cluster RCT, Census, community registries. 2 years	Lady health workers (community nurses) provide Amoxicillin for 5 days versus one dose of another antibiotic and referral	• Treatment failure	• Risk difference treatment failure was -5.2% 995%CI-13.7%, 3.3%)
On diarrhoea			
India, 1987 (282) Before-after with control. HH surveys. 2 years	Nurses and CHW provide ORS	• Case-fatality rates	• Lower in intervention areas (p=0.01)
Thailand, 1988 (283) Before-after with control. HH survey. 7 months	CHW provide ORS	• Knowledge of ORS • Use of ORS	• Knowledge of ORS increased in intervention area by 88.7% (34.4% in control group) • Use of ORS increased in intervention area by 74.4% (16.3 in the control group)
Nepal, 1989	CHW provide ORS	• Child diarrhoea related mortality	• Reduction in diarrhoea related child mortality: RR 0.26 (95%CI 0.07 0.91) after the intervention.
Bangladesh, 2004 (284) Cluster RCT, HH survey. 2 years	CHW provide ORS+zinc versus ORS	• Use of ORS • Use of antibiotics • Seeking care elsewhere	• 75% and 50% use of ORS in the intervention and control arm (p<0.05) • 13% versus 34% use of antibiotics in the intervention and control arm (p<0.05) • Lower seeking care elsewhere in the intervention group (p<0.05)
Mali, 2006 (285) Before-after with controls. HH survey, 2 years	CHW and government prescribing zinc versus only government prescribing zinc	• Use of zinc	Efforts needed on integration of interventions

Mozambique, 2007 (286) Before-after, without control Census, registers. 3 years	CHW provide health education (+ other components of the IMCI strategy)	• Infant and Child mortality • Care seeking behaviour • Use of ORS • Vaccination, breastfeeding knowledges…	• Infant and Child mortality higher reduce in the intervention area compared to national and provincial data • Improved ORS •Improved family and community practices
India, 2008 (287) Cluster RCT, HH surveys, 1 year	CHW and government given ORS+zinc versus ORS	• Use of ORS • Use of antibiotics • Seeking care elsewhere • Diarrhoea prevalence	• Higher use of ORS in the intervention arm • Lower use of antibiotics in the intervention) • Lower seeking care elsewhere in the intervention group • Lower diarrhoea prevalence in the intervention group
Bangladesh, 2009 (196) CRT, 7 years (2 before and 5 after). HH census and periodic HH surveys	**IMCI strategy: CHW provide IEC messages and health facility staff provided treatment**	• Child Mortality • Child diarrhoea related mortality	• Reductions in child mortality by 13.4% (95%CI -14.2, 34.3) in the intervention group. • Increase in pneumonia related child mortality: RR 0.56 (95%CI 0.15 2.11) in the intervention group
Systematic review 2015. Inclusion criteria: (i) RCTs, Cluster RCT, quasi-experimental studies and observational studies; (ii) CHW received shorter professional training than professional workers, (iii) CHW provide treatment, (iv) children 1-59 months, (v) outcome could be mortality, CHW performance or impact on knowledge and (vi) conducted in Africa			
Tanzania, 1986 (288)	Included in previous reviews		
The Gambia, 1990(289) Before-after with controls (1 year before and 3 years after): verbal autopsy, clinical survey of cohort of children	Primary health care	• Child Mortality	• No differences
Kenya, 2001	Included in systematic review 2014, Annex 1 Only 58% of child received appropriate treatment		
Senegal, 2007 (290) Post study without controls (1 year). CDD registers	CHW provide Cotrimoxazole	• Child classification •Appropriate treatment	• 92 % of children were correctly classified. • 97.7 % of suspected pneumonia were appropriately treated; 88% of severe pneumonias were referred; 88% of cases were follow up on the 3rd or 4th day.
Ethiopia, 2006 (194) Post study without controls: surveys (9 years), registers, interviews, FGD and simulation cases (1 year)	CHW provide cotrimoxazole, CQ-SP, tetracycline eye ointment; ORS; paracetamol; vitamin A	• Carers Knowledge • Child management	• 39% and 92% of carers recognised fast or difficult breathing as signs of pneumonia in 1997 and 2006. 94% knew at least two childhood danger signs in 2006. Seeking care for cough and difficult or rapid breathing increased from 30% in 1997to 84% in 2006. • 32/40 CHW scored above 80%, and 24/32 scored above 90% on the management of the 3 diseases.
Uganda, 2006 (291) Post study without control (2nd day after training). Observation- CDD	Skills after training for diagnosing pneumonia	•Child classification	• 71% of the assessments were within ±5 breaths/min from the gold standard; The sensitivity of CHW classification was 75% and the specificity was

performance versus gold standard (mean rate between two researchers), FGD			83%.
Kenya, 2006, 2007 (249, 292, 293) Post study without control (5 years). CDD Registries and observation	CHW provide treatment for malaria, diarrhoea and suspected pneumonia (SP, ORS, co-trimoxazole and Vit A).	•Comparison between evaluation methods: hospital observations versus registries(293). • Appropriate treatment(249) •Factors associated with CHW adherence to guidelines(292).	• 34.3% and 50.7% of treatment error at hospital observation versus registries. Observation overestimate the quality of care provided: hospital minus community= -16.4 (95%CI -25.6, -7.1). • The longitudinal study (1997-2002) showed 79.4% of appropriate treatment. •In 2001, intervention-related factors (refresher training, supervision, CHW selection process, medicine supplies and guideline flipchart) was not associated with guideline adherence.
Zambia, 2010 (167)	Included in Annex 1. 68.2% of children classified with non-severe pneumonia in the intervention arm (using ARI timers) and 13.3% in the control arm (without ARI timers) received early and appropriate treatment (RR 5.32, 95%CI 2.19–8.94). No enough power to detect an effect on mortality.		
Uganda, 2011(294) Post study without control (3nd day after training). Part of a RCT(168, 245). Observation	Included in Annex 1. 96% of adequate use of timers and RDT. 87% adequate in classification. 96% with +RDT received antimalarials, 40% with fast breathing (gold standard) received antibiotic and 91% with both were prescribed both medications.		
Uganda, 2012(244)	Included in Annex 1. 100% of febrile children received ACT in the ACT only group and 98.5% in the ACT+ amoxicillin group. 81.7%of children with fast breathing received amoxicillin. 12% of children without fast breathing received amoxicillin. Poorest quintiles used more HBC than least poor		
Zambia, 2012(175). Part of RCT(167). Registries (1 year)	CHW distribute ACT and Amoxicillin using RDT	•Classification •Appropriate treatment •Stock of drugs •Adverse events •Resolved case	• 94–100% of cases appropriately classified. • Appropriate treatment in 94–100% of episodes. • Over 98% stocks of RDTs, amoxicillin, and • Minor adverse events. • Most febrile children (90%) with negative RDT results recovered after being treated with an antipyretic alone.

Annex 4. Sampling

Regions	Districts implementing HBC	First stage: 2 districts selected per area using PPS	Second stage: Four clusters per district selected using PPS
Northern Region	**East area**: Kpandai Nanumba South Nanumba North Zabzugu/ Tatali Yendi Gushiegu Saboba Cheperoni Bunkpurugu Yonyo East mamprusi	East Mamprusi Saboba	Dagbiribo-ari A Kolinvai A Samini A Gurugu Bubruni Kpalba Lower butune M-ninkondo
	Central area: East Gonja Tamale south Tamale central Tamale North Tolon Kumbugu Saveligu Nanton Karaga West Mamprusi	East Gonja Tolon Kumbugu	Kakrunji NbawdoNo.2 Water works Dabogshei Tolon Kpendua Zantani Zangbalun
	West area: West Gonja, Central Gonja, Bole, Sawla-Tuna-Kawla	Sawla- Tuna- Kalba Central Gonja	Gbinyiri Gurunyiri Kulmasa Soma Agunatupe Kopedeke Kpenjipe Morokura
Volta Region	**North area**: Krachi east and KrachiWest	Krachi east KrachiWest	Yariga 1 Ayisu Kra Ayirafie Battor Nansu Sabaja Onaninja Ankaase Nkenkyene
	Central area: Hohoe municipality Jasikan	Hohoe municipality Jasikan	Likpe Kukurantumi Alavanyo Agoxoe Fodome Amele Lolobi Ashambi Dzoku Oseikrom Gabusu village Apenkwa
	South area*: North Tongu, Akatsi, Keta Ketu North	Ketu North** North Tongu	Torfoe Tamekope Atitteti Agorvie Blah Venu kope MAFI ZONGO Mafi Atitekpo

Annex 5. Supporting data for Table 27. Effect and cost for malaria diagnosis and treatment under HBC and CHPS strategy in the Volta and the Northern Regions

MALARIA				
	Volta Region		Northern Region	
Variables	HBC	CHPS	HBC	CHPS
Number of eligible children for treatment	**75**	**47**	**6**	**197**
Number of non-complicated malaria cases	70	40	5	183
Number of non-complicated malaria cases treated with ACT	17	7	1	26
Number of non-complicated malaria cases treated with ACT or quinine	17	8	1	57
Number of non-complicated malaria cases treated with prompt ACT or quinine	12	1	1	43
Number of no malaria cases treated with antimalarial	1	1	0	3
Number of no malaria not treated with antimalarial	4	6	1	11
Number of cases treated according to protocol (ACT or quinine)	**21**	**14**	**2**	**68**
Number of cases treated according to protocol (prompt ACT or quinine)	**16**	**7**	**2**	**54**
% of cases treated according to protocol (ACT or quinine)	0.28	0.30	33.33	34.52
% of cases treated according to protocol (prompt ACT or quinine)	0.21	0.15	33.33	27.41
Cost per malaria treatment*	4.96	9.52	9.37	8.03

*Source: Table 26

Annex 6. Supporting data for Table 28. Effect and cost for diarrhoea diagnosis and treatment under HBC and CHPS strategy in the Volta and the Northern Regions

DIARRHOEA				
	Volta Region		Northern Region	
Variables	**HBC**	**CHPS**	**HBC**	**CHPS**
Number of eligible children for treatment	**90**	**61**	**8**	**228**
Number of diarrhoea cases	38	31	4	86
Number of diarrhoea cases treated with ORS (or referred)	4	6	1	8
Number of diarrhoea cases treated with zinc (or referred)	6	6	1	3
Number of diarrhoea cases treated with ORS and zinc	3	0	0	0
Number of no diarrhoea cases treated with ORS	3	1	0	8
Number of no diarrhoea cases treated with zinc	4	3	0	0
Number of no diarrhoea cases treated with ORS or zinc	7	4	0	8
Number of no diarrhoea cases not treated with ORS	49	29	4	134
Number of no diarrhoea cases not treated with zinc	48	27	4	142
Number of no diarrhoea cases not treated with ORS or zinc	46	26	4	134
Number of cases treated according to protocol (ORS and zinc)	49	26	4	134
Number of cases treated according to protocol (ORS)	53	35	5	142
Number of cases treated according to protocol (zinc)	54	33	5	145
% of cases treated according to protocol (ORS and zinc)	0.54	0.43	0.50	0.59
% of cases treated with ORS	0.59	0.57	0.63	0.62
% of cases treated with zinc	0.60	0.54	0.63	0.64
Cost per diarrhoea treatment (giving zinc or ORS)*	0.88	7.25	8.36	5.55

*Source: Table 26

Annex 7. Supporting data for Table 29. Effect and cost for suspected pneumonia diagnosis and treatment under HBC and CHPS strategy in the Volta and the Northern Regions

SUSPECTED PNEUMONIA				
	Volta Region		Northern Region	
Variables	HBC	CHPS	HBC	CHPS
Number of eligible children for treatment	**87**	**61**	**7**	**228**
Number of suspected pneumonia cases	25	9	1	15
Number of suspected pneumonia cases that received amoxicillin (or referred)	7	1	0	3
Number of suspected pneumonia cases that received amoxicillin or cotrimoxazole (or referred)	7	1	0	4
Number of no suspected pneumonia treated with amoxicillin or cotrimoxazole	6	9	0	50
Number of no suspected pneumonia not treated with amoxicillin or cotrimoxazole	56	43	6	163
Number of cases treated according to protocol	**63**	**44**	**6**	**167**
% of cases treated according to protocol	0.72	0.72	0.86	0.73
Cost per suspected pneumonia treatment*	1.33	7.45	8.50	6.73

*Source: Table 26

Annex 8. Household survey questionnaire

"ASSESSMENT OF THE MALARIA, DIARRHOEA AND PNEUMONIA HOME BASED CARE STRATEGY IN THE VOLTA AND NORTHERN REGIONS OF GHANA"

Household Survey

Questionnaire for caregivers of children under five

2014

The objective of this questionnaire is to collect information on the knowledge of caretakers about the existence of the HMMAD programme at the communities, its utilization and their satisfaction when using the programme.

Household ID: | | | | |

INFORMED CONSENT

Introduction and interview goal:

Good morning. My name is _____.

I work with the Ghana Health Service. We are here today to discuss your possible participation in a study that will help us improve the health of people in Ghana.

Malaria, diarrhoea and pneumonia are important causes of disease and deaths in your district. The Ghana Health Service started a programme called HOME BASED CARE to help you treat your child with fever and/or diarrhoea at the community, so you do not need to travel long distances and you can get good and quick treatment for your child. We would like to know how this HOME-BASED CARE programme is working at your community and understand how we can improve it so your kids are happy and healthy. For that, we are carrying out interviews with people that have a young child who was sick in the previous 2 weeks.

Procedures: Your participation in this study is entirely voluntary and no one will be penalized if you decide not to participate. If you are willing to participate, we will ask you a few questions on what you do to treat malaria, pneumonia and or diarrhoea. You are free to ask questions and to end this interview at any time. The interview will last approximately 15 to 20 minutes.

Risks: This study bears no risk for you or your family members. You may feel uneasy while explaining how you treat malaria, pneumonia and or diarrhoea. Don't worry, honest answers are important for us and will permit us to know how best the programme can help you to stop malaria, pneumonia and or diarrhoea affecting your child. Please remember that you do not have to answer any questions that make you feel uneasy.

Benefits: If you participate in this study, you will help us find ways to improve access and use of malaria, pneumonia and or diarrhoea treatment services and these interventions can ultimately be used to improve the health of the whole community.

Confidentiality: Any information discussed will remain strictly confidential. Your name and the name of your family will not appear anywhere. To keep your anonymity, we will use a code rather than your name. We will keep the records in closed files and only the survey personnel will have the permission to access them. Your name and other identifying information will not appear in this study's report. The results of this interview will be combined with those of at least 580 other respondents.

Right to refuse or to withdraw from the study: As previously stated, you are free to participate in the study or not. If you do participate, you are free to change your mind and decide not to participate further at any time. Your choice to participate in this interview or your refusal to answer some questions will not be told to others.

Contact Persons: At any moment, if you have questions concerning this study or if you think that this study has caused damage to you, you may contact Mrs. Hannah Frimpong (Tel: 0243235225) or Mrs. Abena Kwaa Addai-Donkoh, (Tel: 0244712919) from the Research and Development Division of the Ghana Health Service. Here is the telephone number to dial if you have any questions regarding your rights related to your participation in this study. *(Hand the interviewee the study manager's and ERC administrator names and telephone numbers).*

Do you want to participate in this study? *[IF YES]*: I'm going to read a declaration to you, and if you agree, I will ask you to sign this sheet to confirm your agreement.

DECLARATION OF CONSENT: Please sign below once you have read this sheet (or you receive explanations) and:

1. You know the reasons and subject of this study
2. You know the risks and benefits related to participation in this study
3. AND you have chosen to participate in this study on your own

Name of the interviewee (or legal representative)	*Signature of the interviewer* *(or legal representative) or thumb printing*	Date
Name of witness	*Signature or thumb printing*	Date

I have explained the aim of the project to the interviewee. To the best of my knowledge, this person understands the goal, procedures, risks and benefits of this project.

	Signature of the interviewer	
Name of the interviewer		Date
	Signature or thumb printing	
Name of witness		Date

NOTE: This consent form, along with the original signature, must be saved in the files by the senior researcher.

FORM ID	

Home Based Care assessment study

Dodowa Health Research Centre
LSHTM

Unique ID: ☐☐☐☐☐☐
(region code, Interviewer code and serial number):

Section 1. IDENTIFICATION (CIRCLE CORRECT ANSWER(S) WHERE CHOICES ARE PROVIDED)		
Interviewer's Name _____	Interviewer Code	Date of interview
Supervisor's Code	Field Editor's Code	Data Entry Clerk Code
Date	Date	Date
District_____	District code	
Town/Village_____	Town/Village Code	
	EA code: Cluster number:	

Section 2. CARE GIVER INFORMATION				
1.	Is the respondent:	Male Female	1 2	
2.	How many children under five living in this household had fever OR diarrhoea OR cough/fast-difficult breathing in the past 2 weeks?	Number of children ☐		
3.	**IF MORE THAN 2 SICK CHILDREN UNDER-5 IN HOUSEHOLD, BY LOTERY** (Pick 1 from a number of pieces of paper with a number on it linked to a specific child)	**Name of the Child**		
4.	Relation to child NAME	Mother Grand Mother Father Other relative (Specify:_____)	1 2 3 4	
5.	Age of respondent	Age in years ☐☐		
6.	Marital status	Single Married Separated Widowed	1 2 3 4	

		Divorced Co-habited Other Specify…..…….	5 6 7	
7.	What is your highest education level?	Primary JHS/Mid SHS/Sec Techical/Commercial/ Vocacional Tertiary Non Formal education None Other Specify…..…….	1 2 3 4 5 6 7 8	
8.	Can you read in (MULTIPLE QUESTIONS)	English Ewe Twi Ga Dagbani Fanti Other Specify……. No, I cannot read in any language	1 2 3 4 5 6 7 8	
9.	What is currently your main occupation?	Farming Artisan Trading Government worker Apprenticeship Housewife Unemployed Other Specify…..……..……	1 2 3 4 5 6 7 8	
10.	What is the main occupation of the head of household?	Farming Artisan Trading Government worker Apprenticeship Housewife Unemployed Other Specify …..…… Do not know	1 2 3 4 5 6 7 8 98	
11.	What is your religion?	Christian Traditional African Religion Islam Athiest Other Specify…… ……. ……..……	1 2 3 4 5	

Section 3: SEEKING CARE FOR FEVER, COUGH/DIFFICULT IN BREATHING OR DIARRHOEA					
I WILL NOW ASK YOU SOME QUESTIONS ABOUT YOUR CHILD (NAME) WHEN HE/SHE WAS SICK					
12.	How old is the child (NAME)? **(please, verify with any documentation)**	Years ☐☐ Months ☐☐ Date of birth DD ☐☐ MM ☐☐ YY ☐☐			
13.	Is (NAME) male or female?	Male Female	1 2		
14.	What signs and symptoms did (**NAME**) have? **(Ask for each of the symptoms)**		**Y**	**N**	
		Fever	1	2	
		Chills	1	2	
		Sweating	1	2	
		Fast Breathing	1	2	
		Head ache	1	2	
		Body ache	1	2	
		Not eating	1	2	
		3 or more stools per day	1	2	
		Blood in the stools	1	2	
		Cough	1	2	
		Noisy breathing	1	2	
		Difficulty in breathing	1	2	
		Breathing fast	1	2	
		Vomiting	1	2	
		Very pale skin	1	2	
		Unconscious	1	2	
		Convulsions	1	2	
		Other (specify): _____	9		
		Not sure	98		
15.	Did you seek care for (NAME)?	Yes ..... 1 No ..... 2 Not sure 98			**IF YES, SKIP TO Q17**
16.	Why didn't you care for (NAME)? (Multiple responses)	Waiting for fever to lessen	1		**SKIP TO Q36**
		Waiting for diarrhoea to lessen	2		
		Didn't seem ill enough	3		
		No money for treatment	4		
		No money for transport	5		
		No time	6		
		Already had medicines in the household	7		
		Previous bad experience			
		Didn't know where to go	8		
		Other	9		
		Specify: _____	10		
		Don't know	98		
17.	Where did you **first** seek care for (NAME)? (1st facility/provider)	CHPS compound	1		
		Health Centre	2		
		Hospital	3		
		Traditional healer	4		
		Community Based Agent	5		
		Licensed Chemical Seller	6		
		Drug peddler	7		
		Private Health facility	8		
		Other	9		
		Specify: _____			
		Don't know	98		

18.	How long after the fever/diarrhoea/cough or difficulty breathing started did you first seek care from this provider for (NAME)?	Same day Day after Two days after 3 to 7 days More than 7 days Don't know	1 2 3 4 5 98	
19.	How did you get to this first provider/ facility	Walking Public transport Community assisted transport Ambulance Other. Specify..... Don't know		1 2 3 4 5 98
20.	How much time did you spend in travelling to seek care (going and coming back home) at this first facility/provider you visited	Less than 15 min Between 15 min- 30 Between 30 min-1 hour Between 1 and 2 hours Between 2 and 3 hours More than 3 hours Other Specify..... Don't know		1 2 3 4 5 6 7 98
21.	For how long did you stay at this first facility/provider you visited (waiting and attending your child)	Less than 15 min Between 15 min- 30 Between 30 min-1 hour Between 1 and 2 hours Between 2 and 3 hours More than 3 hours Other Specify..... Don't know		1 2 3 4 5 6 7 98
22.	How much money did you spend on travelling to this first provider (going and coming back home)	Cost GHcedis: _____ Not sure:……98		
23.	How much money did you spend buying food while in the facility/provider?	Cost GHcedis: _____ Not sure:……98		
24.	Were there any other costs involved at the facility/ provider (excluding buying drugs)?	Yes ..... 1 No ..... 2 Not sure……..….98		**IF NO OR NOT SURE, SKIP TO Q26**
25.	What costs?	Paying for attending my child……1 Paying for the lab……..2 Paying for the NHIS……..3 Other……..4 Specify_____ Not sure……..….98		
26.	Did you seek care for (NAME)'s fever/diarrhoea/cough or difficulty breathing anywhere else?	Yes ..... 1 No ..... 2 Not sure 98		**IF NO OR NOT SURE, SKIP TO Q36**

27.	Where was the **second** place that you sought care for (NAME)? (2nd facility/provider)	CHPS compound ..... 1 Health Centre……..……..2 Hospital……..…..3 Traditional healer…..……4 Community Based Agent ..... 5 Licensed Chemical Seller ..... 6 Drug peddler ..... 7 Private Health facility ..... 8 Other..... 9 Specify: _____ Don't know..... 98	
28.	Why did you seek care elsewhere for (NAME)?	Not getting better ..... 1 Symptoms getting worse ..... 2 To buy/get medication ..... 3 Other..... 4 Specify: _____	
29.	How did you get to this second provider/ facility	Walking Public transport Community assisted transport Ambulance Other. Specify..... Don't know	1 2 3 4 5 98
30.	How much time did you spend in travelling to seek care (going and coming back home) at this second facility/provider you visited	Less than 15 min Between 15 min- 30 Between 30 min-1 hour Between 1 and 2 hours Between 2 and 3 hours More than 3 hours Other. Specify..... Don't know	1 2 3 4 5 6 7 98
31.	For how long did you stay at this second facility/provider you visited (waiting and attending your child)	Less than 15 min Between 15 min- 30 Between 30 min-1 hour Between 1 and 2 hours Between 2 and 3 hours More than 3 hours Other Specify..... Don't know	1 2 3 4 5 6 7 98
32.	How much money did you spend on travelling to this second provider (going and coming back home)?	Cost GHcedis: _____ Not sure:……98	
33.	How much money did you spend buying food while in the facility/provider?	Cost GHcedis: _____ Not sure:……98	
34.	Were there any other costs involved at the facility/ provider (excluding buying drugs)?	Yes ..... 1 No..... 2 Not sure……..….98	**IF NO OR NOT SURE, SKIP TO Q36**

35.	What costs?	Paying for attending my child……..1 Paying for the lab……..2 Paying for the NHIS……..3 Other……...4 Specify_____ Not sure……..….98	
36.	Did (NAME) take drugs for the fever//diarrhoea/cough or difficulty breathing?	Yes ..... 1 No ..... 2 Herbal medication……3 Not sure 98	**IF NO OR NOT SURE, or herbal medication, SKIP TO Q65**
37.	Who suggested to take these drugs?	I asked for drugs…….....1 They were offered by the provider……2 Other. Specify……3 Not sure……..…98	
38.	How long after the fever/cough or difficulty in breathing/diarrhoea started did (NAME) take these drugs?	Same day ..... 1 Day after ..... 2 Two days after ..... 3 Three or more days ..... 4 More than 7 days…….5 Don't know..... 98	
39.	What drugs did (NAME) take for the fever/cough or difficulty in breathing/diarrhoea and from where? *(Include any drugs that were from self-medication and/or from a health care provider)* *Ask if they keep the packages of drugs taken. Show examples of drugs* RECORD THE DRUG CODE AND NAME AND FROM WHERE THESE DRUGS WERE TAKEN. Please, see list below:		

	Drug code	Name	Facility code*
Drug 1			
Drug 2			
Drug 3			
Drug 4			
Drug 5			
Drug 6			
Don't know	98		

***CODES FOR THE FACILITIES/PROVIDERS**

CHPS compound……1
Health Centre……..2
Hospital……..3
Traditional healer…..……..4
Community Based Agent……5
Licensed Chemical Seller……6
Drug peddler……..7
Health facility (private)……8
Left over drug……9
Other……10
Specify: _____
Don't know……..98

GO THROUGH THE LIST IN Q37 ABOVE AND ANSWER THE NEXT QUESTIONS

40.	What was the <u>first</u> drug that (NAME) took? (CROSS CHECK WITH Q37)	Drug code: ..... ☐☐ Not sure 98	
41.	How long after the fever/diarrhoea/difficulty breathing began did (NAME) start taking this <u>first</u> drug?	Same day ..... 1 Day after ..... 2 Two days after ..... 3 Three or more days ..... 4 Don't know 98	
42.	How many times a day did (NAME) take this first drug?	Times per day: ..... ☐ Not sure 98	
43.	How many tablets or spoons or injections did (NAME) take each time? CIRCLE THE TYPE OF DRUG (1 TEA SPOON=5ML)	**Dose each time**: ..... ☐ Not sure ..... 98 **Type**: Tablet……1 Tea Spoon……2 Injection……3 Rectal……4	
44.	How many days were you asked (NAME) to take this first drug?	Number of days: ..... ☐ Not sure 98	
45.	How many days did you take this first drug?	Number of days: ..... ☐ Still taken the drug……9 Not sure 98	
46.	Did (NAME) take all the prescribed/purchased tablets or syrup of this drug?	Yes ..... 1 No ..... 2 Still taking the drug ..... 3 Not sure 8	
47.	Did you buy the drug?	Yes ..... 1 No ..... 2 Not sure 8	
48.	How much did you pay for this drug?	Cost Ghana Cedis _____ Not sure 98	
49.	What was the <u>second</u> drug that (NAME) took? (CROSS CHECK WITH Q37)	Drug code: ..... ☐☐ Not sure .....98 No other drug……1	**IF NO OTHER DRUG, SKIP TO Q65**
50.	How long after their fever/diarrhoea/difficulty breathing began did (NAME) start taking this <u>second</u> drug?	Same day ..... 1 Day after ..... 2 Two days after ..... 3 Three or more days ..... 4 Don't know 8	
51.	How many days were you asked (NAME) to take this second drug?	Number of days: ..... ☐ Not sure 98	
52.	How many days did you take this second drug?	Number of days: ..... ☐ Still taken the drug……9 Not sure 98	

53.	How many tablets or spoons or injections did (NAME) take each time? CIRCLE THE TYPE OF DRUG	**Dose each time**: ..... Not sure.....98 **Type**: Tablet……1 Spoon……2 Injection……..…3 Rectal……4	
54.	Did (NAME) take all the prescribed/purchased tablets or syrup of this drug?	Yes ..... 1 No..... 2 Still taking the drug..... 3 Not sure.....98	
55.	Did you buy the drug?	Yes ..... 1 No..... 2 Not sure..... 8	
56.	How much did you pay for this drug?	Cost Ghana Cedis _____ Not sure.....98	
57.	What was the third drug that (NAME) took? (CROSS CHECK WITH Q37)	Drug code:..... Not sure.....98 No other drug……1	**IF NO OTHER DRUG, SKIP TO Q65**
58.	How long after their symptoms began did (NAME) start taking this third drug?	Same day ..... 1 Day after..... 2 Two days after..... 3 Three or more days ..... 4 Don't know.....98	
59.	How many days were you asked (NAME) to take this third drug?	Number of days: ..... Not sure.....98	
60.	How many days did you take this third drug?	Number of days: ..... Still taken the drug……9 Not sure..... 98	
61.	How many tablets or spoons or injections did (NAME) take each time? CIRCLE THE TYPE OF DRUG	**Dose each time**: ..... Not sure.....98 **Type**: Tablet……1 Spoon……2 Injection……..…3 Rectal……4	
62.	Did (NAME) take all the prescribed/purchased tablets or syrup of this drug?	Yes ..... 1 No..... 2 Still taking the drug..... 3 Not sure.....98	
63.	Did you buy the drug?	Yes ..... 1 No..... 2 Not sure.....98	
64.	How much did you pay for this drug?	Cost Ghana Cedis _____ Not sure.....98	
65.	Did (NAME) have a blood test for malaria?	Yes ..... 1 No..... 2 Not sure.....98	**IF NO, SKIP TO Q71**

66.	How was the blood taken?	From the finger/heel……1 Using a syringe……..……..2 Not sure……...98	
67.	Did (NAME) have the malaria test before taking drugs?	Yes ..... 1 No..... 2 Not sure.....98	
68.	Where did (NAME) get the malaria test done?	CHPS compound..... 1 Health Centre……..2 Hospital…….……..3 Traditional healer…..……..…..4 Community Based Agent..... 5 Licensed Chemical Seller..... 6 Drug peddler ..... 7 Private Health facility..... 8 Other ..... 9 Specify: _____ Don't know.....98	
69.	What was the result of the malaria test?	Positive..... 1 Negative ..... 2 Don't know.....98	**SKIP TO Q71**
70.	Why didn't (NAME) have a blood test for malaria?	Didn't think fever was malaria ….1 Confident it was malaria ……...2 Don't have money ……3 Don't know where to get test…... 4 Wasn't offered one……..……...5 Did not seek care……..6 Other ……...7 Specify: _____ Don't know……..98	
71.	How is (NAME) now?	Fine, he/she recovered..... 1 Still sick ..... 2 Ill again/new illness…….……..3 He/she died……...4 Other……..5 Specify: _____ Don't know.....98	

Section 4. EXPERIENCE WITH COMMUNITY BASED AGENTS AND OTHER HEALTH PROVIDERS

THE GHANA HEALTH SERVICE IS TRYIG TO IMPROVE THE TREATMENT GIVEN TO CHILDREN UNDER FIVE.

I WILL ASK YOU NOW SOME QUESTIONS ABOUT YOUR EXPERIENCE WHEN CONTACTING COMMUNITY BASED AGENTS AND ANY OTHER HEALTH FACILITY VISITED **DURING THIS LAST 2 WEEKS**

72.	Have you ever sought care for (NAME) during last 2 weeks?	Yes No Not sure	1 2 98	**If yes, Skip to Q74**
73.	If no, why you did not go to the CBA **this time** to seek care for your child's illness as first option?	I do not know what CBA are There are no CBAs in my community CBA had run out of stock with that drug Cannot afford the CBA drug Does not like the CBA drug Does not like the CBA service The CBA is not competent Prefer to go to the health facility Other Specify..... Don't know	1 2 3 4 5 6 7 8 9 98	**Skip to Q92**
74.	If yes, can I confirm if you went to a Community Based Agent (CBA) to seek care **this time** for your child's illness as **first** option?	Yes No Not sure	1 2 98	**If no, not sure skip to Q76**
75.	Why did you go to the CBA **this time** to seek care for your child's illness as first option?	A relative /friend recommended it Close to me Flexible opening hours That is where I usually go to Competent nurses Competent doctors Better infrastructure Always drugs Other Specify..... Don't know	1 2 3 4 5 6 7 8 9 98	
76.	Were you satisfied with the service received when you first went to seek care for (Name) illness?	Very satisfied Satisfied Not very satisfied Absolutely not satisfied Not sure	1 2 3 4 98	
77.	If not or absolutely not, why?	Drugs not available Drugs not affordable Drugs not free Have to travel long distances I do not have time to work or to do other things Time to ask for advice and treatment is not flexible Staff not professional Staff is rude Staff do not explain anything Other Specify……..... Don't know	1 2 3 4 5 6 7 8 9 10 98	

78.	If yes or little yes, why?	Drugs readily available Drugs affordable Drugs free Don't have to travel long distances I have more time to work Flexible time to ask for advice and treatment Professional staff Staff is friendly Staff also explains how to be healthy Other Specify……..... Don't know	1 2 3 4 5 6 7 8 9 10 98	
79.	Do you think the service and treatment received was affordable?	Yes No Not sure	1 2 98	
80.	Did you receive advice on dosage per day?	Yes No Not sure	1 2 98	
81.	Did you receive advice on number of days to take drugs?	Yes No Not sure	1 2 98	
82.	Did you receive advice on side effects (any reaction from the drug)?	Yes No Not sure	1 2 98	
83.	Did you receive advice on what to do if symptoms persist?	Yes No Not sure	1 2 98	
84.	Were you suggested to refer (NAME) to another level of facility?	Yes No Not sure	1 2 98	**IF NO, SKIP TO Q90**
85.	Why were you suggested to refer (NAME)?	No drugs Child was too sick Child was too many days sick Child was too young to be treated at the community Child was not getting better CBA was not sure about what to do Other Specify……..... Don't know	1 2 3 4 5 6 7 98	
86.	Were you given a referral form/card to go to another health facility?	Yes No Don't know	1 2 98	
87.	Did your child receive an artesunate suppository for the referral (a suppository for malaria)?	Yes No Don't know	1 2 98	
88.	Did your child receive one dose of amoxicillin for the referral (a medicine for the cough or difficult breathing)?	Yes No Don't know	1 2 98	
89.	If you were advice to go to another health facility, did you go?	Yes No Don't know	1 2 98	
90.	Did your child receive a follow up after the first visit?	Yes No Don't know	1 2 98	**If no, skip to Q92**

91.	When did your child receive a follow up after first consultancy	The day after Two days after 3 days after Other. Specify…… Don't know	1 2 3 4 98	
I WILL ASK YOU NOW SOME GENERAL QUESTIONS ABOUT CBAs AND HEALTH FACILITIES				
92.	How did you find the time accessibility of the CBAs in your community?	Flexible Not always available Other.Specify..... Not sure	1 2 3 98	
93.	How far is you house from the CBAs	Less than 15 min walking Between 15 min- 30 walking Between 30 min-1 hour walking Between 1 and 2 hours walking Between 2 and 3 hours walking More than 3 hours walking Other Specify..... Don't know	1 2 3 4 5 6 7 98	
94.	How far is you house from the closest health facility	Less than 15 min walking Between 15 min- 30 walking Between 30 min-1 hour walking Between 1 and 2 hours walking Between 2 and 3 hours walking More than 3 hours walking Other Specify..... Don't know	1 2 3 4 5 6 7 98	
95.	Which type of facility is the closest to your house	CHPS compound Health Centre District Hospital Regional hospital Private clinic Other: Specify_____ Not sure	1 2 3 4 5 6 98	
96.	How did you find the time accessibility at the closest facility?	Flexible Not always available Other Specify……..... Not sure	1 2 3 98	
97.	Where will you go next time if your child is sick again?	CHPS compound Health Centre Hospital Traditional healer Community Based Agent Licensed Chemical Seller Drug peddler Private Health facility Other Specify: _____ Not sure	1 2 3 4 5 6 7 8 9 98	
98.	Do you have an active health insurance	Yes No	1 2	**If yes, go to Q100**

99.	If no, why?	It is expensive I do not like the service at the health facility I did not know I can be a member I did not know where to go to register I do not think it is necessary The registration is far away from my house It takes too much time to have the NHIS card Other Specify…… Don't know	1 2 3 4 5 6 7 8 98	

Section 5: KNOWLEDGE OF MALARIA, DIARRHOEA AND PNEUMONIA: SIGNS AND PREVENTION

100.	What are the signs or symptoms of **malaria** in a child less than 5 years of age? (Multiple response)	Fever Chills Sweating Headache Body ache/Joint pain Fatigue Bitter mouth Loss of appetite Diarrhoea Vomiting Other Specify:_____ Don't know 98	1 2 3 4 5 6 7 8 9 10 11 98	
101.	What signs and symptoms make you decide that malaria is serious in a child less than 5 years of age? (Multiple response)	Unconscious Convulsions Fast breathing Very hot Yellow eye colour Very pale skin Not breastfeeding Not eating Frequent vomiting Diarrhoea Vomiting Other Specify:_____ Don't know 98	1 2 3 4 5 6 7 8 9 10 11 12 98	
102.	How do people get malaria? (Multiple response)	Mosquito bites Drinking dirty water Not boiling water Bathing in river Bad air Bad talking Spirits Bad food Poor hygiene Other Specify:_____ Don't know	1 2 3 4 5 6 7 8 9 10 98	
103.	In the past year have you seen or heard any messages about malaria (how it is transmitted, how to avoid it, symptoms and what to do when sick?	Yes No Not sure	1 2 98	**If not skip to Q105**
104.	From where did you hear messages about malaria?	Neighbour Family member Friend Community Based Agent (CBA)	**1** **2** **3** **4**	

	(Multiple response)	Nurse from CHPS compound Nurse from Health Centre At the hospital Radio TV Posters Leaflets Newspaper Other Specify:_____ Don't know 98	**5** **6** **7** **8** **9** **10** **11** **12** **13** **98**	
105.	Did [Name of child] sleep under mosquito net last night?	Yes No Not sure	1 2 98	
106.	There is at least 1 mosquito net hanged up in the house? (VERIFY IF THERE IS AT LEAST 1 MOSQUITO NET HANGED UP)	Yes, I have seen it No, I have not seen it Not allowed to check	1 2 3	
107.	Did you sleep under a mosquito net last night?	Yes No Not sure	1 2 98	
108.	Do you know what indoor residual spraying is?	Yes No Not sure	1 2 98	
109.	Would you be happy to have your house sprayed with insecticide to kill mosquitoes?	Yes No Not sure	1 2 98	
110.	Has your house ever been sprayed with insecticide to kill mosquitoes?	Yes No Not sure	1 2 98	
111.	What are the signs or symptoms of **severe diarrhoea** in children less than 5 years of age? (Multiple response)	Diarrhoea present for more than 7 days Diarrhoea with blood in stools Dehydrated, dry mucosa Headache Fatigue Not breastfeeding, not eating Other Specify:_____ Don't know 98	1 2 3 4 5 6 7 98	
112.	Which practices in the community can cause diarrhoea in children less than 5 years of age? (Multiple response)	Not cleaning hands before food preparation Not cleaning hands before eating Not cleaning hands after defecation Not boiling water for drinking/cooking Flies on food The sun Bathing in river Bad air Bad talking Spirits Bad food Other Specify_____ Don't know	1 2 3 4 5 6 7 8 9 10 11 12 98	
113.	In the past year have you seen or heard any health messages about diarrhoea?	Yes No Not sure	1 2 98	**If not skip to Q115**
114.	From where did you hear messages about diarrhoea? (Multiple response)	Neighbour Family member Friend Traditional healer Community Based Agent Nurse from CHPS compound	**1** **2** **3** **4** **5** **6**	

		Nurse from Health Centre At the hospital Radio TV Posters Leaflets Newspaper Other Specify:_____ Don't know	**7** **8** **9** **10** **11** **12** **13** **14** **98**	
115.	What are the signs or symptoms of **severe acute respiratory infection**? (Multiple response)	Duration of symptoms (number of days with symptoms) Breathing quicker than usual Chest in-drawings Noisy breathing Other.Specify…… Don't know	1 2 3 4 98	
116.	What can cause respiratory infections in children less than 5 years of age? (Multiple response)	Infections (microorganisms) Not cleaning hands Not boiling water Bathing in river Being close to a person that coughs No vaccinating my child Bad talking Allergies Spirits Bad food Poor hygiene Other Specify_____ Don't' know	1 2 3 4 5 6 7 8 9 10 11 12 98	
117.	In the past year have you seen or heard any messages about respiratory infections?	Yes No Not sure	1 2 98	**If not skip to Q119**
118.	From where did you hear messages about respiratory infections?	Neighbour Family member Friend Traditional healer Community Based Agent Nurse from CHPS compound Nurse from Health Centre At the hospital Radio TV Posters Leaflets Newspaper Other Specify:_____ Don't know	**1** **2** **3** **4** **5** **6** **7** **8** **9** **10** **11** **12** **13** **14** **98**	

Section 6: HOUSEHOLD CHARACTERISTICS

119.	Do you (or the household head) own or rent your home?	Own Rent Squatters Care takers Rent free Other Specify……..... Not sure	1 2 3 4 5 6 98	
120.	How many rooms are in your household?	Number of Rooms ☐☐ Don't know 98		
121.	What is the **main** material used for flooring in your house? **Interviewer's observation**	Earth/Sand/Mud/Dung Wood Planks Palm / Bamboo Parquet or Polished Strips Ceramic Tiles Cement Other Specify…….....……	1 2 3 4 5 6 7	
122.	Does your house hold have any of the following assets? Read out the list. (MULTIPLE RESPONSE)		Y 1 1 1 1 1	N 2 2 2 2 2
123.	Does any member of your household own? (MULTIPLE RESPONSE)	Bicycles Motorcycles Car Canoe Tractor Other. Specify…….……..	Y 1 1 1 1 1	N 2 2 2 2 2
124.	What is the **main** source of **drinking** water for members of your household?	Piped Water Residence Piped Water in Public Taps Household well Public Well Borehole River, canal or Surface water Rainwater Tanker truck Water sachets Other Specify…….....……..	1 2 3 4 5 6 7 8 9 10	
125.	What type of toilets does your household use?	Flush toilet Pit Latrine Ventilated Improved pit latrine Bucket / Pan latrine Bush/ Field as latrine Other Specify…….....……	1 2 3 4 5 6	
126.	Is your toilet is 'shared by other households?	Yes No	1 2	
127.	What do you use as your **main**	Gas	1	

	source of fuel for cooking in this household? (Multiple answers)	Electricity Charcoal Wood Other Specify…….....……	2 3 4 5	
128.	How many people currently live in your household? Include permanent residents and temporary visitors.	Number of people in household ☐☐ Not sure 98		

Thank you very much for your time

Annex 9. Ethics committee approval

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LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

Observational / Interventions Research Ethics Committee

Blanca Escribano Ferrer
DC / ITD
LSHTM

30 July 2013

Dear Dr. Ferrer,

Study Title: **Can malaria, diarrhoea and pneumonia home based care be included in the National Health Insurance Scheme (NHIS) in Ghana?**

LSHTM ethics ref: **6442**

Thank you for your letter of 4 July 2013, responding to the Observational Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Conditions of the favourable opinion

Approval is dependent on local ethical approval having been received, where relevant.

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	Version	Date
LSHTM ethics application	n/a	20 May 2013
Proposal		4 July 2013
Draft In-Depth interview to managers and health providers		4 July 2013
Draft In-Depth interview to Community Based Agents		4 July 2013
Household Survey - Questionnaire for caregivers of children under five		4 July 2013
Focus Group Discussion Guide For Caretakers		4 July 2013
Draft In-Depth interview to NHIS managers		4 July 2013

After ethical review

Any subsequent changes to the application must be submitted to the Committee via an E2 amendment form. All studies are also required to notify the ethics committee of any serious adverse events which occur during the project via form E4. At the end of the study, please notify the committee via form E5.

Yours sincerely,

Professor John DH Porter
Chair
ethics@lshtm.ac.uk
http://intra.lshtm.ac.uk/management/committees/ethics/

GHANA HEALTH SERVICE ETHICAL REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.

My Ref. :GHS-ERC: 3
Your Ref. No.

Research & Development Division
Ghana Health Service
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21st March, 2014

Blanca Escribano
Dodowa Health Research Centre
Accra

ETHICAL APPROVAL - ID NO: GHS-ERC: 04/09/13

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol titled:

"Assessment of malaria, diarrhoea and pneumonia home based care strategy in Ghana"

This approval requires that you inform the Ethical Review Committee (ERC) when the study begins and provide Mid-term reports of the study to the Ethical Review Committee (ERC) for continuous review. The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Please note that any modification without ERC approval is rendered invalid.

You are also required to report all serious adverse events related to this study to the ERC within seven days verbally and fourteen days in writing.

You are requested to submit a final report on the study to assure the ERC that the project was implemented as per approved protocol. You are also to inform the ERC and your sponsor before any publication of the research findings.

Please always quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
DR. CYNTHIA BANNERMAN
(GHS-ERC VICE-CHAIRPERSON)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra

Annex 10. Papers Published

Three papers were considered for publication corresponding to the three chapter results.

The paper corresponding to Chapter 4 (assessment of the curative component) was published in the Malaria Journal: Ferrer BE, Webster J, Bruce J, Narh- Bana S, Narh C, Allotey N, et al. Integrated community case management and community-based health planning and services: a cross sectional study on the effectiveness of the national implementation for the treatment of malaria, diarrhoea and pneumonia. Malaria Journal. 2016;15(340).

The paper corresponding to Chapter 5 (assessment of the preventive component) has been accepted for publication in the BMC Public Health.

The third paper corresponds to Chapter 6 (cost analysis of HBC) was published in the Malaria Journal: Escribano Ferrer B, Hansen K, Gyapong M, Bruce J, Narh Bana S, Narh C, et al. Cost-effectiveness analysis of the national implementation of Integrated Community Case Management and community-based health planning and services in Ghana for the treatment of malaria, diarrhoea and pneumonia. Malaria Journal. 2017;16(277).

In addition, the OPA was also publised in the BMC Health Services Research: Escribano- Ferrer B, Webster J, Gyapong M. Assessing the impact of health research on health policies: a study of the Dodowa Health Research Centre, Ghana. BMC Health Services Research. 2017;17(435).

Ferrer et al. Malar J (2016) 15:340
DOI 10.1186/s12936-016-1380-9

Malaria Journal

RESEARCH Open Access

Integrated community case management and community-based health planning and services: a cross sectional study onthe effectiveness of the national implementation for the treatment of malaria, diarrhoea and pneumonia

Blanca Escribano Ferrer[1,2*], Jayne Webster[1], Jane Bruce[1], Solomon A. Narh- Bana[2], Clement T. Narh[3], Naa-KorKor Allotey[4], Roland Glover[4], Constance Bart-Plange[4], Isabella Sagoe-Moses[5], Keziah Malm[4] and Margaret Gyapong[2]

Abstract

Background: Ghana has developed two main community-based strategies that aim to increase access to quality treatment for malaria, diarrhoea and pneumonia: the Home-based Care (HBC) and the Community-based Health Planning and Services (CHPS). The objective was to assess the effectiveness of HBC and CHPS on utilization, appropriate treatment given and users' satisfaction for the treatment of malaria, diarrhoea and pneumonia.

Methods: A household survey was conducted 2 and 8 years after implementation of HBC in the Volta and Northern Regions of Ghana, respectively. The study population was carers of children under-five who had fever, diarrhoea and/or cough in the last 2 weeks prior to the interview. HBC and CHPS utilization were assessed based on treatment-seeking behaviour when the child was sick. Appropriate treatment was based on adherence to national guidelines and satisfaction was based on the perceptions of the carers after the treatment-seeking visit.

Results: HBC utilization was 17.3 and 1.0 % in the Volta and Northern Regions respectively, while CHPS utilization in the same regions was 11.8 and 31.3 %, with large variation among districts. Regarding appropriate treatment of uncomplicated malaria, 36.7 % (n = 17) and 19.4 % (n = 1) of malaria cases were treated with ACT under the HBC in the Volta and Northern Regions respectively, and 14.7 % (n = 7) and 7.4 % (n = 26) under the CHPS in the Volta and Northern Regions. Regarding diarrhoea, 7.6 % (n = 4) of the children diagnosed with diarrhoea received oral rehydration salts (ORS) or were referred under the HBC in the Volta Region and 22.1 % (n = 6) and 5.6 % (n = 8) under the CHPS in the Volta and Northern Regions. Regarding suspected pneumonia, CHPS in the Northern Region gave the most appropriate treatment with 33.0 % (n = 4) of suspected cases receiving amoxicillin. Users of CHPS in the Volta Region were the most satisfied (97.7 % were satisfied or very satisfied) when compared with those of the HBC and of the Northern Region.

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Full list of author information is available at the end of the article

Conclusions: HBC showed greater utilization by children under-five years of age in the Volta Region while CHPS was more utilized in the Northern Region. Utilization of HBC contributed to prompt treatment of fever in the Volta Region. Appropriate treatment for the three diseases was low in the HBC and CHPS, in both regions. Users were generally satisfied with the CHPS and HBC services.

Keywords: Home-based care, Community-based care, Integrated community case management (iCCM), Integrated management of childhood illness (IMCI), Malaria, Diarrhoea, Pneumonia, Children under-five

Background

During the past 30 years, the under-five mortality rate has declined in Ghana from 145/1000 live births in 1998 to 60/1000 live births in 2014 with an infant mortality rate of 41/1000 and a neonatal mortality rate of 29/1000 live births. These mortalities are higher in the north of the country and in the rural areas. Despite this decline in under-five year mortality, the Millennium Development target of 40/1000 was not reached [1]. The main causes of under-five mortality are neonatal related causes (38 %), malaria (20 %), pneumonia (11 %) and diarrhoea (8 %) [2]. In 2012, the Child Survival Call to Action set "A Promise Renewed" with the target of decreasing under-five mortality rates to 20 or fewer deaths per 1000 live births by 2035 in all countries [2].

Access to anti-malarials within 24 h of the onset of malaria symptoms is vital to prevent progression to severe malaria or death. The Roll Back Malaria partnership recommends that 100 % of those suffering from malaria should have prompt access to affordable and appropriate treatment within 24 h of onset of symptoms [3, 4].

There are three key strategies that seek to improve physical access to quality treatment which are: extension and quality improvement of formal health care systems, improvement in the informal private sector (mainly drug shops), and the home-based care (HBC) of fevers [5]. The World Health Organization and the Roll Back Malaria partnership states that in settings with limited access to health facilities, diagnosis and treatment should be provided at community level through community case management of malaria, recommending the introduction of rapid diagnostic test (RDT) and rectal artesunate for referral, when possible [4, 6, 7]. Malaria HBC has been shown to be effective and cost effective especially in areas with high malaria transmission, and in areas with medium transmission and low coverage of health facilities [8–13]. Integrated HBC or integrated community case management (iCCM) does not reduce the quality of malaria case management if adequate training is provided and supervision is maintained [14]. Issues related to implementation (e.g., availability of CBAs, availability of drugs or access to facilities), may decrease the expected impact of the strategy. The United Nations Children's Fund (UNICEF) and the World Health Organization officially endorsed iCCM in 2012 [15].

Ghana has developed two main community-based interventions or delivery strategies that aim to reduce barriers to physical access to quality treatment: the HBC and the community-based health planning and services (CHPS).

The HBC strategy started on a pilot basis in Ghana in 1999 to treat suspected malaria cases [16]. The pilot programme initially used chloroquine, shifting to artemisinin-based combination therapy (ACT) in 2005 [17]. In 2009 and in the context of integrated management of childhood illness (IMCI), Ghana developed the *Home Management of Malaria, ARI and Diarrhoea in Ghana* [16] also called iCCM. HBC (or iCCM) was defined as prevention, early case detection and prompt and appropriate treatment of fevers, ARI and diarrhoea in the community.

The HBC strategy corresponds to the lowest level of health care delivery in Ghana and it is designed to be implemented within the health system, with community-based agents (CBA) reporting their activities to care providers at the CHPS compounds (when existing) or to the next health facility level. All CBAs in the three northern regions (Northern, Upper East and Upper West Regions) provide treatment for malaria, diarrhoea and suspected pneumonia cases based on clinical symptoms and with the support of ARI timers for measuring the respiratory rate to diagnose pneumonia cases, mainly with the financial support of UNICEF. Those in the rest of the country have received the same training as the three northern regions but provide only malaria treatment with the support of the Global Fund to fight AIDS, TB and malaria (GFATM), and are supposed to refer diarrhoea and suspected pneumonia cases for further management. Other projects implemented by non-governmental organizations support integrated HBC on a smaller scale in different regions of the country. The HBC guidelines state that the service provided should be free, although some regions (such as the Northern Region) decided that users should give a small amount of money to CBAs to avoid risking lack of continuity and commitment of the strategy as experienced in other countries [8, 18, 19]. No target was set for iCCM

utilization as a proportion of other delivery points for treatment of sick children.

The CHPS strategy started in 1999 after a pilot phase conducted in 1994 [20] attempting to respond to the 1978 Alma Ata Conference and the 'Health for All' principle. A key component of the CHPS strategy is that traditional leaders of the community must accept the CHPS concept and commit themselves to supporting it. The CHPS strategy is based upon a basic facility known as a community health compound, where health care is provided by a resident community health nurse or community health officer who also does a 90 days cycle visiting the communities she/he serves at least once within that period. The services provided include immunizations, family planning, supervising delivery (if trained staff available), antenatal/postnatal care, treatment of common diseases such as malaria, diarrhoea and acute respiratory infections (ARI) and health education. These services are free for those having a valid national health insurance card. No target was set for CHPS utilization as a proportion of other delivery points for treatment of sick children. The target for CHPS coverage is that a geographical area of a 4 km radius and between 4500 and 5000 persons should be covered by a CHPS [21, 22].

After several years of national implementation, there is the need to know how effective HBC and CHPS are at delivering care for children with fever, diarrhoea or cough. There are several studies that looked at the HBC in Ghana. However, most of these studies focused in few districts, looked particularly at malaria HBC and were conducted in a more "controlled" context [23–27]. This study aims to assess the effectiveness of the national implementation of HBC and CHPS in terms of utilization of services, appropriate treatment given and users' satisfaction in the current context, without additional supervision, in a larger area and considering the management of fever, diarrhoea and cough for children under-five years old.

Methods

Ethics

Ethical approval was obtained from the Ghana Health Service-Ethical review committee (ID NO; GHS-ERC: 04/09/13) and from the Ethics Committee of LSHTM (ethics ref: 6442). Administrative approval was obtained from the respective regions and districts. Carers of children gave written consent to be interviewed.

Study site

The Volta and Northern Regions were purposively selected. The principal researcher wanted to include a region implementing iCCM and one malaria only HBC, to have a better picture of HBC in Ghana. Based on this first requirement, the National Malaria Control Programme (NMCP) suggested the Volta and Northern Regions. The Volta Region targeted only rural districts for the HBC implementation and implements mostly malaria HBC (with the exception of some communities supported by NGOs which implement integrated HBC), despite all districts received drugs for the management of diarrhoea and suspected pneumonia in 2013. The Northern Region implements iCCM due to availability of funds from UNICEF. Based on the monthly activities reported through the routine monitoring information (District Health Information System-DHIMS II), the NMCP had some concerns on the low performance of iCCM in Northern Region compared to the other two northern regions (Upper East and Upper West Regions), although the iCCM coordinator in the Northern Region believed this low performance was due to under reporting of activities. In contrast, the NMCP was satisfied with the malaria HBC implementation in the Volta Region. Selecting one "good" and "bad" performing region was believed to be a good strategy to contrast results with those of DIMS II and to see possible differences that could help identify enablers and barriers of the HBC implementation in Ghana. The CHPS strategy is uniform across regions of the country.

The Volta Region has a malaria prevalence of 17 %, diarrhoea prevalence of 7.6 % and suspected pneumonia prevalence of 2.1 % in children under-five (MICS 2011). The rural population corresponds to 66 % of the total population. Two rainfall patterns occur in the southern area of the Volta Region, one major season is in April/July with a peak in June and one minor season is in September/November with a peak in October. The north of Volta Region has one rainy season—May to October with a peak in August.

The Northern Region has a malaria prevalence of 48 %, diarrhoea prevalence of 21.4 % and suspected pneumonia prevalence of 6.3 % in children under-five (MICS 2011) [28]. The rural population corresponds to 70 % of the total population. In the north the rainy season begins in May and ends in October [29]. Climatically, religiously, linguistically, and culturally, the Northern Region differs greatly from the politically and economically dominating regions of southern Ghana, and it is similar to the two other regions in the north of Ghana (Upper East and Upper West).

Study design and sampling procedures

This was an observational study post intervention without controls using a cross sectional household survey. The effectiveness of the implementation of appropriate treatment was assessed against national guidelines. The study population were carers of children under-five years

of age, who had fever, cough and or diarrhoea in the last 2 weeks prior to the interview.

The sample size was estimated using the standard formula for estimation of a proportion and adjusting for clustering: $[3.84p(1-p)/e^2] \times DE$ [30]. A prevalence of 50 % of the population who are satisfied with the strategies was used to obtain a conservative sample size and ensure sufficiency for the estimation of utilization of the community services and several outcomes. A design effect of 1.5 [31] and a precision of 5 % were used. Adding 10 % for non-response, the sample size required in each region was 633, giving a total sample size of 1267 households with a child with fever, diarrhoea or cough in the 2 weeks preceding the survey.

A stratified three-stage cluster survey was conducted in each region. In order to have the sample representative of the whole region, whilst being logistically feasible, regions were divided into three areas. From each area, two districts and from each district, four clusters were selected using probability proportional to size. Then, from each cluster, 27 households were selected, making a total of 648 in each region. To select the districts (first stage) the list of districts implementing HBC (all districts implement the CHPS strategy) with its population was used. To select the clusters (second stage) the list of communities implementing HBC with its population was used. Households with children under-five that had fever, diarrhea or cough in the last 2 weeks prior to the interview were randomly selected in each cluster using a modified expanded programme on immunization sampling technique (third stage) [32]. To select households, a location near the centre of the community was first identified and a random direction was defined by spinning a pen. A random household along the chosen direction pointing outwards from the centre of the community to its boundary was chosen and checked for compliance with the inclusion and exclusion criteria. Whether the criteria were met or not, the next closest household was visited until the required number of households with a child with a fever, diarrhoea or cough in the 2 weeks preceding the survey were surveyed. Interviews were conducted with the carer of the sick child. In cases where there was more than one eligible child in a household, only one was selected randomly by ballot paper.

Data collection

Data collection was done during the 5th to 16th April 2014 in the Volta Region and during the 23rd June to 3rd July 2014 in the Northern Region. Three teams of four field workers with one field supervisor were recruited in Dodowa township for the Volta Region data collection and in Tamale township for the Northern Region data collection. The recruitment followed a standard procedure which included an interview, previous experience as a field worker in DHRC and secondary education level. The training was done in Dodowa for the Volta Region team and in Tamale for the Northern Region team. The training was for a week and included 1-day pilot testing of the questionnaire. The same field supervisors and the trainers were used in both regions.

Data collection was done using a structured questionnaire, which included socio-demographic information of the care taker, care-seeking behaviour, experience with CBAs and other health providers, knowledge of the three diseases and household characteristics.

Definitions

Appropriate provider refers to public or private medical facility, CHPS, CBAs or licensed chemical shop [28]. HBC is delivered by CBAs. Utilization of HBC or CHPS is defined as carers taking their child under-five to a CBA or a CHPS, respectively, when the child has symptoms of fever, cough or diarrhoea.

Flexibility of time of a CBA or of a health facility to attend a child refers to "open hours", meaning the moments during the day that a child can be seen by a provider.

User satisfaction refers to carers experience with the service received after the treatment-seeking visit. Definitions specific to case management of malaria, pneumonia and diarrhoea, and their differentials by HBC and CHPS used in the study are presented in Table 1.

Data management and analysis

Data were double entered and validated using EpiData 3.1. Survey data processing and analysis was done using STATA 12. Initial data examination and prevalence estimates were obtained using tabulations adjusted for survey design. Pearson's design based Chi square was used to test for associations. Survey logistic regression was used to obtain adjusted estimates.

To explore the potential association between key outcome variables and potential predictors, the crude OR was obtained using univariate logistic regression, and the adjusted OR using multivariate analysis based on the framework below (Table 2; Fig. 1). The association of each factor (adjusted only for district) with the outcome was estimated. All individual factors whose association reached significance at $p < 0.1$ were included in a multivariate analysis. All factors that remained significantly associated with the outcome ($p < 0.1$) in this model were retained. The variables included in this model were the core group of individual variables. The same procedure was followed for community and health system factors. All remaining individual, community and health system variables were then combined in a multivariate analysis.

Table 1 Study definitions

Definitions	HBC [16]	CHPS [53]
Malaria	All fever cases when no laboratory tests are available	All fever cases when no laboratory tests are available or when malaria test was positive
General danger signs	Vomiting, convulsions, unconscious or not breastfeeding	Vomiting, convulsions, unconscious or not breastfeeding
Severe malaria signs	Little or no urine, dark coloured urine, marked jaundice or abnormal bleeding	Little or no urine, dark coloured urine, marked jaundice or abnormal bleeding
Appropriate treatment of malaria	Children aged 6 months to 5 years diagnosed with malaria receiving 3 days of ACT If more than 7 days with fever, general danger signs or severe malaria signs, child must be referred with rectal artesunate	Children aged 2 months to 5 years diagnosed with malaria receiving 3 days of ACT If more than 7 days with fever, general danger signs or severe malaria signs, child must be referred with IM quinine, IM or EV or rectal artesunate plus an IM dose of chloramphenicol
Prompt treatment of malaria	Malaria cases that received an antimalarial drug in within the first 24 h of the onset of symptoms	Malaria cases that received an antimalarial drug in within the first 24 h of the onset of symptoms
Diarrhoea	Three or more loose or watery stools in a 24-h period	Three or more loose or watery stools in a 24-h period
Appropriate treatment of diarrhoea	Children older than 6 months with diarrhoea of less than 7 days that receive ORS and zinc for 14 days If the child is less than 6 months, had diarrhoea for 7 days or more, blood in stools or is dehydrated, he/she should be referred with ORS	Children with diarrhoea of less than 14 days receiving ORS and zinc for 14 days If diarrhoea for 14 days or more, blood in stools or is severely dehydrated, he/she should be referred to hospital with ORS
ARI or suspected pneumonia	Cough with fast or difficult breathing[a]	Cough with fast or difficult breathing[b]
Severe pneumonia	Noisy breathing or chest in-drawing	Noisy breathing or chest in-drawing
Appropriate treatment for suspected pneumonia	Children older than 6 months with cough and fast or difficult breathing of less than 7 days receiving amoxicillin for 5 days If the child is less than 6 months or had symptoms for 7 days or more, he/she should be referred If there are signs of severe pneumonia, he/she should be referred with amoxicillin	Children older than 2 months with cough and fast or difficult breathing of less than 14 days receiving amoxicillin or cotrimoxazole for 5 days If the child is less than 2 month or had symptoms for 14 days or more, he/she should be referred If there are signs of severe pneumonia, he/she should be referred with IM chloramphenicol

[a] ARI timers are available in the Northern Region under the iCCM strategy to help diagnose suspected pneumonia. If severe pneumonia is suspected, the child must be referred to a CHPS compound or a Health Centre

[b] Nurses at CHPS compounds do not have ARI timers. The diagnosis is made based on clinical signs. If a severe pneumonia case is suspected, the children must be referred to a higher level of health facility. Some district hospitals, all regional hospitals and teaching hospitals have X-Rays to help diagnose pneumonia. Health centres, district hospitals, regional hospitals and teaching hospitals have laboratory facilities to help diagnose malaria, diarrhoea and pneumonia

All variables that remained significantly associated with the outcome ($p < 0.05$) in this model were retained in the final model. Two-way interactions were tested with all the variables retained in the final model.

Principal components analysis was used to create socio-economic quintiles and compare outcomes across these quintiles. The variables used to generate the socioeconomic quintiles were ownership of the house, number of rooms, type of flooring, availability of electricity, radio, television, refrigerator, telephone, bicycle, motorcycle, car, canoe, tractor, source of water, type of sanitation, main source for cooking and number of people living in the household. The advantage of using a principal components analysis over the more traditional methods based on income and consumption expenditure is that it avoids many of the measurement problems like recall bias, seasonality and data collection time [33].

Results

A total of 1356 interviews were conducted in the Volta and Northern Regions (685 and 671 respectively) (Table 3). Among the children included in the study, fever was the most prevalent reported symptom during the last 2 weeks [621/671 (90.9 %) in the Volta Region and 635/685 (94.4 %) in the Northern Region], followed by cough [408/671 (65.9 %) in the Volta Region and 334/685 (53.1 %) in the Northern Region] and diarrhoea [287/671 (49 %) in the Volta and 291/685 (42.7 %) in the Northern Region] (Table 4).

Table 2 Variables of the framework for HBC and CHPS utilization

Category	Variable
Individual factors	Age of child
	Sex of child
	Age of care taker
	Education of care taker
	Household socio economic status
Community factors	Preventive messages sent by CBAs and CHPS
	Preventive messages sent by other sources
	Open hours (flexibility of time) of a CBA and CHPS to attend a child
Health system factors	Active NHIS card
	Distance to a health facility
	Type of closest facility
	Open hours (flexibility of time) of the closest facility

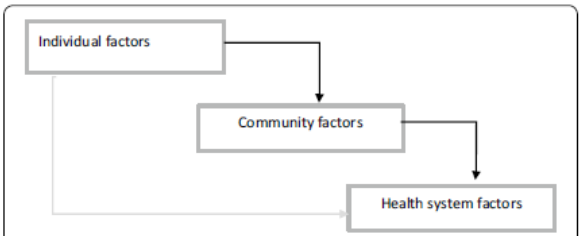

Fig. 1 Simplified conceptual hierarchical framework for HBC and CHPS utilization

Table 3 Number of interviews conducted by district and region

Volta region		Northern region	
District name	Freq.	District name	Freq.
Hohoe municipality	115	Central Gonja	114
Jasikan	113	East Gonja	118
Ketu North	98	East Mamprusi	120
Krachi East	114	Saboba	110
Krachi West	121	Sawla-Tuna-Kalba	106
North Tongu	110	Tolon Kumbungu	117
Total interviews	671	Total interviews	685

Utilization of HBC and CHPS strategies

Almost all respondents in both regions (93 %) indicated that they sought some form of care when the child's symptoms started in the past 2 weeks preceding the survey, and more than 86 % did it from an appropriate provider (Table 4). Seeking care from an appropriate provider was not associated with the SES ($p = 0.6$ and $p = 0.2$ in the Volta and Northern Regions) but it was associated with having an active NHIS card in the Northern Region ($p = 0.01$).

About 30 % of carers visited a community-based health provider (HBC or CHPS) when their child had fever, cough or diarrhoea (29.1 and 32.3 % in the Volta and Northern Region). Although CHPS coverage was found to be similar in both regions (41 and 43 % of households have a CHPS as the closest health facility in the Volta and Northern Region) and the distance to the closest health facility is larger in the Northern Region (61 versus 45 % have a health facility at less than 1 h walking in the Volta and the Northern Region), HBC was more utilized than CHPS in the Volta Region (17.3 % of carers visited a CBA) and CHPS were much more used than HBC in the Northern Region (31.1 % of carers visited a CHPS) (Table 4).

Within regions the utilization of HBC and CHPS varied by districts (Table 5). HBC utilization in the Volta Region ranged from 35.3 % (95 % confidence interval (CI) 20.8–53) in Krachi East to 0.3 % (95 % CI 0.01, 0.9) in Jasikan ($p = 0.001$). In the Northern Region HBC utilization was generally very low and the percentage of carers reporting that they were not aware of CBAs or that they do not have CBAs in the community was higher than in the Volta Region [314/685 (40.6 %) versus 213/671 (29.8 %), respectively]. The utilization of CHPS in the Volta Region varied from 27.1 % (95 % CI 2.5, 84.3) in Krachi West to 2.5 % (95 % CI 0.3, 15.2) in Hohoe municipal ($p = 0.2$). In the Northern Region, the utilization of CHPS ranged from 56.5 (27.9, 81.2) in Saboba to 4.7 (2.4, 9.2) in Central Gonja ($p = 0.004$).

Only 282/671 (38.1 %) of carers in the Volta Region and 397/685 (59.1 %) in the Northern Region reported that they sought care for their child from an appropriate provider the same day or the day after the onset of fever, diarrhoea or cough (Table 4). While children seeking care from a CBA within 24 h of onset of symptoms was significantly higher when compared with all other appropriate providers collated in the Volta Region [58/90, 56 % (95 % CI 48.7, 63.08) versus 224/519, 39.4 % (95 % CI 29.2, 50.5), $p = 0.03$], children seeking care from CHPS in the Northern Region also tended to do it more promptly when compared with other appropriate providers collated [163/227, 77.0 % (95 % CI 70.2, 82.7) versus 234/357, 63.6 % (95 % CI 50.2, 75.2), $p = 0.02$].

Factors associated with HBC and CHPS utilization in the Volta Region

The final regression model showed that carers of sick children were more likely to visit a CBA if children were older than 6 months (adjusted OR 6–23 months 4.1, 95 % CI 3, 5.5; adjusted OR ≥24 months 4.1, 95 % CI 1.4, 11;

Table 4 Prevalence of symptoms and care seeking behaviour by region

Indicator	Volta region N	Volta region %[b]	Northern region N	Northern region %[b]
Had fever during past 2 weeks[a]	621/671	90.9	635/685	94.4
Had diarrhoea during past 2 weeks	287/671	49.0	291/685	42.7
Had cough during past 2 weeks	408/671	65.9	334/685	53.1
Had suspected pneumonia during past 2 weeks	153/671	21.4	80/685	10.2
Sought care (for any of the three symptoms)	639/671	93.1	626/685	92.8
From CBA	90/671	17.3	8/685	1.0
From CHPS	61/671	11.8	228/685	31.3
From health centre	130/671	12.2	155/685	21.1
From hospital	153/671	24.2	83/685	13.0
From private clinic	19/671	4.0	25/685	7.3
From licensed chemical seller	153/671	19.5	88/685	14.9
From drug peddler	29/671	3.3	33/685	5.5
From traditional healer	0/671	0	6/685	0.6
From other providers	4/671	0.4	0/685	0
Care not sought	32/671	6.8	59/685	7.3
Not aware/don't have CBA	213/671	29.8	314/685	40.6
Sought care in the first 24 h (for any of the three symptoms)	299/671	40.0	413/685	62.5
From CBA	58/90	56.0	6/8	79.9
From CHPS	22/61	36.3	163/228	76.9
From health centre	62/130	33.8	104/155	72.4
From hospital	60/153	45.7	54/83	59.0
From private clinic	4/19	20.6	12/25	47.8
From licensed chemical seller	74/153	40.8	58/88	59.1
From drug peddler	16/29	49.7	14/33	55.6
From traditional healer	0	0	2/6	43.2
From other providers	3/4	54.7	0	0
Sought care in the first 24 h in case of fever	278/621	40.2	385/635	62.5
Sought care in the first 24 h in case of diarrhoea	140/287	40.6	159/291	58.3
Sought care in the first 24 h in case of cough	178/408	39.4	188/334	54.9
Sought care in the first 24 h in case of suspected pneumonia	71/153	33.4	47/80	56.4
Sought care from appropriate provider (for any of the three symptoms)	609/671	89.6	587/685	86.4
Sought care from appropriate provider in first 24 h (for any of the three symptoms)	282/671	38.1	397/685	59.1

[a] Fever refers to hot body or chills

[b] Weighted estimates

$p = 0.01$), or if they lived further than 15 min walking distance to a health facility (adjusted OR health facility 15–30 min walking 36.9, 95 % CI 1.6, 805), $p = 0.03$; 30 min–1 h adjusted OR 61.8, 95 % CI 4.8, 788, $p = 0.01$; 1–2 h adjusted OR 85, 95 % CI 6.8, 1056, $p = 0.01$; ≥2 h adjusted OR 36.4 (1.5, 851), $p = 0.03$) (Additional file 1). Flexibility of time of the CBA to attend to a child had a borderline association with utilization of HBC: adjusted OR 14 (95 % CI 0.4, 417), $p = 0.08$. Carers from households in higher socio-economic quintiles were less likely to take their children to a CBA than those in the lowest socio-economic quintile (adjusted OR lower middle quintile 0.2, 95 % CI 0.08, 0.7, $p = 0.03$; adjusted OR upper middle quintile 0.3, 95 % CI 0.06, 1.4, $p = 0.09$; adjusted OR upper quintile 0.3, 95 % CI 0.01, 1.5, $p = 0.08$). No association with the middle SES quintile compared with the lower level was found.

No interaction was found between HBC utilization and any other variable. No factor was found to be associated with the utilization of CHPS compounds.

Table 5 Utilization of HBC and CHPS by district and region

Districts	Volta region[b]						Northern region						
	HBC			CHPS			HBC				CHPS		
	n/N	% (95 % CI)[a]	p	n/N	% (95 % CI)[a]	p	Districts	n/N	% (95 % CI)[a]	p	n/N	% (95 % CI)[a]	p
Jasikan	2/107	0.3 (0.01, 0.9)	0.001	13/107	11.3 (7.2, 15.5)	0.2	Sawla-Tuna-Kalba	1/97	1.1 (0.08, 13)	0.3	61/97	52.4 (22.3, 80.8)	0.004
Krachi East	22/111	35.3 (20.8, 53)		10/111	17.9 (11.5, 26.9)		Central Gonja	1/100	0.1 (0.009, 3.3)		8/100	4.7 (2.4, 9.2)	
Krachi West	23/119	12.7 (0.5, 78)		17/119	27.1 (2.5, 84.3)		Tolon Kumbungu	2/103	3.7 (1.6, 8.4)		24/103	20.0 (6.1, 48.7)	
Hohoe Mun.	10/111	10.9 (4.5, 23.9)		4/111	2.5 (0.3, 15.2)		East Gonja	0/112	0		46/112	22.6 (5.8, 57.7)	
Ketu North	12/91	12.2 (3.6, 33.7)		6/91	7.9 (5.1, 11.9)		Saboba	1/102	1.1 (0.3, 3.8)		55/102	56.5 (27.9, 81.2)	
North Tongu	21/100	19.9 (8.1, 41.2)		11/100	10.6 (1.4, 49.0)		East Mamprusi	3/112	2.4 (0.7, 7.5)		34/112	22.5 (14.6, 57.5)	
Total	90/639	18.5 (5.8, 45.7)		61/639	12.7 (6.7, 22.9)		Total	8/626	1.0 (0.2, 3.9)		228/626	33.7 (10.6,68.6)	

[a] Weighted estimates

[b] All these districts in the Volta Region implement only malaria management, although they have been trained for the management of the three diseases

Factors associated with HBC and CHPS utilization in the Northern Region

Due to low HBC utilization in the Northern Region (n = 8) it was not possible to look for predictors. With regards to CHPS utilization, carers having as the closest facility a health centre or a private clinic were less likely to go to a CHPS compound (adjusted OR health centre 0.01, 95 % CI 0.002, 0.08; adjusted OR private clinic 0.008, 95 % CI 0.001, 0.5, p = 0.02 (Additional file 2). No interaction was found.

Appropriate treatment of malaria under the HBC and CHPS strategies

Regarding appropriate treatment of malaria, 19/77 (45.3 %) and 1/7 (14.9 %) of the children with fever that were taken to a CBA received ACT or were referred with artesunate to a health facility in the Volta and Northern Regions, respectively (Additional file 3); 18/77 (45.0 %) and 1/7 (14.9 %) in the Volta and Northern Regions received ACT and 12/77 (14.9 %) and 1/7 (14.9 %) in the Volta and Northern Regions received ACT within 24 h of the onset of symptoms. In Volta Region, some carers reported that they were prescribed amodiaquine monotherapy (6/78) and quinine (2/77) from CBAs. CBAs are not licensed to prescribe amodiaquine or quinine and amodiaquine should not be given as a monotherapy. However it is difficult to determine if carers were actually given amodiaquine in monotherapy or if carers reported "amodiaquine" as a short name of "artesunate-amodiaquine". How these two drugs were supplied to CBAs was not clear: they may have been provided from the health facilities or CBAs may have purchased them at a local pharmacy for selling. However, carers did not report that they paid for these drugs.

In the case of the CHPS, 34/55 (65.3 %) and 86/209 (41.7 %) of the children with fever were tested for malaria in the Volta and Northern Regions. A high proportion of carers did not know the results of the test [9/37 (19.0 %) and 21/92 (24.9 %) in the Volta and Northern Regions respectively]. Of those who tested positive, 6/23 (20.8 %) and 14/67 (8.6 %) in the Volta and Northern Regions were given an ACT; 0/23 (0 %) and 13/62 (35.1 %) were given quinine (reserved for severe malaria cases that should be treated in hospital [34]) and 3/23 (22.3 %) and 2/62 (3.8 %) were given amodiaquine. When testing negative, only one case in the Volta Region was given ACT and none in the Northern Region. If considering together all uncomplicated malaria cases (those tested positive and fever cases without laboratory confirmation that were not referred), 7/40 (14.7 %) and 26/183 (7.4 %) in the Volta and Northern Regions received ACT (Fig. 2). If malaria cases treated with quinine are included, then the proportion of children appropriately treated increases especially in the Northern Region although still not satisfactory: 8/40 (15.5 %) and 57/183 (35.9 %) in the Volta and Northern Regions. Prompt treatment with ACT or

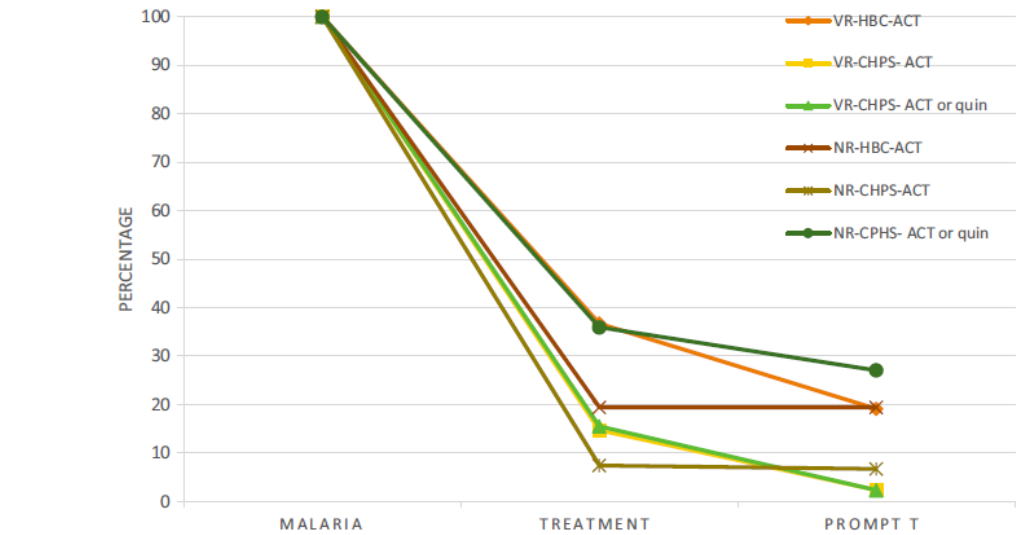

Fig. 2 Case management of uncomplicated malaria under HBC and CHPS by region. (Uncomplicated malaria = cases tested positive or fevers when no test was conducted that were not referred). *VR* Volta region, *NR* Northern region, *quin* quinine, *T* treatment

quinine was also low: 1/40 (2.3 %) and 43/183 (27.3 %) in the Volta and Northern Regions respectively.

Appropriate treatment of diarrhoea under the HBC and CHPS strategies

Of the children with diarrhoea that were taken to a CBA in the Volta Region, 4/38 (7.6 %) and 3/38 (5.7 %) received ORS or were referred and received ORS plus zinc or were referred, respectively.

In the case of the CHPS, only 6/31 (22.1 %) and 8/86 (5.6 %) of children with diarrhoea received ORS, 7/31 (31.3 %) and 4/86 (5.5 %) received zinc and 1/30 (0.3 %) and 0/86 (0 %) received ORS plus zinc in the Volta and Northern Regions, respectively.

Appropriate treatment of suspected pneumonia under the HBC and CHPS strategies

Of the children with cough with fast or difficult breathing that were taken to a CBA, 7/25 (31.8 %) received amoxicillin or were referred in the Volta Region and 0/1 (0 %) received amoxicillin in the Northern Region. In the case of the CHPS, 1/9 (18.7 %) and 4/15 (33.0 %) in the Volta and in the Northern Region received amoxicillin or cotrimoxazole according to the protocol.

Follow-up visits, referrals and second providers' visits

National guidelines state the CBA must conduct a follow-up visit on the day after the first visit [16]. This follow-up visit was conducted for 38/88 (68.8 %) and 4/8 (32.3 %) of the cases in the Volta and Northern Regions. Artesunate suppositories were given along with a written referral in 2 of the 6 fever cases referred in the Volta Region and in none of the two cases in the Northern Region. No amoxicillin was given in case of referral because of suspected pneumonia in either region, and 2/8 (59.9 %) of the cough cases referred received amoxicillin in the Volta Region.

After visiting a CBA, 28/90 (42.4 %) and 4/8 (63.3 %) of the carers in the Volta and in the Northern Region went to a second provider. The main reason for this second visit in the Volta Region was children not getting better [24/28 (98.7 %)] while in the Northern Region the reported reasons were not getting better [2/4 (25.5 %)] and to get drugs [2/4 (74.5 %)] (Additional file 4). After visiting a CHPS, 14/61 (28.0 %) and 21/228 (7.9 %) in the Volta and in the Northern Region went to a second provider. The facilities more often visited were the licensed chemical sellers in the Volta Region to buy drugs [8/14 (50.4 %)] and health centres in the Northern Region because the child was not getting better [9/21 (23.8 %)].

Users' reported satisfaction

In general, users of HBC and CHPS in both regions reported that they were satisfied, although consistently more in the Volta Region (Table 6). Lack of affordability and availability of drugs were the factors more often reported as reasons for dissatisfaction with the services received.

The main reason for not being satisfied when using HBC in the Volta Region was unavailability of drugs [5/8 (80.24 %)], while drugs not available, drugs not affordable and drugs not free [1/1, (100 %)] were the concerns in the Northern Region. It is important to note that three of the seven drugs (42 %) and 3/138 (2.1 %) given by the CBA in the Northern and the Volta Regions were sold to the carers.

Likewise, the main reason for not being satisfied when visiting a CHPS in the Northern Region was drugs not available (5/23, 39.1 %). CHPS users in the Volta Region reported a higher variety of reasons for not being satisfied (drugs not available, travel long distances, not time for seeking care and staff not giving information).

Discussion

This study assessed the effectiveness of HBC and CHPS in terms of utilization, appropriate treatment given and satisfaction of carers of children under-five years of age with fever, diarrhoea or suspected pneumonia in the last 2 weeks prior to the interview.

Table 6 Users' satisfaction after visiting CBA or a CHPS by region

	Very satisfied		Satisfied		Not sure		Not satisfied		Absolutely not satisfied	
	n/N	%	n/N	%	n/N	%	n/N	%	n/N	%
Volta Region										
CBA	29/89	32.6	52/89	58.4	0/89	0	6/89	6.7	2/89	2.2
CHPS	15/61	24.6	42/61	68.8	0/61	0	2/61	3.3	2/61	3.3
Northern Region										
CBA	2/8	16.1	4/8	30.1	1/8	13.6	0/8	0	1/8	39.9
CHPS	29/228	8.4	175/228	85.2	1/228	0.1	21/228	5.3	2/228	0.8

Utilization of HBC and CHPS

This study showed that seeking care from an appropriate provider in case of fever, diarrhoea or cough was high in both regions and higher than that found in previous surveys while being coherent with the increased trend on seeking care because of fever: the 2011 MICS survey showed that approximately 44 and 43 % of fever cases in under-fives in the Volta and Northern Regions sought care from an appropriate provider at any time [28]; the 2013 LQAS survey showed that 60 % of fever cases in under-fives in the Northern Region sought care at any time and 30 % in the first 24 h of onset of symptoms [36] and in the 2014 DHS 73.6 and 83.6 % of fever cases in the Volta and Northern Region sought care at any time [37]. It should be noted that data from the LQAS survey is not representative of the Northern Region as they purposively selected 10 districts out of 20. The MICS and the DHS surveys, use a similar sampling methodology but their sample size of children under-five presenting with fever was between three and 11 times smaller than this study.

The total utilization of community-based interventions was similar and slightly higher in the Northern Region when compared with the Volta Region (32.3 versus 29.1 %). However utilization of HBC versus CHPS was different: HBC was more used in the Volta Region while CHPS was more used in the Northern Region.

The HBC utilization found in this study was similar to the 2013 LQAS survey in the Northern Region (95 % CI 0.7, 6.5 %). However, another study conducted in one district of the Ashanti and Volta Regions in 2008 [26] showed higher HBC utilization (more than 68 and 75 % respectively used HBC a year after the HBC implementation). When compared with other evaluations conducted in Uganda [38], which was a quasi-experimental study before and after 18 months implementation of HBC, and in Burkina Faso, which was a cross sectional study conducted before and after 1 year implementation of HBC, a higher utilization of HBC (25 and 56 % respectively) was found. Two reasons could explain this higher HBC utilization. Firstly, due to differences between districts: the study in the Ashanti and Volta Region only focussed in one district per region and this current study has shown the variation of HBC utilization among districts specially in the Volta Region). Secondly, due to differences between research projects and real world implementation: the length of the projects is generally shorter and the quality and intensity of supervision is usually better in research projects than in routine programme implementation. For example, the HBC strategy in the Northern Region was being implemented for about 8 years before the survey and for 2 years in the Volta Region. Longer time implementing the strategy might bring expertise but also tiredness of the CBAs and the supervisor, stock-out of drugs and the need for CBA replenishment and training. The lower effectiveness of implementation of an intervention in the "real world" as compared to that found in research projects is already being discussed and addressed through the Implementation Research [39–41], which aims to bridge the implementation gap between knowledge and action.

Large differences in HBC utilization were observed between the Volta and Northern Regions. However, the HBC strategy in the two regions started at different times and includes different interventions. In the Northern Region, HBC started in 2007 first addressing malaria cases, and in 2010 the management of diarrhoea and suspected pneumonia cases were included with the technical and financial support of UNICEF. The HBC in the Volta Region started in 2012 and includes only drugs for the management of malaria cases with the financial support of the GFATM, while diarrhoea and suspected pneumonia cases should be referred for further treatment. Therefore, one could argue that a higher HBC utilization in the Northern Region would be expected as a wider range of conditions are treated by the CBAs compared with Volta Region (which was not the case). Considering that this study was conducted in communities where according to policy HBC is being implemented, it is surprising that 30 % of carers in the Volta Region and 41 % in the Northern region indicated that they were not aware of the presence of CBAs or they did not have CBAs in the community. During informal communications with CBA and community chiefs while conducting the survey, the field team was informed that some CBAs travelled and no one had replaced them yet, others stopped working as they did not have drugs to work with and some CBAs were known in one area of the community while not in another area, suggesting that social and personal issues might also affect the knowledge and the utilization of the CBA services. Therefore, sociocultural issues, stock out of CBA drugs or high turnover of CBAs could explain the lower utilization of HBC in the Northern Region as it has also been reported in other studies in Ghana and elsewhere as a barrier to implementation [27, 38]. A further qualitative study might help to understand causes of the low HBC utilization in the Northern Region.

With respect to the Volta Region, HBC utilization was not associated with living far from a CHPS or with low flexibility of CHPS for attending patients. The HBC strategy in the Volta Region was found to be coherent with the guidelines in terms of not treating children under 6 months, is reaching the poorest in coherence with its intention of being a "pro-poor" intervention and it is more used when there is no health facility close to the

house. It is worth noting that a study in Uganda in 2007 [38] concluded that HBC was less likely to reach the poorest and the authors could not explain why. Two other studies in Uganda and Zambia found that proximity to a health facility is a deterrent against HBC utilization [42, 43] and another one found that HBC is not cost-effective in the context of proximity to a health facility [11]. For future planning and considering only the therapeutic component of the HBC (which is the one evaluated in this paper), implementation of HBC should consider to target areas without a health facility (as it was with the strategy of the NMCP in the Volta Region).

With regards to CHPS utilization, proximity to a CHPS was found to be associated to CHPS utilization in the Northern Region (and not in the Volta Region, were carers chose a provider based on different criteria). The percentage of carers visiting a CHPS compound was higher than the results of the LQAS survey (between 6 and 10 % of carers visited a CHPS compound when their child was sick). No other comparable studies on CHPS utilization were found in the literature to contrast these results.

Carers visiting a CBA in the Volta Region and visiting a CHPS in the Northern Region did it more promptly when compared with other providers. When diagnosed with malaria, children visiting a CBA also received ACT more promptly than when visiting any other provider in the Volta Region (22.4 versus 3.8 %, $p = 0.05$). Prompt treatment received from a CBA was reported in other studies conducted in Rwanda [44], Uganda [38, 45], Ghana [26, 27], Nigeria [26], Burkina Faso [27, 46], Tanzania [47], Ethiopia [27] and Malawi [27]. Most of these studies looked at the performance of HBC at a point in time or in before-after cross-sectional studies. Only the two studies in Uganda (an RCT and a quasi-experimental study) were designed to test for a difference in prompt treatment seeking between HBC and standard treatment and their results were similar: 62 versus 37 %, $p = 0.0001$ [45] and a significant difference at post intervention (12.3 %, $p = 0.05$) [38].

Appropriate treatment

Both HBC and CHPS failed in reaching the target of treating 100 % of eligible children with ACT, amoxicillin and/or ORS + zinc. This worrying fact should question the local health authorities particularly on the adequacy of the drug supply chain. Acknowledging the difficulty of interpreting the HBC figures due to the low numbers of carers visiting a CBA in the Northern Region, it seems that HBC was more used and performed better in the Volta Region when compared with the Northern Region while CHPS in the Northern Region were more used and performed better than in the Volta Region.

More malaria cases were treated with quinine (reserved for complicated cases) than with ACT in the CHPS of Northern Region. As only between 0 and 11 % of cases seen in health facilities in Ghana are complicated cases [48, 49] a possible explanation for the frequent use of quinine could be stock-outs of drugs The percentage of uncomplicated malaria cases treated with ACT in this study is lower than that found in other studies [23, 26, 27]. The source of information (CBA records versus carers' information) could contribute to the different results. It is important to note that both, CBA records and carers' information are not the gold standard for collecting this type of information, which is considered to be the direct observation of CBA work [14]. CBA registers may suffer from inaccurate or incomplete reporting and household surveys may suffer from recall bias and misunderstanding. However, the few studies that collected data from both sources found similar results [14, 26, 27]. As mentioned before, other factors that could explain differences in performance are better supervision, better supply of drugs with the involvement of the research teams, as well as a shorter duration of the research projects when compared to program implementation. Another study conducted in Burkina Faso [46] with less external supervision or anti-malarial supply had similar results to this study (54 % of the febrile children received ACT from a CBA).

With regards to diarrhoea management, a common finding was the low percentage of cases correctly treated and children receiving either ORS or zinc, but not both at the same time. The LQAS survey in the Northern Region also found a low proportion of diarrhoea cases treated with ORS and zinc when visiting a CBA or a CHPS, suggesting that it might be due to stock-outs of drugs. CBAs are provided with drugs during the monthly community welfare clinics conducted by CHPS' or health centres' nurses. However, this integration of services does not seem to cover all drug needs. Results of the 2011 MICS and the 2014 DHS also showed a low proportion of diarrhoea cases correctly treated (2011 MICS: 32 and 30.1 % of diarrhoea cases received ORS and 0 and 0.2 % received zinc from an appropriate provider excluding pharmacies in the Volta and Northern Regions respectively; 2014 DHS: 41.3 and 48.7 % of diarrhoea cases received ORS and 0 and 5 % received zinc from an appropriate provider excluding pharmacies in the Volta and Northern Regions). The low coverage of ORS and almost negligible use of zinc to treat diarrhoea cases was also reported by Gill et al. [50]. In their paper about bottlenecks, barriers and solutions to the low implementation of effective measures to reduce childhood pneumonia and diarrhoea deaths in low and middle income countries, they stated that the main bottlenecks for diarrhoea appropriate treatment were concentrated in downstream areas related to provision of ORS and zinc in the community.

The study results regarding the appropriate treatment of suspected pneumonia cases cannot be compared with the 2011 MICS and the 2014 DHS as these surveys did not report on this indicator based on the different providers visited. Another three studies conducted in Africa on HBC [43, 51, 52] showed a better performance (between 63 and 98 % of suspected cases received amoxicillin). However, two of them [43, 51] used a different methodology to diagnose suspected pneumonia cases (registries and direct observation of CBA as opposed to carers' reports) and another one used carers reported symptoms but in the context of a cluster randomized trial.

Finally, there is the need to reflect on the fact that some cases received amoxicillin, ORS or zinc when visiting a CBA in the Volta Region (as the GFATM is only supporting ACT). It seems feasible to believe that CBAs still had some of these drugs distributed in 2013 in stock, or CBAs bought these drugs to be distributed among sick children.

CBA's referrals and second visit to health providers

This study showed a higher proportion of carers that sought care elsewhere after visiting a CBA than the study in Dangme West district [23] (where only 3.9 % of the carers sought care elsewhere). Since for the HBC strategy in the Volta Region CBAs were expected to refer diarrhoea and suspected pneumonia cases, one would expect a higher proportion of carers seeking care elsewhere in the Volta Region. However, 63 and 42 % of carers in the Northern and Volta Region sought care elsewhere after visiting a CBA because of unavailability of drugs and children not getting better. This is coherent with the LQAS survey where only 16 % of the CBAs had ACT, ORS, Zinc and amoxicillin on the day of the survey in the Northern Region. With regards to the HBC in the Volta Region, it is important that iCCM coordinators emphasize on the importance of referral with a form, as seeking care elsewhere can be seen as a failure of the program while referral can be interpreted as appropriate management of cases.

The low coverage of appropriate treatment found should make us reflect upon the new "Integrated community case management guidelines" which will include pregnancy and neonatal care, nutrition in under-fives and the inclusion of RDT for the diagnosis of malaria. Before adding more components to the HBC strategy, adherence to protocol through ensuring availability of drugs, adequate supervision and continuous replacement of CBAs must be ensured.

Users' satisfaction

Lack of availability and affordability of drugs were the main factors for carer dissatisfaction of services in both regions. Therefore, emphasis must be given to avoiding drug stock outs. Also, a reflexion must be undertaken about carers paying CBAs for drugs. Although paying for CBAs' drugs can be a strategy to retain CBAs in their task, carers valued free drugs as a positive element of the HBC strategy. Secondly, it is a contradiction with the NHIS which established free treatment for children under-five. Thirdly, because this practice is not considered in the guidelines, which only states "to ensure that cost of iCCM would not be a barrier to accessing treatment, drugs should be given to clients at no cost or National Health Insurance Scheme (NHIS) may cover all drugs".

Limitations of the study

Response rate was very high for the survey with no refusals to participate. The variables described in the study represent only the population of sick children during the last 2 weeks prior the interview and not the whole population.

The study looked at programme implementation against guidelines of the national programme. Comparison between north and south was descriptive, understanding that regions are different from the cultural and epidemiological point of view and without directly comparing malaria HBC with integrated HBC. Different epidemiological burden would not be expected to influence results, as the target population was children with symptoms. However, finding these children when doing the data collection was easier in the Northern Region as the prevalence of the three diseases was higher. As this is a cross-sectional study, no reference to causality can be made, only association among variables.

Results are based on responses of carers of children under-five. Morbidity data collected is subjective as it is based on a mother's perception of illness and their understanding about their children's disease and the treatment given, with no validation of their responses by for example comparison with that of the CBAs by looking at the CBAs forms or CHPS registries. Therefore, interpreting results particularly related to suspected pneumonia must be done with caution as fast breathing, chest in drawing or noisy breathing can be perceived differently by the carers and the provider and therefore, treated differently. The same is the case with diagnostic procedures and treatment given and understood. A patient could have been given "artesunate-amodiaquine" but referred to have received "amodiaquine". Or the patient might not remember the name of the drug, even with the help of the drugs pictures that were taken to the field to conduct the survey. However, the use of carers' reports to classify malaria, diarrhoea and suspected pneumonia has been used in the MICS, DHS and other studies [52]. In addition, two studies on anti-malarial use and dosage using

both sources of data (HBC records and carers's reports) showed similar results [26, 27]. Finally if some children were misclassified (for example being attributed with one symptom while they do not have it), this is not likely to have introduced a differential bias between HBC and CHPS.

Some of the results had large confidence intervals even though the formula used to calculate the sample size was adequate. The clustering of indicators by district was larger than expected and therefore a bigger design effect could have been more appropriate (Design effect = 2 instead of 1.5). As a result, the sample size was small for some indicators.

Conclusions

HBC was more used in the Volta Region while CHPS was more used in the Northern Region. HBC utilization was almost non-existent in the Northern Region. Poorer children, children older than 6 months and those living far from a health facility were more likely to use HBC in the Volta Region. HBC contributed to prompt treatment of fevers in the Volta Region.

Appropriate treatment for the three diseases was low in the HBC and CHPS areas, in the Volta and Northern Regions. Carers were satisfied with the services received. Lack of availability and affordability of drugs were the factors more reported as cause of dissatisfaction.

More efforts should be made in the provision of drugs, ensuring that CBAs are in service and in monitoring the CBA and CHPS performance, especially if more components are to be included in the HBC strategy. A well-functioning integration of services might help to improve provision of drugs and supervision. Sustainability of HBC needs to be addressed. A cost-effectiveness study of the HBC compared with CHPS might help to guide decisions on future financing and motivation to CBA in Ghana.

Additional files

Additional file 1. Unadjusted and adjusted predictors of HBC and CHPS utilization in the Volta Region.

Additional file 2. Unadjusted and adjusted predictors of CHPS utilization in the Northern Region.

Additional file 3. Proportion of symptomatic children receiving appropriate treatment under HBC and CHPS by region.

Additional file 4. Places and reasons for seeking care elsewhere after visiting CBA or a CHPS by region.

Abbreviations

ACT: artemisinin-based combination therapy; ARI: acute respiratory infection; CBAs: community-based agents; CHPS: community-based health planning services; DHS: demographic health survey; GFATM: global fund for AIDS, tuberculosis and malaria; GHS: Ghana health service; iCCM: integrated community case management; IMCI: integrated management of childhood illness; LQAS: lot quality assurance sampling; MICS: multiple indicator cluster survey; NHIS: National health insurance scheme; NMCP: National malaria control programme; ORS: oral rehydration salts; RDT: rapid diagnostic test; UNICEF: United Nations Children's Fund.

Authors' contributions

BEF conceived the study, participated in the design, coordinated the field work, performed the statistical analysis and drafted the manuscript. JW participated in the study conception, study design and in drafting the manuscript. JB participated in the statistical analysis. CTN coordinated the field work in the Volta Region, SN coordinated the field work in the Northern Region. NA participated in the study conception and design. RG participated in the field work in the Volta region. CP, IS and KM participated in the study conception. MG participated in the study conception, study design and supported the field work. All authors read and approved the final manuscript.

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Acknowledgements

We thank the participants in the study for their valuable information to improve the health care for malaria, diarrhoea and pneumonia. We thank the field workers, supervisors and data entry staff for their critical work in collecting and entering data. We thank Dr. Patricio Marquez (World Bank) for his interest in the study and technical support. We also acknowledge the financial support received from the National Malaria Control Program with GTFAM funds.

Competing interests

The authors declare that they have no competing interests.

Received: 11 February 2016 Accepted: 9 June 2016
Published online: 02 July 2016

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Escribano Ferrer et al. Malar J (2017) 16:277
DOI 10.1186/s12936-017-1906-9

Malaria Journal

RESEARCH Open Access

Cost-effectiveness analysis of the national implementation of integrated community case management and community-based health planning and services in Ghana for the treatment of malaria, diarrhoea and pneumonia

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Abstract

Background: Ghana has developed two main community-based strategies that aim to increase access to quality treatment for malaria, diarrhoea and suspected pneumonia: the integrated community case management (iCCM) and the community-based health planning and services (CHPS). The aim of the study was to assess the cost-effectiveness of these strategies under programme conditions.

Methods: A cost-effectiveness analysis was conducted. Appropriate diagnosis and treatment given was the effectiveness measure used. Appropriate diagnosis and treatment data was obtained from a household survey conducted 2 and 8 years after implementation of iCCM in the Volta and Northern Regions of Ghana, respectively. The study population was carers of children under-5 years who had fever, diarrhoea and/or cough in the last 2 weeks prior to the interview. Costs data was obtained mainly from the National Malaria Control Programme (NMCP), the Ministry of Health, CHPS compounds and from a household survey.

Results: Appropriate diagnosis and treatment of malaria, diarrhoea and suspected pneumonia was more cost-effective under the iCCM than under CHPS in the Volta Region, even after adjusting for different discount rates, facility costs and iCCM and CHPS utilization, but not when iCCM appropriate treatment was reduced by 50%. Due to low numbers of carers visiting a CBA in the Northern Region it was not possible to conduct a cost-effectiveness analysis in this region. However, the cost analysis showed that iCCM in the Northern Region had higher cost per malaria, diarrhoea and suspected pneumonia case diagnosed and treated when compared to the Volta Region and to the CHPS strategy in the Northern Region.

Conclusions: Integrated community case management was more cost-effective than CHPS for the treatment of malaria, diarrhoea and suspected pneumonia when utilized by carers of children under-5 years in the Volta Region. A revision of the iCCM strategy in the Northern Region is needed to improve its cost-effectiveness. Long-term financing

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strategies should be explored including potential inclusion in the National Health Insurance Scheme (NHIS) benefit package. An acceptability study of including iCCM in the NHIS should be conducted.

Keywords: Home- based care, Integrated community case management (iCCM), Malaria, Diarrhoea, Pneumonia, Children under-five, Cost-effectiveness analysis

Background

In December 2014 a new global coalition of more than 500 leading health and development organizations worldwide was launched to urge governments to accelerate reforms that ensure everyone, everywhere, can access quality health services without being forced into poverty [1]. This global coalition, called the Universal Health Coverage (UHC), comprises two main components: quality essential health service coverage and financial coverage—both extended to the whole population [2].

With UHC on the global health agenda, governments of many low and middle-income countries are under pressure to scale up essential health services to meet the needs of their people. This means that governments need to prioritize effective interventions to scale up. Health technology assessments (HTAs) have been recognized as a tool for priority setting particularly useful in this UHC context [3]. HTA examines the cost-effectiveness of an intervention as well as the organizational implications and social consequences, bridging the gap between the evidence and policy making [4]. HTA can be used to prioritize an intervention in a particular context as mentioned before (ex-ante HTA) or it can be used as a monitoring tool, providing information to governments and funders to continue or discontinue certain interventions, helping to address sustainability (ex-post HTA) [3, 4].

Ghana has developed two main community based strategies that aim to reduce barriers to physical access to quality treatment: the iCCM and CHPS. Both strategies are implemented in the ten regions of Ghana through the Ghana Health Service and under the umbrella of the Ministry of Health. The iCCM strategy (then called home-based care) started on a pilot basis in Ghana in 1999 to treat suspected malaria cases [5]. The pilot programme initially used chloroquine, shifting to artemisinin-based combination therapy (ACT) in 2005 [6]. In 2009 and in the context of integrated management of childhood illness (IMCI), Ghana developed the Home Management of Malaria, ARI and Diarrhoea in Ghana [5]. iCCM was defined as prevention, early case detection and prompt and appropriate treatment of fevers, ARI and diarrhoea in the community. The iCCM strategy corresponds to the lowest level of health care delivery in Ghana and it is implemented through community-based agents (CBAs) selected by the community which received a 5-days training. The iCCM guidelines states that the service provided by the CBAs should be free [5] although some regions decided that users should give an small amount of money to CBAs to avoid risking continuity of the strategy. The HBC current funding is primarily reliant on external multilateral and bilateral donors as in many other countries [7–12]. The long-term financial plan for iCCM in Ghana is not clear.

The CHPS strategy started in 1999 after a pilot phase conducted in 1994 [13] attempting to respond to the 1978 Alma Ata Conference and the 'Health for All' principle. A key component of the CHPS strategy is that traditional leaders of the community must accept the CHPS concept and commit themselves to supporting it. The CHPS strategy is based upon a basic facility known as a community health compound, where health care is provided by a resident community health nurse or community health officer who also does a 90-day cycle visiting the communities she/he serves at least once within that period. Community health nurses receive formal training for a minimum of 2 years. Services provided by accredited CHPS are free for those having an active national insurance card.

After several years of national implementation, it is important to know how effective and cost-effective iCCM and CHPS are at delivering preventive and curative health services known to contribute to reducing the morbidity and mortality of children under-five. Studies that have looked at the effect of the iCCM in Ghana mostly focused in a few districts, looked particularly at the management of malaria home-based care, neglecting the cost-effectiveness and the preventive component, and were conducted in a more "controlled" context [14–18]. Ferrer et al. [19] reported on the utilization, effectiveness and users' satisfaction of the curative component of iCCM and CHPS. This paper presents a cost-effectiveness analysis of iCCM versus CHPS. This study is an approach to ex-post HTA which considers the real costs and effectiveness of both interventions (iCCM and CHPS) which is key to policy decisions. Results from this study may be used to improve performance and to guide decisions on sustainable financing strategies particularly regarding iCCM.

Methods

Study site

The Volta and Northern Regions were purposively selected. Criteria for selecting these regions are described

in Ferrer et al. [19]. In brief, the first criteria was the inclusion of a region implementing iCCM but providing only treatment for malaria and a region providing treatment for malaria, diarrhoea and pneumonia, to have a better picture of the iCCM strategy in Ghana. The second criteria was different implementation performance levels, based on the routine information system. The CHPS strategy is uniform across all ten regions of the country. The iCCM in the Volta Region was supported mainly through the Global Fund and targeted only rural districts for the iCCM implementation. Volta Region had a population of 1,901,179 habitants, 17 districts, 674 CHPS and 920 CBAs in 2014; malaria prevalence was 17%, diarrhoea prevalence was 7.6% and suspected pneumonia prevalence was 2.1% in children under-five [20]. The rural population corresponded to 66% of the total population. Two rainfall seasons occur in the middle and coastal belts. One major season is in April/July with a peak in June and one minor season is in September/November with a peak in October. The north of Volta Region has one rainy season—May to October with a peak in August.

The iCCM in the Northern Region was supported mainly through UNICEF and targeted all communities. It had a population of 2,479,461 habitants, 20 districts, 210 CHPS and 5000 CBAs in 2014; malaria prevalence was 48%, diarrhoea prevalence was 21.4% and suspected pneumonia prevalence was 6.3% in children under five [21]. The rural population corresponded to 70% of the total population. In the north, the rainy season begins in May and ends in October [22]. Climatically, religiously, linguistically, and culturally, the Northern Region differs greatly from the politically and economically dominating regions of central and southern Ghana, and it is similar to the two other northern regions (Upper East and Upper West).

Measurement of effect

The effectiveness measure used was 'case appropriately diagnosed and treated'. This refers to a malaria, diarrhoea or suspected pneumonia case that received treatment according to treatment guidelines (Table 1) or a child without malaria, diarrhoea or suspected pneumonia that was not prescribed the recommended drugs to treat malaria, diarrhoea or pneumonia. Definitions of a malaria, diarrhoea and suspected pneumonia case are presented in Table 1. Appropriate diagnosis and treatment is a proxy indicator of child mortality. Malaria cases can progress rapidly to complication and death if malaria treatment is not administered in the first 24–48 h from onset of symptoms [23]. Prompt treatment with a full course of effective antibiotics is key to reduce pneumonia deaths [24]. ORS and zinc are effective therapeutic interventions to reduce diarrhea mortality [25].

Data from a cross sectional household survey was used to assess the number of cases appropriately diagnosed and treated under the iCCM and CHPS [19]. In brief, a stratified three stage cluster survey was conducted in the Volta and Northern Regions. In order for the sample to be representative of the whole region, whilst being logistically feasible, regions were divided into three areas. From each area, two districts and from each district four clusters were selected using probability proportional to size. Then, from each cluster 27 households were selected, making a total of 648 households in each region. To select the districts (first stage) the list of districts implementing HBC (all districts implement the CHPS strategy) with its population was used. According to the NMCP, from the 24 districts in the Volta Region, only eight were targeted for the implementation of iCCM and these comprised the sampling frame. In the Northern Region all districts and communities were included in the sampling frame, as iCCM was implemented everywhere. To select the clusters (second stage) the list of communities implementing iCCM with its population was used. Then, households with children under-five that had fever, diarrhoea or cough in the last 2 weeks prior to the interview were randomly selected in each cluster using a modified expanded programme on immunizations sampling technique (third stage) [26]. To select households, a location near the centre of the community was first identified and a random direction was defined by spinning a pen. A random household along the chosen direction pointing outwards from the centre of the community to its boundary was chosen and checked for compliance with the inclusion and exclusion criteria. Whether the criteria were met or not, the next closest household was visited until the required number of households with a child with a fever, diarrhoea or cough in the 2 weeks preceding the survey were surveyed. Interviews were conducted with the carer of the sick child. In cases where there was more than one eligible child in a household, only one of them was selected randomly by ballot paper.

Data collection was done using a structured questionnaire which included socio-demographic information of the carer, care-seeking behaviour, treatment received and source of treatment, experience with health providers and costs involved when seeking care.

Measurement of costs

Economic costing was done from the societal perspective, which considers costs from the perspective of households and the health system. The societal perspective is broader than the health system or government budget perspective [27], and allows comparison with previous studies. It is important to consider household costs because they can be significant, they may deter caregivers

Table 1 Study definitions and treatment guidelines

Definitions	iCCM [5]	CHPS [52]
Malaria	All fever cases when no laboratory tests are available	All fever cases when no laboratory tests are available or when malaria test was positive
Appropriate treatment of malaria	Children aged 6 months to 5 years diagnosed with malaria receiving 3 days of ACT	Children aged 2 months to 5 years diagnosed with malaria receiving 3 days of ACT
	If more than 7 days with fever, general danger signs or severe malaria signs, child must be referred with rectal artesunate	If more than 7 days with fever, general danger signs or severe malaria signs, child must be referred with IM quinine, IM or EV or rectal artesunate plus an IM dose of chloramphenicol
Prompt treatment of malaria	Malaria cases that received an antimalarial drug in within the first 24 h of the onset of symptoms	The same definition as in iCCM
Diarrhoea	3 or more loose or watery stools in a 24-h period	The same definition as in iCCM
Appropriate treatment of diarrhoea	Children older than 6 months with diarrhoea of less than 7 days that receive ORS and zinc for 14 days	Children with diarrhoea of less than 14 days receiving ORS and zinc for 14 days
	If the child is less than 6 months, had diarrhoea for 7 days or more, blood in stools or is dehydrated, he/she should be referred with ORS	If diarrhoea for 14 days or more, blood in stools or is severely dehydrated, he/she should be referred to hospital with ORS
ARI or suspected pneumonia	Cough with fast or difficult breathing[a]	The same definition as in HBC[b]
Appropriate treatment for suspected pneumonia	Children older than 6 months with cough and fast or difficult breathing of less than 7 days receiving amoxicillin for 5 days	Children older than 2 months with cough and fast or difficult breathing of less than 14 days receiving amoxicillin or co-trimoxazol for 5 days
	If the child is less than 6 months or had symptoms for 7 days or more, he/she should be referred	If the child is less than 2 months or had symptoms for 14 days or more, he/she should be referred
	If there are signs of severe pneumonia, he/she should be referred with amoxicillin	If there are signs of severe pneumonia, he/she should be referred with IM chloramphenicol

[a] ARI timers are available in the Northern Region under the iCCM strategy to help diagnose suspected pneumonia. If severe pneumonia is suspected, the child must be referred to a CHPS compound or a Health Centre

[b] Nurses at CHPS compounds do not have ARI timers. The diagnosis is made based on clinical signs. If a severe pneumonia case is suspected, the children must be referred to a higher level of health facility. Some district hospitals, all regional hospitals and teaching hospitals have X-rays to help diagnose pneumonia. Health centres, district hospitals, regional hospitals and teaching hospitals have laboratory facilities to help diagnose malaria, diarrhoea and pneumonia

from using a service and they might be a cause of poverty (catastrophic cost). Data on cost was collected from the household survey, the Health Administration and Support Services division (HASS) of the Ghana Health Service, the National Malaria Control Programme, CHPS and from the NGO Plan International which supports HBC in the Volta Region. Unit cost was defined as the total cost incurred in diagnosing and treating one case of malaria, diarrhoea or suspected pneumonia.

Two activities were used to calculate the cost per case diagnosed and treated: (1) estimation of unit cost for treating a malaria, diarrhoea and suspected pneumonia case from the iCCM, CHPS, and households and (2) combination of unit cost for treating a malaria, diarrhoea and suspected pneumonia case under the iCCM and CHPS strategies with the household costs to obtain unit cost from the societal perspective.

Estimation of unit costs for treating a malaria, diarrhoea and suspected pneumonia case from the iCCM, CHPS and households

iCCM costs

Costs per diagnosing and treating a malaria, diarrhoea and suspected pneumonia case under the iCCM strategy were divided into direct and indirect costs. Direct costs referred to those involved directly in the service. Indirect costs referred to productivity loses due to the time a CBA spent away from their usual activities (attending a sick child). Direct recurrent costs included training of CBAs (according to policy it happens every 2 years), training of supervisors (according to policy it happens every 2 years), supervision (every year), training material for supervisors and CBAs and IEC material for CBAs (last several years), registers (every year) and cost of drugs (every year). Direct capital costs included ARI timers (to measure the breath rate to diagnose suspected pneumonia cases), box to keep CBA items and the incentive package (includes bicycles, raincoats, boots, torchlights and t-shirts) which, according to policy, is given once at the beginning of the intervention to motivate CBAs.

With regards to the Volta Region, Plan International provided information on cost for training CBAs and supervisors. Training expenditures were annualized using the expected life time of 2 years and the recommended discount rate of 3%. Annualizing capital costs means that even though a good has been purchased at a specific point in time, one needs to consider that its benefits will be enjoyed over several years, and therefore, its

costs will be spread over these years. The directorate of the Volta Region provided information on the quantities of training material, registers, boxes and incentive package received from the national level, while the national level provided information about the cost per item sent to the regions. A 10% of freight costs were added to the unit costs. The training and IEC materials, the boxes and the incentive package are supposed to last several years, and therefore, they were annualized using the expected life time of 8 years and the discount rate of 3% [31]. The NMCP reported no ARI timers in the Volta Region. The number of drugs used in 2014 was obtained from the DHIMS2. The cost of drugs used was the median price from a list of suppliers obtained from the International Drug Price Indicator Guide [36] with an addition of 10% freight costs as when calculating CHPS costs.

The regional directorate of the Northern Region provided information about costs of training CBAs and supervisors. Training expenditures were annualized using the expected life time of 2 years and the recommended discount rate of 3% [31]considering that, according to policy, these trainings happen every 2 years. The directorate of the Northern Region provided information on the quantities of training and IEC material, registers, boxes and incentive package received from the national level, while the national level provided information about the cost per item sent to the regions. To these item cost, a 10% of freight costs were added. The training materials, the boxes and the incentive package were annualized using the expected life time of 8 years and the recommended discount rate of 3% as I did for the Volta Region. The unit cost of ARI timers used was US$3.5 plus a 10% of freight costs as recommended by UNICEF. The number of drugs used in 2014 was obtained from the DHIMS2. The cost of drugs used was the median price from a list of suppliers obtained from the International Drug Price Indicator Guide [36] with an addition of 10% freight costs as when calculating CHPS costs and iCCM costs in the Volta Region.

As indirect cost, the time of the CBAs attending a sick child was included. The opportunity cost to their time was estimated from interviews with four CBAs, two in each region. CBA time was assigned a monetary value based on the agricultural labour wage the main occupation of the population, particularly in rural areas [28]—which was 0.41 GHC/h [29, 30]. One GHC was equivalent to US$ 0.31 in 2014. All costs were estimated for 2014 and were converted to US dollars. Direct and indirect costs were allocated to malaria, diarrhoea and suspected pneumonia case management based on the percentage of iCCM activity reported in 2014 through the DHIMS-II.

CHPS costs

Two CHPS compounds were visited in each region to collect information during the 5th to 16th April 2014 in the Volta Region and during the 23rd June to 3rd July 2014 in the Northern Region. The criteria used to select these facilities was average performing facilities based on their activity (outpatient visit per nurse). This information was provided by the regional directorates. In addition, as cost information was collected during the household survey, the criteria of feasibility was also considered. This means that to select two CHPS among average CHPS, those that were closer to the communities being surveyed were considered. Two CHPS compounds were selected in Hohoe district (Volta Region), one in Central Gonja district (Northern Region) and one in Tolon-Kumbugu district (Northern Region).

Direct cost were considered from the CHPS perspective, including recurrent and capital costs (Table 2). As recurrent cost, salaries of personnel including any allowances received, medicines, disposables, stationary, utilities and maintenance costs were considered. 2014 recurrent expenditures were obtained from the financial officer at the respective health districts. Capital cost were the building, vehicles, furniture and equipment that were annualized using the expected life time of 30, 8, 10 and 8 years, respectively, and the recommended discount rate of 3% [31]. The size of the CHPS facilities was estimated based on plans of standard CHPS facilities available from the HASS division. The information on construction cost per m^2 for such buildings was obtained from the same division. An inventory of equipment and furniture was developed during the field visits at the two CHPS in each region. These items were valued using a price list from the HASS division. If the cost of an existing equipment or furniture was not in the list provided by the HASS division, market surveys were conducted to value these items. To do this, the average of a sample of at least three different prices were considered for one equipment or furniture as suggested in the guidelines for cost data collection in the field in ACT consortium projects [32]. These sample prices were mainly obtained online in the case of equipment and in Ghanaian shops in the case of furniture. All costs were estimated for 2014 (taking into account the inflation rates when needed) and were converted to US dollars.

The allocation of recurrent and capital costs to outpatient visits was performed using the standard step down costing methodology [33]. First, all resources were allocated to all cost centres using different allocation criteria suggested in the guidelines of ACT consortium projects [32] (step 1). Then, the overhead costs were allocated to support and final centres also using relevant allocation

Table 2 Cost per diagnosing and treating a malaria, diarrhoea and suspected pneumonia case under the iCCM strategy in the Volta and Northern Region in 2014 (US$)

	Volta Region			Northern Region		
	Malaria	Diarrhoea	Pneumonia	Malaria	Diarrhoea	Pneumonia
Programme costs						
Training CBAs	881.43	125.57	40.73	18,756.66	25,024.98	9579.92
Training supervisors	446.84	63.66	20.65	7062.53	9422.77	3607.17
Supervision	0.00	0.00	0.00	1473.76	1966.28	752.72
Training and IEC materials	60.93	8.68	2.82	1069.25	1426.58	546.11
CBA drugs	36,088.88	837.48	1266.76	12,698.00	4343.24	5966.96
ARI timers	0.00	0.00	0.00	0.00	0.00	658.15
Registers	430.25	61.29	19.88	5961.00	7953.11	3044.57
Time of CBAs	1426.16	210.89	68.40	484.11	645.90	247.26
Drugs box	86.39	12.31	3.99	1448.60	1932.72	739.87
Incentive package	1167.01	166.25	53.92	20,478.34	27,322.03	10,459.27
Total programme costs	40,587.89	1486.12	1477.14	69,432.25	80,037.61	35,602.01
Average cost per case	1.54	0.38	1.12	7.77	6.72	7.80

criteria (step 2). Finally, support centres costs were allocated to outpatient visits (step 3).

To differentiate cost per malaria, diarrhoea and suspected pneumonia treatment in under-fives from the rest of the outpatient visits, a bottom up costing method was conducted. Interviews with staff captured self-reported time for doing a RDT and treating a case of malaria, diarrhoea and suspected pneumonia in children under-5 years of age. The average cost of RDT was taken from two market surveys by the Global Fund and the Programme for Appropriate Technology in Health (PATH) [34, 35] which gave an average cost of US$0.35 plus a 10% of freight costs. Details of the drugs given were taken from a sample of patients (between 6–12 cases per disease in each CHPS). The cost of drugs used was the median price from a list of suppliers obtained from the International Drug Price Indicator Guide [36] with an addition of 10% freight costs as recommended by the guide.

Household costs

Household costs incurred when visiting a CBA or a CHPS facility were also divided into direct and indirect cost. Direct costs included cost per transport to provider and any other direct cost incurred at the provider such as drug costs or diagnostic costs. Indirect costs related to productivity loses and referred to time travelling to a CBA/CHPS and time spent at/with the provider. These costs were obtained from the household survey conducted in 2014. Cost of carers time was calculated based on the agricultural labour wage [29, 30].

These household costs were obtained from the household survey conducted in 2014. Carers seeking care when their child was sick, were asked about all the different cost involved based on the different provider they visited. Therefore, household costs when visiting a CBA or a CHPS (or any other provider) were different and were accounted in the analysis.

Estimation of unit costs for treating a malaria, diarrhoea and suspected pneumonia case under the HBC and CHPS strategy from the societal perspective

Facility and programme costs were added to the household costs to obtain costs from the societal perspective under the HBC and CHPS strategies. Household costs related to drugs or RDT were also considered (even if they were already included when analysing the unit cost for the management of malaria, diarrhoea and suspected pneumonia from the HBC and CHPS perspective). Although the difference between including or excluding these costs was very little, as they are an extra cost for the household, it was decided to include them in the final cost.

Data from the survey showed that no deaths were reported after visiting a CBA or a CHPS in the Volta and Northern Regions. Reported referrals after visiting a CBA were 14.1 and 20.1% in the Volta and Northern Region, respectively, and 5.9 and 4.3% after visiting a CHPS compound. However, 42 and 63% of carers sought care elsewhere after using iCCM and 28 and 7.9% after using CHPS in the Volta and Northern Regions, respectively. This high proportion of carers visiting a second provider (particularly for the iCCM strategy) is important as it represents an extra cost to diagnose and treat a case. Therefore, costs due to this second visit to a provider

were also taken into consideration and added to the unit cost for the diagnosis and management of malaria, diarrhoea and suspected pneumonia. To do this, the proportion of carers that sought care to a health facility or to a licensed chemical seller because of malaria, diarrhoea or suspected pneumonia was multiplied by the cost of a second visit. The cost of the second visit was calculated by adding programme/facility costs to household costs. This included: (1) the average of iCCM cost for diagnosing and treating a malaria, diarrhea and suspected pneumonia (if second provider was a licensed chemical seller or a drug peddler), or CHPS cost (if second provider was a health facility); (2) the average cost for traveling to the second provider and (3) the average money spent at the second provider visited. Taking into account that CHPS were the health facility more often used in this second visit, and that expenditures from other health facilities, from licensed chemical sellers or from drug peddlers were not available, it was believed that using CHPS and CBA cost was the best approach to calculate the cost for diagnosis and treating a case in the second visit.

Measurement of the cost-effectiveness

The appropriate comparison of costs and effects between two programmes or interventions is the incremental cost-effectiveness ratio (ICER) [33]. In this study, rather than presenting ICERs numerically, the results were presented with the aim of helping to guide policy makers. Based on the cost-effectiveness plane [33], the following classifications were used to explore in which circumstances it might be appropriate to support the HBC strategy with public funds:

a. iCCM dominates: iCCM is less costly and more effective.
b. iCCM is more costly and more effective.
c. iCCM is less costly and less effective.
d. iCCM is dominated: iCCM is more costly and less effective.

From a policy-maker's perspective, if iCCM dominates it would justify the support of this strategy with public funds, without necessarily saying that the CHPS strategy should be discontinued (as iCCM aims to complement CHPS—and not to substitute them—as a strategy to increase access to quality treatment). If iCCM is more costly and more effective, the decision on financing iCCM or not will depend on the government's willingness to pay, as there is no threshold to suggest how much extra money is reasonable to pay per extra case appropriately treated (while there is a suggested threshold on cost per DALYs averted or QALY gained that considers an intervention "highly attractive" or cost-effective [37]). If iCCM is less costly but less effective, it is not likely to be considered worthwhile using public funds unless the difference in effectiveness is minimal. If iCCM is dominated, this suggests that the intervention should not be supported as it is currently being implemented.

Sensitivity analysis

To deal with uncertainty in this study a one-way sensitivity analysis was conducted. The parameters chosen for the sensitivity analysis were discounting rates (3, 5 and 7%), facility costs (average, lower and higher costs), different degrees of iCCM and CHPS utilization (based on the limits of the 95% CI obtained from the household survey) and iCCM effectiveness (50% increase and decrease).

Results

Calculation of the unit costs for diagnosing and treating a malaria, diarrhoea and suspected pneumonia case in children under-5 years of age from the health system, household and societal perspective is presented, followed by the cost-effectiveness and sensitivity analyses.

Unit cost for treating a malaria, diarrhoea and suspected pneumonia case from iCCM, CHPS, and households

Average iCCM programme costs in the Volta Region were lower when compared with those of the Northern Region: diagnosing and treating a malaria case costs US$1.54 and US$7.77, a diarrhoea case costs US$0.38 and US$6.72 and a suspected pneumonia case cost US$1.12 and US$7.80 in the Volta and Northern Region, respectively (Table 2). The much higher iCCM costs in the Northern Region when compared with those of the Volta Region was mainly due to (1) higher costs for training and for the incentive package in the Northern Region (due to a higher number of CBAs); (2) a lower number of visits to sick children in the Northern Region (17,898 and 30,839 visits in the Northern Region and Volta Region) and (3) a much lower number of IEC activities (177,484 and 99 IEC activities conducted in the Volta Region and the Northern Region).

Across the Volta and the Northern Regions, the cost per diagnosing and treating a malaria case in a CHPS varied from US$4.65 to US$9.95; the cost per treating a diarrhoea case varied from US$3.05 to US$8.16 and the cost per treating a suspected pneumonia cased varied from US$3.11 to US$8.79 (Table 3). When compared with the Northern Region, the Volta Region had the lower and higher costs per malaria, diarrhoea and suspected pneumonia case diagnosed and treated across both regions. These differences in the Volta Region were mainly due to the existence of a bigger facility with smaller reported activity compared to a smaller facility

Table 3 Cost per diagnosing and treating a malaria, diarrhoea and suspected pneumonia case in four CHPS facilities in the Volta and Northern Region in 2014 (US$)

	Volta Region						Northern Region					
	CHPS 1			CHPS 2			CHPS 1			CHPS 2		
	Malaria	Diarrhoea	Pneumonia	Malaria	Diarrhoea	Pneumonia	Malaria	Diarrhoea	Pneumonia	Malaria	Diarrhoea	Pneumonia
Recurrent expenditures												
Salaries	625.15	338.48	43.72	582.09	119.40	104.48	745.52	342.01	9.84	1386.98	290.05	7.91
Stationery	9.15	4.96	0.64	4.84	0.99	0.87	2.16	0.99	0.03	56.08	11.73	0.32
Utilities	0.00	0.00	0.00	2.04	0.42	0.37	0.00	0.00	0.00	2.24	0.47	0.01
Training	12.46	6.75	0.87	3.02	0.62	0.54	54.83	25.15	0.72	35.33	7.39	0.20
Capital expenditures												
Buildings	15.73	8.52	1.10	34.81	7.14	6.25	12.86	5.90	0.17	17.55	3.67	0.10
Equipment	54.30	29.40	3.80	9.41	1.93	1.69	82.78	37.97	1.09	18.06	3.78	0.10
Furniture	7.32	3.96	0.51	10.43	2.14	1.87	4.15	1.90	0.05	1.82	0.38	0.01
Overhead												
Administration	37.32	20.21	2.61	86.54	17.75	15.53	30.75	14.11	0.41	60.82	12.72	0.35
Accounting	10.41	5.64	0.73	92.10	18.89	16.53	15.41	7.07	0.20	118.90	24.86	0.68
Health information	20.38	11.04	1.43	113.58	23.30	20.39	10.36	4.75	0.14	345.80	72.32	1.97
Cleaning	71.27	38.59	4.99	61.16	12.55	10.98	7.48	3.43	0.10	26.90	5.63	0.15
Laundry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.40	9.91	0.27
Stores	28.22	15.28	1.97	26.38	5.41	4.73	0.00	0.00	0.00	134.51	28.13	0.77
Security	0.00	0.00	0.00	52.08	10.68	9.35	0.00	0.00	0.00	0.00	0.00	0.00
Support centres												
Dispensary drugs	499.06	115.27	16.52	33.07	19.91	35.23	365.31	102.18	7.42	1739.20	99.70	4.30
Dispensary overhead	71.98	38.97	5.03	96.70	19.84	17.36	0.00	0.00	0.00	111.46	23.31	0.64
Diagnostics	330.36	0.00	0.00	344.65	0.00	0.00	109.81	0.00	0.00	273.12	0.00	0.00
Total	1793.12	637.06	83.93	1552.90	260.97	246.16	1441.42	545.47	20.17	4376.15	594.04	17.79
Average cost per case	4.65	3.05	3.11	9.95	8.16	8.79	4.76	3.92	5.04	8.32	5.40	5.93

with higher reported activity. In the Northern Region, the micro-costing exercise showed that the large differences observed in diagnosing and treating a malaria case in the two CHPS sampled were mainly due to the use of ACT syrup in one of the CHPS (which cost US$ 0.1/ml) instead of ACT tablets (which costs US$ 0.01/tablet).

Diagnosing and treating malaria was found to be more costly than diarrhoea or suspected pneumonia in 3 out of 4 CHPS facilities. All three diseases needed similar resources in terms of building, furniture and equipment. However, in the case of malaria the cost increased because of the time invested in doing the RDT and the laboratory costs. In addition, and as mentioned above, the cost of ACT syrup was higher than the cost of ACT tablets and higher than ORS (0.07/sachet), zinc (0.02/tablet) or amoxicillin (0.004/ml). Household costs represent the cost of time used to travel to the provider, the money spent on travel, the cost of time spent with the provider, the money spent at the provider in terms of food and other costs involved such as paying for the service or for drugs. As expected, household costs were higher when visiting a CHPS facility than when visiting a CBA, particularly because of longer distances from households to a CHPS facility than to a CBA, higher cost of transport and longer time at a CHPS facility than with a CBA. Household costs ranged from US$0.04 when visiting a CBA in the Northern Region (corresponding to a 0.4% of the total cost per case) to US$1.54 when visiting a CHPS in the Volta Region (corresponding to 20.6% of the total cost per case) (Table 4).

Unit cost for treating a malaria, diarrhoea and suspected pneumonia case from the societal perspective

To obtain costs from the societal perspective, household costs were added to programme costs of the iCCM and CHPS strategies (Table 5).

Costs involved due to a second visit to a provider after visiting a CBA or a CHPS facility were added to programme/facility costs. In the Volta Region, average costs for this second visit were US$3.34 and US$0.41 per malaria case treated under the iCCM and CHPS strategy respectively; US$0.41 and US$0.11 per diarrhoea case treated under the iCCM and CHPS strategy and US$0.14 and US$0.02 per suspected pneumonia case treated under the iCCM and CHPS strategy respectively. In the Northern Region, average costs for the second visit to a provider were US$1.56 and US$0.61 per malaria case under the iCCM and CHPS strategy respectively; US$1.53 and US$0.16 per diarrhoea case treated under the iCCM and CHPS strategy and US$0.66 and US$0.001 per suspected pneumonia case treated under the iCCM and CHPS strategy, respectively.

After adding household costs and those of the second visit to a provider, the cost per diagnosing and treating a malaria case under the iCCM strategy was US$4.96 and US$9.37 in the Volta and Northern Regions and US$9.52 and US$8.07 in a CHPS in the Volta and the Northern Regions; to treat a diarrhoea case costs US$0.88 and US$8.36 under the iCCM in the Volta and Northern Regions and US$7.25 and US$5.54 in a CHPS in the Volta and the Northern Regions. Finally, treating a suspected pneumonia case cost US$1.33 and US$8.50 under the iCCM strategy in the Volta and the Northern Regions and US$7.45 and US$6.73 in a CHPS in the Volta and the Northern Regions, respectively.

Cost-effectiveness analysis

Tables 6, 7 and 8 presents the average cost per case appropriately diagnosed and treated (average cost per malaria, diarrhoea and suspected pneumonia cases appropriately diagnosed and treated according to protocol in a group of 100 eligible children, meaning that those that needed the treatment received it, and those that did not need the treatment did not receive it) and the ICERs. Due to the low numbers of children visiting a CBA in the Northern Region [19], the iCCM data of the Northern Region were excluded from this analysis.

In the Volta Region, iCCM was more attractive than CHPS not only for the appropriate diagnosis and treatment of malaria, but also for the appropriate treatment of diarrhoea and suspected pneumonia. Note that even though the GFATM only provides ACT drugs for the iCCM strategy in the Volta Region, CBAs received training for the management of the three diseases [19]. If no drugs were available to treat a diarrhoea and pneumonia case (CBAs were provided with ORS, zinc and amoxicillin in 2013), CBAs were supposed to refer cases for further management, and this referral was also considered as appropriate treatment.

The average cost per malaria, diarrhoea and suspected pneumonia case appropriately diagnosed and treated was lower under the HBC than under the CHPS strategy. iCCM had lower costs than CHPS to diagnose and treat malaria, diarrhoea and suspected pneumonia cases while the effectiveness of both strategies was similar or slightly higher under the iCCM strategy (Tables 6, 7, 8).

The ICERs showed that HBC dominates CHPS for the prompt ACT or quinine treatment of malaria, for the treatment of diarrhoea with ORS or referred and for the treatment of diarrhoea with ORS and zinc (or referred). In the case of the management of suspected pneumonia, HBC was less costly and had the same effectiveness of CHPS. The management of malaria with ACT or quinine (including prompt and not prompt treatment) merits a further comment. Treating a malaria case under iCCM

Table 4 Cost per diagnosing and treating a malaria, diarrhoea and suspected pneumonia cases from the household perspective under the iCCM and CHPS strategy in the Volta and Northern Region in 2014 (US$)

Variables	Volta Region						Northern Region					
	CBA			CHPS			CBA			CHPS		
	Malaria	Diarrhoea	Pneumonia	Malaria	Diarrhoea	Pneumonia	Malaria	Diarrhoea	Pneumonia	Malaria	Diarrhoea	Pneumonia
Value of time lost to provider (1)	0.03	0.03	0.03	0.12	0.12	0.12	0.02	0.02	0.02	0.08	0.08	0.08
Travel cost (2)	0.00	0.00	0.00	1.10	1.10	1.10	0.00	0.00	0.00	0.18	0.18	0.18
Value of time lost at provider (3)	0.03	0.03	0.03	0.05	0.05	0.05	0.02	0.02	0.02	0.07	0.07	0.07
Food in provider (4)	0.01	0.01	0.01	0.22	0.22	0.22	0.00	0.00	0.00	0.35	0.35	0.35
RDT cost (5)	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00
Drug cost (6)	0.01	0.03	0.00	0.25	0.05	0.00	0.00	0.08	0.00	0.12	0.03	0.54
Average cost per case	0.07	0.09	0.06	1.81	1.54	1.49	0.04	0.11	0.04	0.91	0.72	1.24

(1) Refers to the value of time carers spent travelling to provider to sick care for their children; (2) Money spent on transport to provider by carers when seeking care; (3) Value of time spent at provider by carers when seeking care; (4) Money spent by carers buying food at provider when seeking care for their children; (5) Money spent paying for RDT; (6) Money spent paying for drugs

Table 5 Cost per diagnosing and treating a malaria, diarrhoea and suspected pneumonia case from the societal perspective under the iCCM and CHPS strategy in the Volta and Northern Region in 2014 (US$)

	Volta Region						Northern Region					
	CBA			CHPS			CBA			CHPS		
	Malaria	Diarrhoea	Pneumonia	Malaria	Diarrhoea	Pneumonia	Malaria	Diarrhoea	Pneumonia	Malaria	Diarrhoea	Pneumonia
Provider perspective												
Programme cost per case	1.54	0.38	1.12	7.30	5.60	5.95	7.77	6.72	7.80	6.54	4.66	5.49
If second provider was sought	3.34	0.41	0.14	0.41	0.11	0.02	1.56	1.53	0.66	0.61	0.16	0.00
Total facility/programme cost per case	4.88	0.79	1.26	7.71	5.71	5.97	9.33	8.24	8.46	7.15	4.82	5.49
Household perspective												
Value of travel time lost to provider	0.03	0.03	0.03	0.12	0.12	0.12	0.02	0.02	0.02	0.08	0.08	0.08
Travel cost	0.00	0.00	0.00	1.10	1.10	1.10	0.00	0.00	0.00	0.18	0.18	0.18
Value of time lost at provider	0.03	0.03	0.03	0.05	0.05	0.05	0.02	0.02	0.02	0.07	0.07	0.07
Food in provider	0.01	0.01	0.01	0.22	0.22	0.22	0.00	0.00	0.00	0.35	0.35	0.35
RDT	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00
Drugs	0.01	0.03	0.00	0.25	0.05	0.00	0.00	0.08	0.00	0.12	0.03	0.54
Total household cost per case	0.07	0.09	0.06	1.81	1.54	1.49	0.04	0.11	0.04	0.91	0.72	1.24
Average cost per case	4.96	0.88	1.33	9.52	7.25	7.45	9.37	8.36	8.50	8.07	5.54	6.73

Table 6 Cost-effectiveness for diagnosing and treating malaria per 100 eligible children from de societal perspective in 2014 (US$)

Variables	Volta Region		Northern Region	
	iCCM	CHPS	iCCM	CHPS
Number of eligible children for treatment	100	100		100
Number treated with ACT or quinine[a]	24	19		30
Number treated with prompt ACT or quinine	17	4		23
Number treated according to protocol (ACT or quinine)	28	30		35
Number treated according to protocol (prompt ACT or quinine)	21	15		27
Costs per 100 children (ACT or quinine)	US$119.04	US$182.30		US$244.57
Cost per child treated according to protocol (ACT or quinine)	US$4.25	US$6.12		US$7.09
Cost per child treated according to protocol (prompt ACT or quinine)	US$5.58	US$12.24		US$8.92
Incremental costs per 100 children (ACT or quinine)	US$63.26			
Incremental effect per 100 children (ACT or quinine)	2			
Incremental cost-effectiveness ratio (ACT or quinine)	iCCM is less costly and less effective			
Incremental costs per 100 children (prompt ACT or quinine)	US$63.26			
Incremental effect per 100 children (prompt ACT or quinine)	6			
Incremental cost-effectiveness ratio (prompt ACT or quinine)	iCCM is dominant			

[a] *Source* Additional file 1

Table 7 Cost-effectiveness for diagnosing and treating diarrhoea per 100 eligible children from de societal perspective in 2014 (US$)

Variables	Volta Region[b]		Northern Region	
	iCCM	CHPS	iCCM	CHPS
Number of eligible children for treatment	100	100		100
Number treated with ORS (or referred)[a]	8	11		7
Number treated with ORS and zinc (or referred)	11	7		4
Number treated according to protocol (ORS or referred)	59	57		62
Number treated according to protocol (ORS and zinc)	54	43		59
Costs per 100 children (ORS)	US$6.84	US$83.20		US$38.88
Cost per 100 children (ORS and zinc)	US$9.78	US$47.54		US$19.44
Cost per child treated according to protocol (ORS or referred)	US$0.12	US$1.45		US$0.62
Cost per child treated according to protocol (ORS and zinc)	US$0.18	US$1.12		US$0.33
Incremental costs per 100 children (ORS or referred)	US$76.35			
Incremental effect per 100 children (ORS or referred)	2			
Incremental cost-effectiveness ratio (ORS or referred)	iCCM is dominant			
Incremental costs per 100 children (ORS or referred)	US$37.76			
Incremental effect per 100 children (ORS or zinc)	11			
Incremental cost-effectiveness ratio (ORS and zinc)	iCCM is dominant			

[a] *Source* Additional file 2

[b] Appropriate treatment for diarrhoea under the iCCM strategy in the Volta Region includes those treated with ORS and zinc or referred for further management. The cost per treatment of those referred is included to allow comparison with CHPS

was less costly (US$119.04 versus US$182.30 were used to treat 100 children under the iCCM and CHPS strategy, respectively) but slightly less effective than under the CHPS strategy (28 and 30% of cases were treated according to protocol under iCCM and CHPS, respectively). Due to the small difference in effectiveness and the larger difference in cost, it can be concluded that iCCM was also cost-effective for the treatment of malaria with ACT or quinine when the promptness in treatment was not considered.

Sensitivity analysis

The one-way sensitivity analysis explored how varying specific values influenced the average cost per case

Table 8 Cost-effectiveness for diagnosing and treating suspected pneumonia per 100 eligible children from de societal perspective in 2014 (US$)

Variables	Volta Region[b]		Northern Region	
	iCCM	CHPS	iCCM	CHPS
Number of eligible children for treatment	100	100		100
Number treated with amoxicillin or cotrimoxazol[a]	15	16		23
Number treated according to protocol	72	72		73
Costs per 100 children	US$19.87	US$122.13		US$156.44
Cost per child treated according to protocol	US$0.274	US$1.693		US$2.13
Incremental costs per 100 children	US$102.25			
Incremental effect per 100 children	0			
Incremental cost-effectiveness ratio	iCCM is less costly and the same effective than CHPS			

[a] *Source* Additional file 3

[b] Appropriate treatment for suspected pneumonia under the iCCM strategy in the Volta Region includes those treated with amoxicillin or referred for further management. The cost per treatment of those referred is included to allow comparison with CHPS

appropriately diagnosed and treated from the societal perspective in both strategies as well as the ICERs. For simplicity in presenting the data, only one ICER per disease was included, the one that better reflects the adherence to guidelines (prompt ACT for malaria, ORS and zinc for the management of diarrhoea and amoxicillin for the management of suspected pneumonia). iCCM in the Volta Region remained more cost-effective than CHPS for the diagnosis and treatment of malaria, diarrhoea and suspected pneumonia cases when using different facility costs, different discount rates and different iCCM and CHPS utilization. When iCCM effectiveness was reduced by 50%, iCCM remained cost-effective only for the treatment of diarrhoea (Table 9).

Discussion

Before the adoption of the iCCM and CHPS strategies in the Ghana Health System, RCT were conducted to assess their efficacy in Ghana [13, 16]. In addition, another study was conducted to assess the cost-effectiveness of two strategies of HBC [38], although without presenting the cost per fever treated under the standard care. The current evaluation used data from an observational study to analyse the cost-effectiveness of iCCM and CHPS strategies after 2 and 8 years of iCCM implementation in the Volta and the Northern Regions respectively for the treatment of malaria, diarrhoea and suspected pneumonia in children under-five. Results from this evaluation may be used to improve iCCM and CHPS implementation and to guide policy makers in the discussion about long term financing of iCCM.

This study brings more light to the scarce evidence on iCCM cost-effectiveness. Three comparable studies were found on the cost-effectiveness of malaria HBC versus standard care conducted in Ghana [38], Uganda [39] and Zambia [40]. No studies were found on the cost-effectiveness of treatment of diarrhoea and/or pneumonia delivered through iCCM. A systematic review that looked at the effect of community-case management of pneumonia in Africa concluded that there is a lack of evidence on its efficacy [41].

Results from the current study showed that iCCM in the Volta Region was more cost effective than CHPS for the management of malaria, diarrhoea and suspected pneumonia in children under-five, even after the sensitivity analysis modifying health facility costs, discount rates and service utilization. However, if the iCCM effectiveness was reduced by 50%, HBC remained less costly but less effective than CHPS and therefore, less cost-effective. These results are coherent with the three studies mentioned above, which concluded that iCCM was more cost-effective than the standard care (defined as the care received from a health facility). The RCT conducted in the south of Ghana [38] and the Markov modelling using data from Uganda [42] looked at the cost per DALY averted. The study conducted in Zambia [40] used case appropriately diagnosed and treated as the effectiveness measure, concluding that malaria iCCM was more cost-effective than the standard care. Some differences however can be seen between the Zambia study and the current study: the Zambia analysis was done from the provider perspective, used registries instead of survey data to assess effectiveness, and RDTs were used within the iCCM strategy. Excluding household costs could bias results in favour of CHPS (the current study showed that household costs were higher when visiting a CHPS than a CBA). Using registries instead of surveys to collect effectiveness data could also introduce differences: registers might suffer from incomplete reporting and survey data might suffer from recall bias and misinterpretation of symptoms. Using an RDT for malaria diagnosis in iCCM could increase iCCM cost (due to staff time and

Table 9 Sensitivity to selected parameters of the cost-effectiveness ratio and the incremental cost-effectiveness ratio (ICER) for treating malaria, diarrhoea and suspected pneumonia in children under-five under iCCM and CHPS in the Volta Region

Indicators	iCCM	CHPS	iCCM	CHPS	iCCM	CHPS
	Average facility cost		**More costly facility**		**Less costly facility**	
Costs per 100 children (ACT or quinine)	119.0	182.3	141.1	234.0	97.0	130.6
Number treated according to protocol (prompt ACT or quinine)	21	15	21	15	21	15
Incremental cost-effectiveness ratio (prompt ACT or quinine)	iCCM dominates		iCCM dominates		iCCM dominates	
Cost per 100 children (ORS and zinc)	9.8	47.5	11.2	64.4	8.3	30.7
Number treated according to protocol (ORS and zinc)	54	43	54	43	54	43
Incremental cost-effectiveness ratio (ORS and zinc)	ICCM dominates		iCCM dominates		iCCM dominates	
Costs per 100 children (amoxicillin)	19.9	122.1	20.5	168.9	19.1	75.6
Number treated according to protocol (amoxicillin)	72	72	72	72	72	72
Incremental cost-effectiveness ratio (amoxicillin)	iCCM less costly/same effectiveness		iCCM less costly/same effectiveness		iCCM less costly/same effectiveness	
	3% discount rate		**5% discount rate**		**7% discount rate**	
Costs per 100 children (ACT or quinine)	119.04	182.30	121.20	187.66	127.68	202.60
Number treated according to protocol (prompt ACT or quinine)	21	15	21	15	21	15
Incremental cost-effectiveness ratio (prompt ACT or quinine)	iCCM dominates		iCCM dominates		iCCM dominates	
Cost per 100 children (ORS and zinc)	9.78	47.54	9.78	48.46	9.89	49.84
Number treated according to protocol (ORS and zinc)	54	43	54	43	54	43
Incremental cost-effectiveness ratio (ORS and zinc)	iCCM dominates		iCCM dominates		iCCM dominates	
Costs per 100 children (amoxicillin)	19.87	122.13	19.87	124.59	19.87	127.87
Number treated according to protocol (amoxicillin)	72	72	72	72	72	72
Incremental cost-effectiveness ratio (amoxicillin)	iCCM less costly/same effectiveness		iCCM less costly/same effectiveness		iCCM less costly/same effectiveness	
	Average utilization		**Higher utilization**		**Lower utilization**	
Costs per 100 children (ACT or quinine)	119.04	182.30	110.40	166.21	144.00	226.91
Number treated according to protocol (prompt ACT or quinine)	21	15	21	15	21	15
Incremental cost-effectiveness ratio (prompt ACT or quinine)	iCCM dominates		iCCM dominates		iCCM dominates	
Cost per 100 children (ORS and zinc)	9.78	47.54	8.67	43.48	12.78	50.23
Number treated according to protocol (ORS and zinc)	54	43	54	43	54	43
Incremental cost-effectiveness ratio (ORS and zinc)	iCCM dominates		iCCM dominates		iCCM dominates	
Costs per 100 children (amoxicillin)	19.87	122.13	14.64	112.13	36.46	128.85
Number treated according to protocol (amoxicillin)	72	72	72	72	72	72
Incremental cost-effectiveness ratio (amoxicillin)	iCCM less costly/same effectiveness		iCCM less costly/same effectiveness		iCCM less costly/same effectiveness	

Table 9 continued

	Average effectiveness		Higher effectiveness		Lower effectiveness	
Costs per 100 children (ACT or quinine)	119.04	182.30	111.86	178.28	88.40	186.13
Number treated according to protocol (prompt ACT or quinine)	21	15	31	15	11	15
Incremental cost-effectiveness ratio (prompt ACT or quinine)	iCCM dominates		iCCM dominates		iCCM is less costly and less effective	
Cost per 100 children (ORS and zinc)	9.78	47.54	6.82	47.15	14.40	47.87
Number treated according to protocol (ORS and zinc)	54	43	59	43	49	43
Incremental cost-effectiveness ratio (ORS or zinc)	iCCM dominates		iCCM dominates		iCCM dominates	
Costs per 100 children (amoxicillin)	19.87	122.13	19.55	121.97	19.97	122.30
Number treated according to protocol (amoxicillin)	72	72	80	72	65	72
Incremental cost-effectiveness ratio (amoxicillin)	iCCM dominates		iCCM dominates		iCCM is less costly and less effective	

laboratory costs) but drug costs might be reduced (if CHW adhere to RDT results).

The cost-effectiveness analysis was not conducted in the Northern Region due to the low numbers of carers visiting a CBA. However, the cost analysis showed that iCCM programme costs in the Northern Region were higher than those in the Volta Region and higher than CHPS costin the Volta and in Northern Region, particularly due to the higher number of CBAs registered doing few preventive and curative activities.

Long term financing is a cornerstone of iCCM, often financed by health partners without a clear sustainability strategy. However, if iCCM is an effective and cost-effective intervention, other financial plans must be considered. In Ghana, the NHIS pays health providers for services included in the insurance benefit package. A condition to include a service into the NHIS benefit package is its cost-effectiveness. The current study showed that the curative component of the iCCM strategy in the Volta Region was more cost-effective than CHPS. In addition, iCCM contributes to health equity as it was able to reach the poorest in the Volta Region [19], and it was associated with disease knowledge and healthy behaviours in the Northern Region.

All these points should make the iCCM strategy "attractive" to be included in the NHIS benefit package. However, the NHIS must have the money to finance this strategy without increasing the already high burden of the insurance expenditure. In the period 2009–2013 the NHIS expenditures exceeded revenues [43–45]. The 2014 and 2015 reports were not available. Revising the NHIS benefit package as planned in 2014 [46] and considering iCCM strategy among the possible benefits based on the results of this study could be a positive way forward. From the point of view of implementation, it is important to reflect on how the NHIS could reimburse iCCM activities. CHPS are facilities registered under the NHIS. CBAs curative activities reported to CHPS could be reimbursed by the NHIS as activities related to CHPS, which is informally happening already in some districts. If the preventive component of iCCM is also considered (which is likely to be cost-effective when compared to CHPS-because of its lower costs and higher effect on disease knowledge and health behaviour, although not assessed here), some IEC activities, particularly those done in partnership with CHPS under Community, IMCI could also be reimbursed by the NHIS. This could help the sustainability of iCCM, retain CBAs and improve the quality of the intervention. However, control measures must be put in place to avoid reporting false activity. Another issue to be considered is the acceptability, particularly of the CHPS and the NHIS. An acceptability study should be conducted to assess the perceptions of different stakeholder.

Limitations of the study

The effectiveness measure in this study was obtained from a cross sectional study. Effectiveness data in economic evaluations are often recommended to be from RCT although there are limitations such as the comprehensiveness (only one source of data) and the short time horizons. To overcome these limitations, there is now a tendency to use data from systematic reviews or even better, from decision analytic modelling [33]. This is true if one wants to prove the efficacy and efficiency of a new intervention. But if one wants to evaluate the effectiveness and efficiency of a proven intervention in a real life routine setting, meaning evaluating its costs and effects during actual implementation as in an ex-post HTA, then data from observational studies are more relevant [3, 4, 33] and have been used in several studies in the UK, Asia and Africa [40, 47–51].

The effectiveness measure used was 'case appropriately diagnosed and treated' as a proxy indicator of child mortality. Even though intermediate outputs are admissible in cost-effectiveness analysis (although it is better to use a final health outcome) [33], this measure might bring difficulties when summarizing results from each of the three diseases evaluated. However, the fact that results were similar among the three diseases evaluated (iCCM was more cost-effective for the treatment of malaria, diarrhoea and suspected pneumonia) made the interpretation easier. In addition, the effectiveness measure used does not have a threshold to define whether an intervention is cost-effective or not. Ideally, the government should be questioned about their willingness to pay per extra case appropriately treated. However, as the iCCM strategy was less costly than CHPS, this limitation was solved. Case appropriately diagnosed and treated measures the quality of care given as it refers to adherence to guidelines. However, it does not consider the outcome of death or disability (although the cost for visiting a second provider was considered in case the child did not recover). Even it would not be expected that not considering death and disability might influence the results—no deaths or disability were reported—using DALYs or QALYs might have solved the issue of the different end points of treatment. In addition, the use of DALYs/QALYs might have allowed a comparison of the study results with other diseases and studies.

Case appropriately diagnosed in this study refers to adherence to guidelines and not to adherence to microscopy results which is the gold standard method for diagnosing malaria (which cannot be performed at this community level). This means that the appropriate diagnosis of malaria under the iCCM strategy refers to a child with fever, while in the CHPS refers to a child with a positive RDT or a child with fever if not RDT was performed. Although some fever cases might be misclassified as malaria cases, this is something to consider when revising the iCCM guidelines but not in this current study (which objective is to assess the iCCM and CHPS implementation and the adherence to guidelines).

Data from the cross-sectional study brought relevance to the evaluation but also brought limitations. Carers of sick children chose their providers based on different criteria (such as proximity, trust, availability or perceived severity of disease), reflecting the actual utilization of the services. This self-selection also affected the cost-effectiveness analysis: few carers of sick children chose to visit a CBA in the Northern Region. Due to these low numbers of carers visiting a CBA in the Northern Region it was not possible to conduct the cost-effectiveness analysis. Self-selection is a factor to be considered when addressing cost- effectiveness. Children would have been taken to a CHPS if their disease was perceived to be more severe by their carer, reducing the cost-effectiveness of CHPS compared to iCCM. However, this study aimed to assess the cost-effectiveness of iCCM in the routine system, and therefore, this self-selection should be considered as part of the system and not as a source of bias.

Sources of facility costs came from data of two CHPS in the Volta Region and two in the Northern Region. Although the analysis took into consideration average costs, and higher and lower facility cost for the sensitivity analysis, it would have been better to have at least one more CHPS in each region to have a better representation of CHPS costs. Unfortunately, it was not possible to add another CHPS to the cost analysis.

Finally, different epidemiological burden would not be expected to influence results, as the target population was children with symptoms. However, finding these children when doing the data collection was easier in the Northern Region as the prevalence of the three diseases was higher.

Conclusions

This study added to the scarce evidence on the iCCM cost-effectiveness. iCCM for treating malaria, diarrhoea and suspected pneumonia in children under-5 years of age was more cost-effective than treatment through CHPS in the Volta Region. High programme costs in addition to low curative and preventive activities made the HBC strategy in the Northern Region more costly than in the Volta Region. A revision of the iCCM strategy in the Northern Region is needed to improve its cost-effectiveness. This study supports the need for a long-term financing strategy, such as inclusion of iCCM in the NHIS benefit package. However, a revision of the NHIS benefit package and an acceptability study must be conducted before making such a decision. Then, the appropriateness of a pilot study including iCCM services in the NHIS could be considered.

Additional files

Additional file 1. Effect and cost for malaria diagnosis and treatment under HBC and CHPS strategy in the Volta and the Northern Regions.

Additional file 2. Effect and cost for diarrhoea diagnosis and treatment under HBC and CHPS strategy in the Volta and the Northern Regions.

Additional file 3. Effect and cost for suspected pneumonia diagnosis and treatment under HBC and CHPS strategy in the Volta and the Northern Regions.

Abbreviations

ARI: acute respiratory infection; CBAs: community-based agents; CHPS: community-based health planning services; CHW: community health workers; DALYs: disability adjusted life years; GHS: Ghana health service; HTA: health technology assessment; HBC: home-based care; iCCM: integrated community case management; ICER: incremental cost-effectiveness ratio; IMCI: integrated

management of childhood illness; NMCP: National malaria control programme; QALY: quality adjusted life years; RCT: randomized controlled trial.

Authors' contributions
BEF conceived the study, participated in the design, coordinated the field work, performed the statistical analysis and drafted the manuscript. KSH participated in the study conception, study design and in drafting the manuscript. MG participated in the study conception, study design and supported the field work. JB participated in the statistical analysis. CTN coordinated the field work in the Volta Region, SN coordinated the field work in the Northern Region. NA participated in the study conception and design. RG participated in the field work in the Volta region. CA participated in the field work in the Volta region. CP and IS participated in the study conception. JW participated in the study conception, study design and in drafting the manuscript. All authors read and approved the final manuscript.

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Acknowledgements
We thank the participants in the study for their valuable information to improve the health care for malaria, diarrhoea and pneumonia. We thank the field workers, supervisors and data entry staff for their critical work in collecting and entering data. We thank Dr. Kalipso Chalkidou (NICE) for her interest in the study and technical support. We also acknowledge the financial support received from the National Malaria Control Programme with GTFAM funds.

Competing interests
The authors declare that they have no competing interests.

Availability of data and materials
The data base is property of the Dodowa Health Research Centre and it can be made available on request.

Consent to participate and Consent for publication
Carers of children gave written informed consent to be interviewed and for publication.

Ethics approval
Ethical approval was obtained from the Ghana Health Service-Ethical review committee (ID NO; GHS-ERC: 04/09/13) and from the Ethics Committee of LSHTM (Ethics Ref: 6442). Administrative approval was obtained from the respective regions and districts.

Funding
The field work was financed by the NMCP.

Publisher's Note
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Received: 19 October 2016 Accepted: 26 June 2017
Published online: 05 July 2017

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Escribano-Ferrer et al. BMC Health Services Research (2017) 17:435
DOI 10.1186/s12913-017-2383-0

BMC Health Services Research

RESEARCH ARTICLE Open Access

Assessing the impact of health research on health policies: a study of the Dodowa Health Research Centre, Ghana

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Abstract

Background: The importance of assessing research impact is increasingly recognised. Ghana has a long tradition of research dating from the 1970s. In the Ghana Health Service there are three health research centres under the Research and Development Division. Dodowa Health Research Centre (DHRC) is the youngest in the country dating from the 1990s. The objective of this study is to analyse the influence of the research conducted in DHRC on national and local health policies.

Methods: The study used the Research Impact Framework. Six projects were selected based on a set of criteria. Thirteen interviews were conducted with researchers and policy makers using a semi-structured interview guide.

Results: DHRC had numerous policy impacts in terms of researchers participating in policy networks, increasing political capital and influencing policy documents. Factors identified to be associated with policy impact included collaboration with policy makers at the design stage, addressing health priorities, and communicating results mainly through the participation in annual review meetings.

Conclusions: DHRC was successful in influencing health policies. Recommendations were made that could be included in the DHRC strategic planning to improve the research process and its policy impact.

Keywords: Research policy impact, Research translation into policies, Research process, Policy analysis

Background

Research impact, understood as the benefits from research or the payback of research [1–3], is increasingly becoming recognised as important. Public and private funders want to know the value received for the funds given, and want to see tangible results in order to justify continuing, or increasing funds and support for research [4–6].

Since the mid-1990s, efforts were made to evaluate research impact and justify expenditure on health services research using several approaches. The traditional approach focussed on academic production such as the number of publications [3, 7, 8], as well as in assessing the economic value of the research [9] and the health impact in terms of mortality reduction [10]. Since 1996 new methodologies have been developed combining several categories or areas where research can have an impact. Each of these new methodologies has a different focus. For example, one methodology considers a logic model, that starts with research conception and ends with results dissemination and utilization [5]. Another approach applies a systems perspective, with the objective to strengthen the health research systems [11]. Others focus on informing decision making and effectively transmitting evidence to policymakers [12]; developing a set of impact as well as performance indicators [13, 14]; making a practical approach, trying to identify categories that have not yet been taken into account [15]; addressing interdisciplinary research [16] and lastly, taking into account small-scale projects [17].

These different methodologies have been developed progressively in an attempt to address important aspects related to research impact: (i) the length of time required for research to have an effect; (ii) the need for considering different areas of effect and different types

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of research; (iii) how to address difficulties in quantifying research impacts; (iv) how to address difficulties in attributing a policy or an impact to a particular research result; and finally (v) the need for a method to be easy to use and (vi) to allow comparisons with regards to time and within institutions.

Ghana has a long tradition in medical research dating from the late 1970s and 1980s. In the Ghana Health Service and under the Research and Development Division there are 3 health research centres that represent the three ecological zones in the country: Navrongo Health Research Centre (NHRC) in the north, Kintampo Health Research Centre (KHRC) in the centre of the country, and Dodowa Health Research Centre (DHRC) in the south. DHRC is the youngest in the country established in the early 1990s [18, 19].

DHRC is situated in Dodowa, the district capital of the Dangme West district (now Shai-Osudoku and Ningo-Prampram districts since July 2012) of the Greater Accra Region. At the time of the study, the population of Dangme West district was 148,909 inhabitants with 21 static health facilities (15 public and 6 private), 53 chemical sellers, 5 Pharmacies and 5 laboratories (3 public and 2 private) [20]. In coordination with the national level, the district health directorate prepared annual plans and annual reports- the later presented during annual review meetings. DHRC was created as part of the agreements between the Government of Ghana and the British Oversees Development Agency (now DFID) to establish an operational research satellite station in the early 1990's. Since its origin, DHRC has developed a close relationship with the Dangme West District Health administration. The first building was placed in the district health administration, and its staff join the health district annual reviews meetings.

The research centre has been growing since its origin in terms of human and financial resources, equipment, research projects and influence in the health sector. But the limited resources and unlimited needs of the Ghana Health Sector require that the research centre remains effective, in terms of being able to show the impact of its research.

In 2005, the research centre set up a Health and Demographic Surveillance System (HDSS). This HDSS covers an area of 1528.9 km^2. In terms of research, DHRC has focused on malaria operational research since its inception. Due to the expansion of the centre, a new infrastructure was built in 2006/2007 to host the new research centre [19]. From 2005 to 2011, the annual budget of the centre increased from US$ 371,000$ to 897,000$ and the staff boost from 33 to 120 people, being 7 in administration, 7 in support services, 17 in computer centre, 69 field workers and 20 scientists. The number of publications has been low, ranging from 0 to 4 papers published per year for the period 2004–2011. In 2011, DHRC developed its first strategic plan 2012–2016 to guide the continuous growth of the research centre, to improve its performance and to be more efficient [20]. This strategic plan includes the mission, vision and values of the health research centre, the strategic goals, its research agenda, a chronogram, a budget and a monitoring and evaluation plan. A set of indicators was developed to be monitored annually. Some of these indicators are the number of peer reviewed publications, the number of posters presented, number of presentations of research results to policy makers at national level, number of partnerships and collaborations with other institutions, website with actualized information and annual reports disseminated to funders, the Ghana Health Service and the Ministry of Health. However, these indicators cannot inform about the use of the evidence generated for policy making. This study aims to analyse the influence of the research conducted in DHRC on national and local health policies. It will complement the monitoring and evaluation plan, and its findings might be included in the next strategic plan. This is the first study addressing research impact on health policies conducted in any of the three health research centres.

Methods

Analytical framework: Research impact framework

Among the different approaches to assess research impact mentioned above we chose the Research Impact Framework (RIF) for this study. The Research Impact Framework (RIF) was developed by Kuruvilla et al. [15, 21] as a relatively economic way to identify the academic and 'real world' impacts of research projects and programs. The RIF is appropriate for this study because it focuses on policy impact, is potentially easy to implement, allows identification of unexpected impacts and facilitates comparison across time and cases. The RIF helps to systematically analyse areas where projects could have an impact. It describes 4 categories that can be influenced by research: research related impact, policy impact, service impact and societal impact (Table 1). Each category has subcategories that can be assessed for possible impact of a specific research project. Policy impact refers to research informing and influencing policy [15]. The subcategories to explore the policy impact are participation in policy networks, the increase in political capital, the level of policy-making influenced, the type of policies influenced and the nature of the policy impact.

To use this framework, [21] proposed an approach that includes project selection, in-depth interviews, documentary analysis and the elaboration of impact narratives for each project.

Table 1 Research Impact Framework [15]

Research-related impacts	Policy impacts	Service impacts	Societal impacts
• Type of problem/knowledge • Research methods • Publications and papers • Products, patents and translatability potential • Research networks • Leadership and awards • Research management • Communication	• Level of policy-making • Type of policy • Nature of policy impact • Policy networks • Political capital	• Type of services: health/ intersectoral • Evidence-based practice • Quality of care • Information systems • Services management • Cost-containment and cost-effectiveness	• Knowledge, attitudes and behaviour • Health literacy • Health status • Equity and human rights • Macroeconomic/related to the economy • Social capital and empowerment • Culture and art • Sustainable development outcomes

Research projects selection

Research projects conducted in Dodowa were selected to assess their policy impact based on the following criteria:

(i) Projects had to be completed between 2004 and 2010 to allow time for the generation of the evidence and for the findings to have had an impact. The lower limit of 2004 was set because of records availability and to avoid recall bias.

(ii) Projects needed to reflect a broad range of research conducted in Dodowa. They reflected a multidisciplinary research, including projects that were focused on clinical practice, on the health system and on the social and behavioural level. They also reflected different types of study design, ranging from qualitative studies to randomized control trials. The grade of difficulty for translating some research results into policies was also considered. Finally, the budget of the project was explored and compared. In practical terms, projects where the researcher moved away from the country or was not available were excluded.

Nine out of eleven projects met the first requirement [18, 19]. From the nine studies, six were selected based on the second requirement and the availability of the researcher-the principal researcher was not available in three of the nine projects. The topic areas of the studies selected were deployment of rectal artesunate, malaria rapid diagnostic tests (RDT), home management of fevers in children under-five, male involvement in family planning (FP) decision making and practice, tuberculosis (TB) enablers' package and mutual health organizations in Ghana.

In-depth interviews and documentary analysis

To analyse the influence of the research conducted in DHRC, interviews were conducted using a semi-structured guide based on the RIF to address the policy impact of a specific project. Questions regarding the research process and factors that influence the translation of research into policies were also included. Interviews were conducted with researchers and policy makers related to the research topics. With researchers because they were the more knowledgeable on project details, project implementation, research products and dissemination. With policy makers to compare their knowledge and perceptions with those of the researchers on a specific project. To select the researchers to be interviewed, we identified principal researchers of the selected research projects. To select the policy makers to be interviewed, we identified program coordinators, for example the director of malaria or tuberculosis program if the research project was related to malaria or tuberculosis.

In addition and as suggested by the DHRC Institutional Review Board, policy makers with an important role in research and policy making (even if they were not related to the studies) were also interviewed about the relevance of the projects conducted in Dodowa (addressing real health needs), the research process and factors that influence the translation of research into policies. Examples of policy makers with an important role in research and policy making were the director of Research at the Ministry of Health or the director of Planning at the Ghana Health Service.

In total, 13 interviews were conducted: four with principal researchers, four with policy makers related to projects and five with policy makers not related to the projects under study. Some researchers and some policy makers were involved in more than one study. All interviews were recorded.

A documentary analysis was conducted before and after the interviews. Before the interviews, documentation on the six projects selected were reviewed [18, 19, 22–26]. After the interviews, and because interviewees were asked to show evidence (policy documents) regarding research influencing policy making, a documentary analysis was conducted to verify the inclusion of research findings in those documents. In addition, reported participation of the researchers involved in the selected studies in different committees or networks with policy makers was also verified. Therefore, the documentary analysis conducted after the interviews intended to triangulate results obtained from the interviews.

Analysis

The analysis of the interviews was done manually. Responses of researchers and policy makers were organised

in a table based on themes pre-determined before the interviews, according to the RIF, the research process and categories of factors that might influence the translation of research into policies. Using this classification, general perceptions of researchers and policy makers on themes described above were examined in turn and compared. Then, a review of the policy documents suggested by the participants during the interview was done to verify the inclusion of research findings in national and local health policies. Because these policy documents did not include a bibliography (in most of the cases), it was not possible to ensure that the policies were due/referred to a specific research study. Therefore, it was only possible to state if research findings were present in policy documents.

Structured narratives

Results of this analysis were presented in project structured narratives. This key information includes research objectives, study conception and design, budget, collaborators, main findings, research products, dissemination and policy impact. These narratives were shown to the interviewees to validate that the information given was well reflected in the narratives and to get authorization for their use (Table 2 and Additional file 1: Table S1-S5).

Results

Results showed that DHRC had numerous policy impacts (Table 3). The participation of researchers in policy networks is a way to influence policy makers by sharing the researcher's expertise and results. All selected studies had team members joining policy networks. All of them used the existing country dissemination mechanism involving policy makers, mainly at local and at national level. The regional level was only used in one study.

Increasing political capital means that researchers gain value and credibility in the dialogue with policy makers, thus being able to influence policies. Authors from four projects were involved in the technical committees to develop guidelines and policy documents (3 at national level and 1 at the international level). These authors are recognised scientists in malaria diagnostics, community management of fevers and the NHIS in Ghana.

Verifying if research results are present in policy documents is a way to check if policies are evidence based. Findings from three of the six projects selected (the *rectal artesunate, the RDT and the home management of fevers projects*) were found in policy documents. Recommendations from two studies were found in district health annual reports (*male involvement in FP and TB enablers projects*). With regards to the mutual health organizations study, it was difficult to draw a conclusion. No contradictions were detected between the studies' results and policies.

Research conducted in DHRC influenced policies mainly in two ways: (i) a supportive way, where there was already an international policy and the research findings supported it, and (ii) widening accepted beliefs regarding a practice. The level of influence was mainly at national level (four of the six projects).

Discussion

The results found on the impact of the research conducted in DHRC on national and local policies are linked with several factors that influence policy making-some identified and reported elsewhere while others were identified in this study as described below.

DHRC has been successful in contacting and involving policy makers since research conception. The proximity of the research centre to Accra could have been a facilitating factor. Alternation of the same individuals between research and policy making may also improve the interaction and the translation of research into policies and can be seen in Ghana and in other low and middle income countries [27]. Collaboration and partnership between both communities from research conception until dissemination of findings has been also identified in 5 reviews [28, 29] as a facilitator factor for the use of research for policy making. It helps to address real research needs and increases the willingness to use research results.

The general opinion among policy makers interviewed was that DHRC is successfully meeting research needs. Interviewees believed that addressing health priorities is one of the research determinants for policy impact, which was also identified in 3 reviews [30–32]. Studies belonging to a multi-country initiative (e.g. ACT consortium) and with recognized actors were perceived to have a stronger impact on health policies than studies without this kind of support, as reported elsewhere [27]. Studies with a smaller budget had more influence at the local level than at the national level and its impact on policies was more difficult to determine, although this was not identified in any of the 5 reviews.

Structured communication channels are important to make the research accessible and to promote good governance and less individual or particular influence of specific projects on policies [28]. Interviewees described that researchers used more formal than informal mechanisms. In Ghana, researchers communicate their results during the annual reviews among other ways of disseminating results. Even though the review meetings are part of the policy process, researchers and policy makers from the GHS identify these meetings as a structured way of communicating results to policy makers. These are in fact windows of opportunity in which research results can be influential, and they are also occasions to identify and share health problems. In terms of research

Table 2 Deployment of rectal artesunate in the Dangme West district for severe malaria in children under- five

Analysis areas	Key topics	Key dates
Research project focus and funding	Research problem: the project aims to assess the feasibility of the deployment of rectal artesunate at community level.	2004
	Geopolitical context: Ghana, Tanzania and Mozambique.	
	Funders and funding process: WHO through a call process.	
	Budget: 258.000$	
Research project evolution/process	Conception: WHO put a call on the website. Justification: Studies on the efficacy of rectal articulate were conducted in Ghana in Navrongo research centre. Dodowa conducted the only study in Ghana to look at the feasibility of deployment rectal artesunate in a real context. The study was considered by the researcher and by the policy makers as addressing an important health problem, an urgent matter and a complex issue.	
	Study design/Research methods: Observational study with 2 phases (formative and intervention). The design was defined as good quality study.	
	Research collaborators: WHO, Tanzania and Mozambique research centres, malaria control program, district health director and health centres. Those collaborators were involved in the study from the conception until the dissemination of results giving financial and technical support.	
	Key projects events/concerns: turnover of staff already trained and difficulties with following systematically all procedures (at community or health facility) were challenges during the implementation of the study.	
	Main findings/recommendations: the study produced evidence on the feasibility of administrating artesunate at community level, and the compliance of referral to health facility after the drug administration. Results are considered to be clear and concrete.	
	Dissemination of findings: results were presented to the community, to the district authorities, at the regional health management review, at the national dissemination forum, at the 6th INDEPTH scientific in Burkina Faso ("Using community members to dispense rectal artesunate for the initial management of severe malaria in under-five children in a rural district in Ghana") and at the Global Health Forum in Geneva in 2008 ("Reaching the Un-Reached in the Event of Severe Malaria in Under Five Children in a Rural District in Ghana"). PI believes that the results have been communicated effectively. More than 400 hundred people received the research results.	
Main research products	Project report and Power point presentation: Done. No policy brief.	2006
	Articles: Article published in 2016 [33].	2016
Policy impacts	Level of policy making: the project had an impact at national level, at health managers and at health providers' level.	
	Type of policy: the study influenced clinical practice policies on the management of malaria cases.	
	Nature of policy impact: This was a mobilization of support where research findings supported the feasibility of including rectal articulate on guides and protocols in Ghana.	
	Policy networks: researchers informed policy makers through the dissemination mechanisms (district, regional and national dissemination forum).	
	Political capital: the researcher believes they gained value in reaching policy agreements. Research results were considered in policy documents. The researcher expressed that the more research is conducted, the more influence researchers gained.	
	Inclusion in policy documents: Recommendations are included in the Anti- Malaria Drug Policy (MoH), Guidelines for Case Management of Malaria and the Home management of Malaria, ARI, and Diarrhoea guidelines Who benefited: all children in Ghana and health managers through capacity building. Unintended outcomes: None.	2007 2009 2010

products and how DHRC disseminated its results, interestingly there was no direct link between production of articles and inclusion in policies. For example, findings of the "*rectal artesunate study*" study were included in three documents although no article had been produced at that time. Policy briefs were done in only one study, showing that this was not a common practice in DHRC and it was not one of the determinants for policy impact among the studies analysed, contrary to what was reported elsewhere [25]. National dissemination of results (formal or informal) was done in five of the six projects, while international dissemination was done in three studies.

Table 3 Policy impact of research conducted in DHRC. Comparison between studies

Studies selected	Budget	Type of research	Conception/support and collaboration	Dissemination	Policy impact (level, type, nature, policy networks, political capital and references in policy documents)
Deployment of rectal artesunate in the Dangme West district for severe malaria in children under five (2005)	258,000$	Behavioural research*	WHO call. Malaria program (NMCP), Tanzania and Mozambique research centres, district health team and community. Policy makers involved since the beginning.	Power point at local, regional and national and international level. Formal and informal communications. No policy brief. 1 article (not published at the time of our study).	Level: national. Type: clinical practice policies. Nature: supportive way. Policy networks: Participation on the existing dissemination mechanism. Political capital: researcher involved in a technical committee for Home Management of Malaria. Research results can be found in 3 documents [34–36].
Individually randomized trial of rapid diagnostic tests in rural Ghana (2007)	170,500$	Clinical research	PI initiative. GMP and ACT funds. NMCP, LSHTM, and district health team and ACT consortium. Policy makers involved since the beginning.	Power point at local, regional and international level. Report to the NMCP. No policy brief. 4 articles.	Level: National and international. Type: clinical practice policies. Nature: supportive way. Policy networks: Participation on the existing dissemination mechanism. Political capital: researcher involved in task force for malaria diagnosis in Ghana and in the ACT consortium. Research results can be found in 2 documents [35, 37].
Home management of fevers (malaria and pneumonia) in children under-five: a cluster randomized controlled trial in southern Ghana (2007)	856,000$	Clinical research	WHO call. Makerere, Amsterdam and Maastricht Univ., NMCP, Child Health program and district health team. Policy makers involved since the beginning.	Power point to local and international level. No policy brief. 2 articles.	Level: national and international. Type: Service and clinical practice policies. Nature: supportive way. Policy networks: links with INDEPTH, TDR and ICCM. Political capital: mainly at international level. Findings support the home based care strategy and the Malaria, ARI and Diarrhoea Home based care guidelines [36].
Assessments of male involvement in family planning decision making and practice and its influence on the uptake of Family Planning in the Dangme West district (2005)	5400$	Behavioural research	Ghana-Dutch collaboration. District health team involved since the beginning	Power point at local and national level. No Policy brief. No article.	Level: local. Type: service policies. Nature: redefining/widening accepted believes on FP. Policy networks: participation on the existing dissemination mechanism. Political capital: none. District annual reports reflect an increase of community sensitization campaigns. Indicators showed increased on FP acceptors from 8.7 in 2007 to 47% in 2011 [38–42].
Examination of the TB Enablers Package in the Dodowa sub-district of the Dangme West District in the Greater Accra Region of Ghana (2009)	6000$	Health system research	Georgetown University. District health team involved since the beginning.	Power point at local level. No Policy brief. No article. Informal communication at national level.	Level: local. Type: governance policies. Nature: redefining/widening practices related to TB enablers. Policy networks: participation on the dissemination mechanism at local level. Political capital: increased links with TB program coordinator (new research came to the centre in 2011). District annual report in 2011 showed more detailed description on who benefitted from TB enablers [42].

Table 3 Policy impact of research conducted in DHRC. Comparison between studies *(Continued)*

Mutual health Organizations (MHO's) in Ghana and implications for improving the success of health Insurance in Ghana (2004)	6081$	Health system research	Ghana-Dutch collaboration. Erasmus Univ., GHS and District health team, involved since the beginning.	Power point at national and international level. Policy brief to GHS. 1 article.	Level: National and international. Type: governance policies. Nature: instrumental use of research designing and implementing the NHIS. Policy networks: participation on the dissemination mechanism at national level. Participation in a team for the NHIS implementation. Political capital: authors are reference people on insurance in Ghana. No policy documents were found that reflect research findings.

With regards to the impact framework used, authors felt that the RIF was useful and easy to use. However, results might be influenced by the knowledge and vision of the researchers and policy makers interviewed, which suggested possible areas and policy documents that might have been influenced by the research. Although policy makers in general don't want to speak negatively about their researcher colleagues, the fact that for each study a researcher and a policy maker was interviewed made the process more comprehensive, making it possible to analyse one issue from the two perspectives. Finally, the review of the suggested policy documents to verify the inclusion of research findings was critical to make the evaluation valid. This review also had some challenges as not all documents included references. In those cases, one can only state that the policy is coherent with research findings without ensuring that a particular study influenced a policy.

Results from this study have an importance at different levels. At DHRC level, results can be used to show stakeholders the impact of the research conducted, being accountable and justifying the need for continuous support. It also showed a path to improve DHRC performance. This study sets a practical example on how to evaluate research impact that other research institutions in Ghana and elsewhere can follow. The methodology and results of this study was presented to the other two health research centres and major policy makers of the Ghana Health Service in a seminar on research translation into policy. Although this study did not explore the impact of DHRC at international level, the participation of researchers in international networks and the funding from WHO and the ACT consortium suggest that the research conducted in DHRC might have influenced international policy. Finally, the fact that factors associated to research translation reported in this study were also found in other studies conducted elsewhere, support the validity of our results and reminds what any researcher must consider if he/she aims to influence policy.

Conclusions

DHRC had policy impact in terms of participation in policy networks, increasing capital value of the researchers and influencing policy documents. DHRC good practices that may explain these positive results included the collaboration with policy makers at the design stage, addressing health priorities, and communicating results mainly through the participation in annual review meetings.

Moving towards continuous improvement, DHRC could consider some recommendations for the next strategic plan to improve the research process and its impact. Some of these recommendations are already described in the strategic plan and they are now being reinforced. Recommendations include conducting research coherent with research agendas and facilitating research collaboration with other research institutions to bring expertise and to increase credibility and power to influence policies. DHRC was already contacting policy makers at the design stage. The findings of this study are encouraging in this respect, and suggest to continue this contact during implementation and dissemination of results. New recommendations are to strengthen the communication of findings through the creation of incentives for publishing, the elaboration of policy briefs, budget lines for communication in each research study and the promotion of staff training on research communication. Another recommendation is to support the district data analysis, setting a technical collaboration between both institutions where district staff can benefit from the scientists' knowledge on analyses and the scientist can better identify research needs. Finally, DHRC could schedule and conduct policy impact evaluations periodically.

Additional file

Additional file 1: Table S1. Individually randomized trial of rapid diagnostic tests in rural Ghana. **Table S2.** Home management of fevers in children under-five: a cluster randomized controlled trial in southern Ghana. **Table S3.** Assessments of male involvement in family planning decision making and practice and its influence on the uptake of family planning in the Dangme West district. **Table S4.** Examination of the TB enablers package in the Dodowa sub-district of the Dangme West district in the Greater Accra region of Ghana. **Table S5.** Mutual health organizations (MHO's) in Ghana and implications for improving the success of health insurance in Ghana. (ODT 59.6 kb)

Acknowledgements
We thank the study participants, researchers and policy makers, for their time, expertise and contributions on reducing the gap between research and policy. We are grateful to DHRC team for their interest and support when conducting the study.

Funding
No funding was received in the collecting of the data for this study. The individual studies received funding from different sources.

Availability of data and materials
The data base is property of the Dodowa Health Research Centre and it can be made available on request.

Authors' contributions
BEF conceived the study, participated in the design, coordinated the field work, performed the statistical analysis and drafted the manuscript. JW and MG participated in the study conception, study design and in drafting the manuscript. All authors read and approved the final manuscript.

Competing interests
The authors declare that they have no competing interests.

Ethics approval and consent to participate
Ethical approval was obtained from the Dodowa Health Research Center – Institutional review board (ID NO: DHRC-IRB CPN03/02/13); from the Ghana Health Service-Ethical review committee (ID NO: GHS-ERC: 16/03/13) and from the Ethics Committee of LSHTM (ethics ref.: 6375).

Publisher's Note

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Received: 1 March 2017 Accepted: 13 June 2017
Published online: 24 June 2017

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