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**Economics of integrating HIV and sexual and reproductive
health services: An examination of technical and cost efficiency
in Kenya and Swaziland**

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**Thesis submitted in accordance with the requirements for the
degree of Doctor of Philosophy of the
University of London**

JANUARY 2015

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Funded by: Bill and Melinda Gates Foundation

Research group affiliation: Social and Mathematical Epidemiology (SaME)

Dedication

To the memory of Allan Obure. Daddy, I wish you were here to see this day
come to fruition!

DECLARATION

I, CAROL ATIENO OBURE confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Signature

A handwritten signature in dark ink, appearing to read "C. Obure", is centered within a light gray rectangular box.

January 05, 2015

Abstract

Within high HIV prevalence settings, the integration of HIV and SRH services has been widely regarded as beneficial in not only improving individual outcomes and reducing HIV transmission, but also improving the efficiency of service delivery. However, while ample evidence exists on the behavioural, health and social outcomes, evidence on the economic benefits of integrating these services remains scarce which is a barrier to creating effective policy.

This thesis therefore aimed to contribute to the understanding of the optimal organisation of HIV and SRH services in high and medium HIV prevalence settings. To achieve this aim, data was collected from 40 health facilities providing integrated HIV and SRH services in Kenya and Swaziland. Costs of providing these integrated services were estimated and the impacts of integration (among other organizational and contextual factors) on the technical and cost efficiency explored using non-parametric and parametric methods respectively. This thesis presents the first study to analyse both technical and cost efficiency in this context. It further extends the literature on efficiency measurement in low and middle income settings by considering two particularly relevant aspects of health care provision: quality of care and the impact of organisational and contextual factors on the technical efficiency of health facilities.

The findings from this thesis are especially relevant to the on-going discussions of the optimal organisation of HIV and SRH services in resource constrained settings. These findings not only show that inefficiencies exist in the provision

of integrated HIV and SRH services but underscore the importance of investigating both technical and cost efficiency as the results differ depending on the type of efficiency analysed.

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List of Abbreviations

Ca Cx	Cervical cancer
DEA	Data envelopment analysis
DMU	Decision making unit
DRH	Division of reproductive health
FP	Family planning
HCT	HIV counselling and testing
IPPF	International Planned Parenthood Federation
LMIC	Low and middle income country
MCH	Maternal and child health
MNCH	Maternal, new-born and child health
NASCOP	National AIDS and STI Control Programme
NERCHA	National emergency response council on HIV and AIDS
NGO	Non-governmental organisation
NSF	National strategic framework
PITC	Provider initiated testing and counselling
PLWHIV	People living with HIV
PMTCT	Prevention of mother to child transmission of HIV
PNC	Post natal care
PPF	Production possibilities frontier
RH	Reproductive health
SFA	Stochastic frontier analysis

SRH	Sexual and reproductive health services
SSA	Sub-Saharan Africa
STI	Sexually transmitted infections
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNFPA	United Nations Population Fund
VCT	Voluntary counselling and testing
WCC	Weak cost complementary

Chapter 1 Introduction

1.1 Background

HIV continues to have devastating effects on communities in resource-constrained settings in sub-Saharan Africa. Although HIV incidence has declined in the last decade, sub-Saharan Africa remains the centre of the global HIV epidemic with nearly 69% of the 34 million infected with HIV worldwide [1]. With women of reproductive age being disproportionately affected [1], one of the significant efforts to achieve universal access to HIV prevention, care and treatment in countries with sexually driven epidemics has been the integration of HIV and sexual and reproductive health (SRH) services [2]. Integration in this context, has involved the provision of SRH and HIV prevention and treatment services in the same setting as a unified strategy to address client's risk of unintended pregnancies and HIV transmission [3].

The rationale for integrating HIV and SRH services stemmed from both theoretical considerations and empirical findings. The most compelling reason for integrating HIV and SRH services has been that the majority of HIV infections are sexually transmitted or are associated with pregnancy, childbirth and breastfeeding [4-6]. Delivery of an integrated SRH package has therefore been widely regarded as beneficial in reducing undiagnosed infections, thus improving individual outcomes and reducing HIV transmission. For persons living with HIV (PLWHIV), integration of these services may improve access to family planning and other key SRH services and allow them to be able to achieve their fertility related needs and reduce perinatal HIV transmission [7].

In addition to improving behavioural, social and health outcomes, it has been widely believed that integration of HIV and SRH services can increase efficiency of service delivery thereby maximising the use of resources [8]. Integration within the wider service context, has a strong foundation in economics where it has generally been defined as the “bundling or aggregation of goods or services” with the aim of increasing profitability [9]. Therefore the strategic rationale for integrating services or goods production is the achievement of economies of scale and scope. Economies of scale refer to cost savings achieved from increased volume of output. Economies of scope on the other hand, refer to a reduction in production costs resulting from the shared use of resources in the production of a combination of outputs [10].

Within the HIV and SRH service context, economic theory suggests several potential efficiency advantages at various levels. At the service delivery level, it has been assumed that integration of these services could offer cost savings through sharing of staff, facilities, equipment, administrative and other overhead costs and resources. With respect to health systems, integration can result in cost savings in several areas such as health management information systems, monitoring and evaluation and supply chain management [11].

1.2 Thesis justification

Empirical evidence on the impact of integrating components of HIV prevention, care and treatment into family planning services and SRH services has been broadly positive for most outcomes. Evidence of positive impacts of integration on client satisfaction, access to SRH services, condom use, uptake of HIV testing

and quality of services, reduced clinic-based HIV-related stigma, HIV and STI incidence, and mixed outcomes for contraceptive use have been documented [12-17]. Provision of counselling and testing (CT) services for HIV and education on risk reduction strategies within SRH settings has also been shown to influence behaviour change among those who perceive a low HIV infection risk [13].

While there is a growing body of evidence on the social, behavioural and health benefits of integrating HIV/STI services into SRH services [7, 12-17], a number of reviews have consistently demonstrated research gaps on the costs of delivering integrated HIV and SRH services and the efficiency gains associated with such integration [8, 12, 18-21]. This limited evidence on the efficiency of integrated HIV and SRH services is a barrier to creating effective policy.

The few studies [22-24] identified suggesting that integration of HIV services into SRH services yielded cost savings were conducted at a relatively small scale and only focused on the integration of HIV CT into one component of SRH services, family planning services. A recent study conducted in Kenya [25] evaluated the costs, cost-efficiency and cost-effectiveness of integrating family planning into HIV care and treatment services and also found evidence of cost efficiency associated with integration. However, like the other studies, this study was of a considerable small size with only 12 sites and all in one region.

The relative dearth of cost studies in low and middle-income (LMIC) settings is not only limited to the HIV/SRH context [26, 27]. One of the main reasons for this is the lack of reliable and accurate records of resources used to provide

health services in these settings. Few health facilities regularly collect the information needed for such studies making data collection time consuming and very expensive. Furthermore, activity data required for the calculation of unit costs are often rarely available and unreliable if they exist. Moreover, inconsistencies among facilities limit the usefulness of this data. There is therefore a pressing need for empirically sound estimates of costs of health services and in particular HIV and SRH services for a variety of applications including setting public health care budgets and assessing the impact of interventions in low and middle income countries.

1.3 Thesis aims

The overarching aim of this thesis is to contribute to the understanding of the optimal organisation of HIV and SRH service delivery by addressing the evidence gaps on the costs and efficiency gains associated with the integration of these services. To achieve this aim, the thesis applies standard economic techniques to estimate costs of HIV and SRH services and assess the technical and cost efficiency of a sample of public and non-governmental (NGO) health facilities providing integrated HIV and SRH services in two high and medium HIV prevalence settings.

1.4 Thesis objectives

The specific objectives of this thesis are to:

1. Estimate the costs of integrated HIV and SRH services;

2. Describe how costs of delivering HIV and SRH services vary across different facility types in Kenya and Swaziland;
3. Evaluate relative technical efficiency of health facilities providing integrated HIV and SRH services taking into account quality of services;
4. Examine the cost drivers of integrated HIV and SRH services and determine existence or nonexistence of economies of scale and scope associated with integration; and
5. Draw conclusions from objectives 1-4 on how integration of services affects costs and efficiency in order to inform policy debates on delivery of HIV and SRH services in medium and high HIV prevalence settings.

1.5 Candidate's role

This PhD research was nested within a five-year research programme evaluating the integration of HIV and SRH services in Kenya, Swaziland and Malawi, the Integra Initiative. A consortium of three organizations – Population Council, London School of Hygiene and Tropical Medicine (LSHTM) and the International Planned Parenthood Federation (IPPF) – supported by the Bill and Melinda Gates Foundation (BMGF), came together to address the lack of evidence around the feasibility, effectiveness, cost and impact of a range of existing or potential models for delivering integrated HIV and SRH services in high and medium HIV prevalence settings.

This thesis focuses on research conducted in Kenya and Swaziland where three different models for delivering HIV services in 40 public and NGO affiliated SRH clinics were evaluated. Malawi is excluded from the analysis in this thesis as the

study in this country focused only on integration of HIV services for youth in that context.

The candidate, a research fellow on the economics evaluation team, conceived the research questions for this thesis in collaboration with Dr Anna Vassall, principal investigator for the economic evaluation of the Integra Initiative.

The candidate was involved in the design of the economic evaluation of costs and efficiency in both Kenya and Swaziland and developed the periodic activity review questionnaire and also contributed to the development of the cost data collection tools. The candidate led the data collection at baseline and end line for the economics study in both Kenya and Swaziland between July 2009 and May 2012 and coordinated logistics planning, managing the Integra project partnerships and reporting to study partners. Upon completion of primary data collection, the candidate performed all data entry, cleaning and the analysis of primary data. The candidate drafted all the manuscripts included in this thesis.

The candidate developed the quality of care index used in chapter 7 using data collected by another study arm coordinated by Charlotte Warren, a co-investigator of the Integra Initiative. The candidate also provided input into the conceptual design of the integration indices developed by the broader Integra Initiative and analysis of data used to develop the structural index of integration.

1.6 Organisation of thesis

This thesis is presented in the traditional format with each chapter presenting a different component of the study. The thesis is organised as follows: Chapter 2 provides background information on the issue of integration within the HIV and SRH context. It then presents an overview of the history of integration from policy to practice, and describes the study context.

Chapter 3 develops the requisite economic theory of production for the multiproduct firm and provides the economic rationale for joint production. It also discusses the measurement of economies and scale and concludes with a discussion of production in health care and efficiency concepts in health.

Chapter 4 provides a review of the literature on the methods of efficiency measurement in health care and issues in efficiency measurement. Particular emphasis is placed on non-parametric DEA techniques for measuring technical efficiency. Finally, it presents a review of applications of DEA techniques for efficiency measurement in health care in low and middle-income countries.

Chapter 5 describes the conceptual framework for the empirical research and provides a detailed description of the data and the sources of data used in the subsequent analysis.

The remainder of the thesis is concerned with presenting the results of the analysis. Chapters 6-9 have been written up as standalone research papers that have been submitted to journals or will be submitted to journals for the broader

dissemination of the project results. Each of these chapters is prefaced by a brief preamble.

Chapter 6 begins to fill in the gap in the literature on the cost of integrated HIV and SRH services. The chapter provides a descriptive analysis of the total and unit economic costs of delivering six integrated sexual reproductive health and HIV services in 40 public and NGO facilities in Kenya and Swaziland over a two-year period.

Chapter 7 presents a comparison of the costs of integrated HIV counselling and testing/provider initiated counselling and testing (PITC) and the costs of stand-alone voluntary counselling and testing centres (VCT) using data from the baseline survey of costs.

Chapter 8 presents the analysis of technical efficiency of the facilities providing integrated HIV and SRH services. A two stage semi-parametric analysis is used to estimate the technical efficiency of health facilities and infer the determinants of technical efficiency. In the first stage, technical efficiency of the health facilities is estimated using non-parametric data envelopment analysis. These efficiency estimates are then regressed against a set of environmental factors in the second stage, to evaluate the determinants of technical efficiency using a truncated regression. This analysis extends the literature on technical efficiency measurement in low and middle income settings by considering two particularly relevant aspects of health care provision: quality of care and the effect of organisational and contextual factors.

To determine whether a quality/efficiency trade off exists among study facilities, quality is treated as a dimension independent of efficiency and health facilities are benchmarked on these two dimensions simultaneously.

In Chapter 9, the econometric model of costs is used to provide a better understanding of the drivers of costs and evaluate the existence of economies of scale and scope in order to corroborate the findings from chapters 6 and 7. The relationship between various measures of integration and the costs of integrated HIV and SRH services are specifically examined.

Finally, chapter 10 summarises the key findings from the PhD study and covers key contributions of the thesis. It also identifies the limitations of the thesis and discusses the implications of the overall findings on policy, practice and future research priorities.

Chapter 2 Background and context

2.1 Introduction

This chapter provides a definition of integration, an introduction to the concept of integration within the HIV and SRH context and policy developments around integration. The chapter also presents a background on the study context and the national responses of Kenya and Swaziland to the HIV crisis. The chapter specifically highlights the policy endorsements for integrating HIV and SRH services in a bid to improve the delivery and uptake of HIV services in both countries.

2.2 Defining integration

There is a lack of consensus on what integration in the HIV/SRH context entails. In fact, within this context, various other terms such as synergies, linkages, convergence and mainstreaming have been used interchangeably to refer to the same concept. Generally, integration can be defined as incorporating aspects of two or more types of services as a single coordinated and combined service to ensure continuum of care [28].

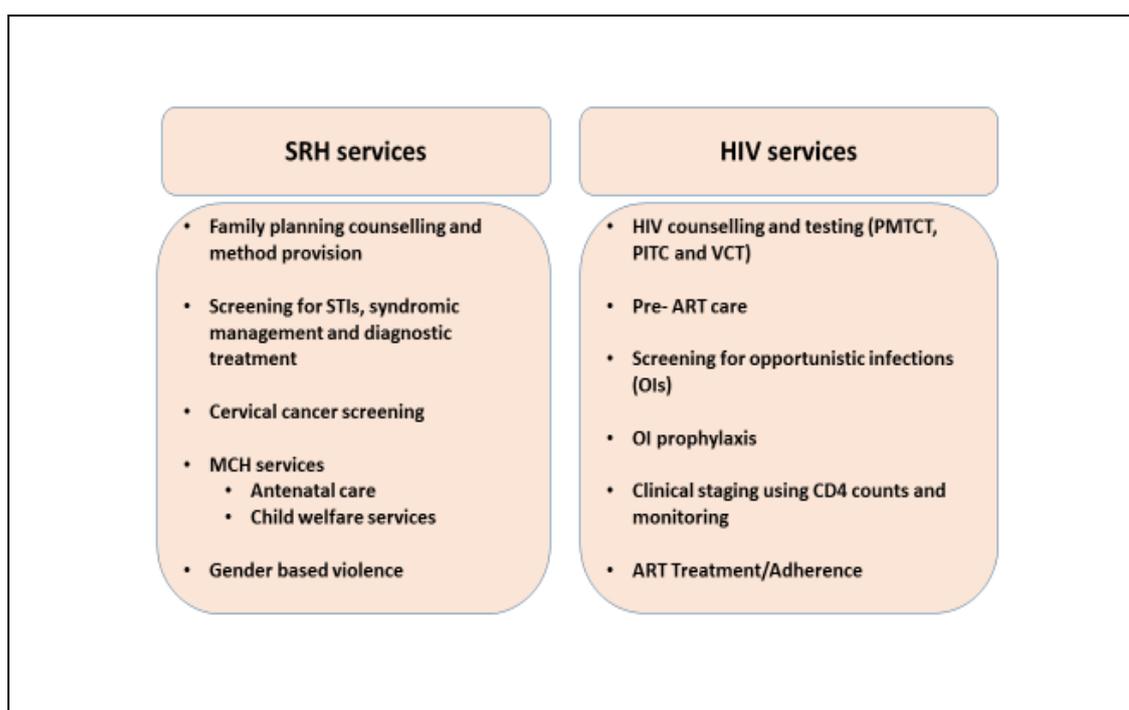
Multiple approaches for organizing integrated HIV and SRH service delivery exist. In its simplest form integration may involve service providers responding to an increased array of clients' reproductive health needs by referring clients for HIV and/or SRH services to a separate clinic with separate providers. At the end of the spectrum, integration may involve the provision of counselling/testing and clinical care and treatment of HIV/STI infections

together with other SRH services by a single provider. This thesis focuses on the latter.

2.3 Integration of HIV and SRH services

SRH services comprise a range of services which include family planning, STI screening and management, cervical cancer (Ca Cx) screening and MCH services (including antenatal care (ANC), postnatal care (PNC) and child welfare services (CWC)). HIV services on the other hand include HIV prevention, counselling and testing (which include provider initiated counselling and testing (PITC), voluntary counselling and testing (VCT) and prevention of mother to child transmission of HIV (PMTCT)) and HIV care and treatment (both pre-ART care and ART services). Figure 2-1 provides an illustration of the various components of SRH and HIV services.

Figure 2-1: Components of SRH and HIV Services



International and national policy and programme responses to HIV and SRH issues have historically been separate. However, the rapid rise in HIV prevalence in the 1990s coupled with the high incidence of other sexually transmitted infections in many sub-Saharan African countries heightened international concerns about the relative lack of services to adequately address these problems [14].

The high HIV prevalence rates, particularly among females of reproductive age, formed an impetus for the commitment by the international community at the 1994 International Conference on Population and Development (ICPD) in Cairo, to provide comprehensive reproductive health services including the management of STIs and HIV [13, 14]. The ICPD recommendations emphasized shifting the agenda from controlling fertility to ensuring that women were able to achieve personal reproductive goals safely and effectively [14]. Considerable attention was paid to the best way to provide reproductive health services with particular emphasis placed on integrating previously vertically organised sexual reproductive health and HIV services.

The decade following the 1994 ICPD conference witnessed greater commitment by the international community to integrating sexual and reproductive health and HIV services at the policy, systems and service delivery levels in many sub-Saharan African countries. From 2001, a number of key international commitments and developments supporting sexual reproductive health and HIV integration were made. In 2001, the UN General Assembly special session on HIV/AIDS linked the achievement of HIV-prevention targets to delivery of an integrated set of interventions which included antenatal care, HIV counselling

and testing, HIV-related care, treatment and support services and appropriate SRH services [29].

In 2004, the Glion Call to Action on family planning and HIV/AIDS in women and children [30] focused on linkages between family planning and prevention of mother to child transmission, while the New York call to commitment: linking HIV/AIDS and SRH highlighted the public health rationale for integration[31].

Renewed commitment to reaching as close as possible universal access to HIV prevention care and treatment services by 2010 and support for integration of HIV interventions with wider health services including maternal and child health, sexual and reproductive health and tuberculosis was made in 2005 by the G8 [32].

Further, in 2006, a political declaration on HIV/AIDS was made at the United Nation General Assembly challenging the global health community to forge closer links between sexual reproductive health and HIV through better policy and programme coordination [33] and most recently in the 2011 UN Declaration on HIV/AIDS [34].

These policy developments were accompanied by a rapid expansion in HIV services and dedicated financing for HIV programmes with commitments rising from US\$ 1600 million in 2001 to US\$ 15,900 million in 2009 [35]. These included substantial financing from the United States' President's Emergency Plan for AIDS Relief; and the Global Fund to Fight AIDS, Tuberculosis and Malaria.

2.4 Integration from policy to practice

2.4.1 Integration of HIV/STI services into family planning and ANC services

An initial focus was placed on integrating HIV prevention and testing services into FP and ANC services provided at most primary health outlets in developing countries [6]. Potential benefits of integrating HIV/STI services into FP services have been identified as increased knowledge of HIV prevention strategies among women of reproductive age who are at high HIV risk but might not otherwise seek HIV counselling and information. Similarly, integrating HIV counselling and testing into ANC services usually referred to as PMTCT not only helps prevent infection among pregnant uninfected women and but can also identify pregnant women who are HIV infected and hence prevent mother to child transmission [36].

Generally, HIV/STI prevention tasks such as information, education and communication, counselling and condom promotion have been integrated into family planning services more frequently than care tasks such as laboratory screening, clinical diagnosis and treatment or referral for treatment and care [17]. While in some settings it is possible to provide family planning, maternal health and child services as well as HIV/STI services at the same site, in others, where comprehensive service provision is not feasible, referrals for HIV and STI services have been incorporated into existing family planning and maternal and child health services [14].

2.4.2 Family planning integrated into VCT and PMTCT services

Counselling and testing services offer a prime opportunity for the integration of HIV and reproductive health services. Voluntary counselling and testing (VCT) centres attract clients who may not normally visit a family planning clinic such as the youth and men. VCT centres therefore provide an opportunity to reach more clients with family planning counselling and provide HIV-positive clients with the help they need to avoid unintended pregnancies and adopt dual protection for prevention of pregnancies, HIV and other STI infections [37]. Additionally, providing family planning services at counselling and testing facilities enables providers to offer more targeted family planning counselling because clients know their HIV status[38].

Integration of family planning and prevention of mother to child transmission of HIV services has been cited as offering an opportunity to integrate family planning services more broadly into antenatal care. An emphasis on family planning to HIV positive clients during the antenatal care period creates an opportunity to promote the use of contraceptive in the immediate post-partum period [39].

2.4.3 Family planning into HIV care and treatment

Integration of FP services into HIV care and treatment entails the provision of FP information, counselling, risk assessment, health monitoring and treatment procedures that may include referral for/or provision of FP commodities within HIV care and treatment clinics. It has been hypothesized that provision of

integrated FP and HIV care and treatment services can increase contraceptive use among female clients receiving HIV care and treatment services. Improved access to and uptake of contraceptive for HIV positive clients are expected to decrease maternal morbidity, mortality as well as improve neonatal outcomes [40].

A variant of this model also entails provision of family planning services by community-based health workers (CHWs), who are increasingly engaged in resource-limited settings to provide treatment adherence support for people on HIV and TB treatment [41]. In these settings, CHWs provide home-based care services and are able to provide oral contraceptive pills and female and male condoms.

2.5 Study context

2.5.1 Kenya

Kenya is a multi-ethnic society situated on Africa's east Coast (See Figure 2-2), divided into 8 provinces and 158 districts as of the 2009 Population and Housing Census. Classified by the World Bank as a low income country, it has a gross national income (GNI) per capita of US\$ 943 [42] and a ranking of 145 in the UNDP Human Development Index (HDI) in 2012 [43].

With an annual population growth rate of 2.9%, Kenya's population has increased rapidly from 8 million in 1960 to an estimated 40 million at the last national census conducted in 2009. The vast majority of Kenya's population is rural with an estimated 68% of the total population living in rural areas [44].

According to the 2008/09 Kenya demographic health survey (KDHS), the contraceptive prevalence rate is 46% and unmet need for family planning estimated at 24% [45], largely due to inadequate provision and poor access to FP commodities.

Figure 2-2: Map of Kenya



Source: Google maps

HIV in Kenya

Kenya has a generalised HIV epidemic. Although HIV prevalence appears to have declined in the last decade, the latest data from the Kenya AIDS Indicator Survey (KAIS) 2012 [46] indicate an adult population (15-64) HIV prevalence of 5.6 % which has dropped from the reported 7.4% in 2007 [47], and an estimated 1.2 million persons living with HIV. However, wide regional differences exist with highest prevalence in the Nyanza region at 15.1% and lowest in the Eastern North region at 2.1% [46]. In terms of sex and age distribution, a higher proportion of women aged 15 to 64 years (6.9%) were infected with HIV compared to men (4.4%)[46].

National Response to HIV

Kenya declared HIV a national disaster in 1999 and a national coordinating body, the National AIDS Control Council (NACC), tasked with the overall responsibility for multi-sectoral resource mobilization, policy, planning, and coordination of the HIV response was formed. The NACC was mandated to provide leadership in delivering HIV prevention, care, and treatment services. It was also responsible for capacity building and training of health workers, developing guidelines for testing and counselling, and accelerating the delivery of anti-retroviral treatment.

NACC facilitated the development of the Kenya National HIV/AIDS Strategic Plan (KNASP) 2005/06-2009/10 [48], which set out a multi-sectoral response to the HIV epidemic by engaging and mobilizing all key social and economic

sectors in the national response. The KNASP 2005/06-2009/10 had three priority areas: prevention of new infections in both the general population and among vulnerable groups; improvement of the quality of life of people infected with and affected by HIV; and mitigation of socio-economic impact of HIV.

One of NACC's key intervention strategies was the promotion and provision of counselling and testing services to all Kenyans who wished to know their HIV status. This was followed by a national guideline for Prevention of Mother-to-Child HIV/AIDS Transmission (PMTCT) in 2000, encouraging all pregnant women to know their HIV status.

Further developments included the formal approval and adoption of the country's first *National Reproductive Health Policy (NRHP)*, with the theme "Enhancing the Reproductive Health Status for All Kenyans", in October 2007. The policy provided a framework for increasing equitable, efficient, and effective delivery of high-quality reproductive health services throughout the country [49].

The *National Reproductive Health Policy* outlined priority actions for improving maternal health, reducing neonatal and child mortality, reducing the spread of HIV/AIDS and achieving women's empowerment and gender equality. The policy essentially allowed the government to incorporate and address the integration of HIV and reproductive health, as well as other key emerging issues such as RH commodities security, the prevention of mother-to-child transmission of HIV, emergency obstetric care, adolescent RH issues, gender-based violence, RH needs of persons with disabilities and the elderly [49].

This was followed in 2009, by the *National Reproductive Health and HIV/AIDS Integration* strategy. The strategy reflected an endorsement of integration of HIV and reproductive health services generally and family planning services specifically.

Delivery of HIV and SRH Services

The 2009 *National Reproductive Health and HIV and AIDS Integration strategy* not only provided a framework for improved coordination and collaboration among key agencies and organisations offering integrated RH and HIV services but also provided guidance on delivery of integrated services [50]. The strategy outlined service delivery levels and corresponding service areas relevant to the RH and HIV services that can be integrated. It provided a road map for implementing an essential package for RH and HIV integration taking into account the setting and context [50].

Despite having a national strategy, at the service delivery level, the integration of HIV and SRH services varies from facility to facility in Kenya. While HIV prevention and referral for care services increasingly appear to be an integral part of family planning services, family planning concerns in VCT settings have been minimally addressed. In VCT and PMTCT settings, the focus has been on the provision of FP information and a limited range of non-surgical contraceptives, particularly condoms.

2.5.2 Swaziland

The Kingdom of Swaziland is a small landlocked country in Southern Africa (see Figure 2-3) with an estimated population of 1.2 million [51]. Swaziland is classified as a lower middle income country with a GNI per capita of US\$ 2860 [52]. With an annual population growth rate of 1.4%, the vast majority of Swaziland's population (79%) live in rural areas, and almost 40% of the population are under the age of 15. Life expectancy is 48.5 years for women and 49.7 years for men and contraceptive prevalence is 50% [51].

Figure 2-3: Map of Swaziland



Source: Google maps

HIV in Swaziland

With an estimated adult HIV prevalence of 26 per cent among 18-49 year olds, Swaziland has the world's most severe generalised HIV/AIDS epidemic [53]. The most recent Swaziland HIV Incidence Measurement Survey [54], conducted in 2011, found that prevalence was higher in women (38%) compared to men (23%). The country also suffers from the highest death rate from HIV and one of the lowest average life expectancies.

National response to HIV

In response to the HIV crisis, the National Emergency Response Council on HIV and AIDS (NERCHA) was created in 2001 under the Prime Minister's Office and subsequently through an act of parliament to coordinate and facilitate the National multi-sectoral HIV/AIDS response. It was also mandated to oversee the implementation of the national strategic plans and framework.

Under NERCHA's leadership, the kingdom created and implemented a strategic response to HIV focused on five key programme areas:

1. Social and behaviour change communication programmes;
 2. Reduction of multiple concurrent partners among sexually active population;
 3. Increased and comprehensive knowledge of HIV and AIDS;
 4. Scaling up of prevention of mother to child transmission of HIV (PMTCT);
- and

5. Male circumcision of HIV negative men, with 15-24 being a priority age group.

Since 2001, NERCHA has made steady progress in coordinating the HIV/AIDS response culminating in the commissioning of the Swaziland National strategic framework (NSF) for HIV and AIDS 2009-2014 [55] by the Government of Swaziland in 2009. The NSF (2009) provided guidance on programmes grouped under four thematic areas of a) prevention b) treatment, care and support c) impact mitigation and d) response management [55].

Delivery of HIV and SRH services

Swaziland's most recent *National Policy on Sexual and Reproductive Health* (2013)[56] forms the basis and mandate for all SRH activities, outlining the national strategic pillars for improving SRH by providing comprehensive SRH services including HIV services among other programs. Specifically, the policy aims to facilitate integration of HIV/AIDS services into FP services and vice versa.

Furthermore, PMTCT and HIV counselling and testing services are located within the Ministry of Health's Reproductive Health Department and are recognized as an integral part of maternal, new born and child health (MNCH) services.

2.6 Conclusion

This chapter has provided background on integration of HIV and SRH services focusing on sub Saharan Africa where HIV has been one of the greatest challenges to development over the last two decades. In both Kenya and Swaziland, increased morbidity resulting from HIV/AIDS has negatively affected productivity and eroded the accumulation of human capital and its transfer between generations. In addition to killing millions of people at their most productive age, HIV has imposed a significant burden on the already fragile economies and their overstretched health care systems.

The chapter also provided background information on Kenya and Swaziland and their national responses to HIV highlighting the policy endorsements for integrating HIV and SRH services in a bid to improve the delivery and uptake of HIV services.

Chapter 3 Economic theory of production

3.1 Introduction

The aim of this chapter is to provide the requisite economic theory underpinning joint production of services and constitutes the conceptual framework on which the remainder of this thesis will be built. To achieve this aim, the chapter begins with an overview of production theory and the production functions. Key economic concepts relating to joint production and efficiency are then reviewed. This is followed by an application of the economic theory to the delivery of health care services.

3.2 Theory of production

The economic theory of production focuses on the organization and structure of the production process, which is simply defined as the process of transforming inputs into outputs. The theory of production is based upon the assumption that given input prices and a required level of production, the firm chooses amounts of inputs that will minimize costs. Production decisions are therefore influenced by the firms' desire to produce a given level of output using the least amount of inputs.

A central principal of the theory of the production is the production function, which presents the technical relationship between inputs and outputs. Production functions are widely used to define the relationships between inputs and outputs by graphically depicting the maximum amount of outputs that can be obtained from a given amount of inputs. In a single output context, the

production function maps those combinations of inputs, which use the least resources to produce a given level of output.

In the multi-output production model, production can be represented by a production possibilities frontier (PPF) for a given level of inputs. Like the production function, the PPF maps the technically efficient combinations of outputs for a given level of inputs. Combinations of output inside the PPF are technically feasible but inefficient as production could be expanded for at least one output for the given resources available.

In addition to providing an understanding of the different relationships between different combinations of inputs and outputs, production functions can be used to understand the relationship between a single input and output, referred to as the marginal contribution of an input to an output [57].

An analogous concept to the production function is the cost function which represents the minimum cost that a firm can incur in producing a set of outputs [58]. The cost function takes into account the value of the input, combining all the inputs into a single measure (usually costs) and is therefore useful in cases where multiple inputs are used to produce multiple outputs. If cost-minimizing behaviour can be assumed, then the cost minimization problem, which is solved to find the cost function, is the dual of the production function. Duality implies that as long as prices are constant, the cost function can be derived from the production function and vice versa.

3.3 Economics of joint production

The economics of joint production distinguishes between two cases: first, where a firm produces multiple products under separate production processes rarely using common variable inputs but using common fixed inputs. The other case is where a number of outputs are produced from a single production process. In the latter, all outputs share common fixed and variable inputs.

The strategic rationale for joint production, in the truest sense where a number of outputs are produced from a single production process, includes existence of economies of scale and scope. Similarly, within the health service context, the efficiency of integrated health services may be influenced by the presence of scale and scope economies.

3.3.1 Economies of scale

The conventional concept of economies of scale refers to the change in costs as output levels increase. Economies of scale therefore exist when costs of production increase by a smaller proportion than the increase in scale or volume of output. Economies of scale may arise from the imperfect divisibility of fixed capital and specialised human resources. Fixed capital allows for spreading of fixed costs across a larger volume of output. Similarly, another source of scale economies is the spreading of fixed costs associated with general management and administration over more units of production. Joint production can also promote economies of scale when it encourages the additional consumption of one or both outputs.

3.3.2 Economies of scope

Closely related to economies of scale is the concept of economies of scope. Whereas economies of scale relate primarily to the efficiencies associated with the level of production of outputs, economies of scope relate to efficiencies gained from combining processes or activities in the production of multiple outputs. Economies of scope are therefore defined as the cost savings of producing a vector of outputs in one unit compared to producing the same bundle in completely specialised units.

These savings can result from: i) reducing excess capacity by producing a broader output mix therefore lowering fixed costs and; ii) 'cost complementarity' across outputs, defined as the property of a cost function in which increasing one output reduces the marginal cost of all other outputs. Following Panzar and Willig's [59] definition, a multiproduct firm is said to achieve economies of scope if it can produce its outputs together at a lower cost than would occur if each output were produced separately by stand-alone firms. Conversely, there are diseconomies of scope when the cost of joint production is higher than separate production.

3.3.3 Measurement of economies of scale and scope

Previous empirical literature has mainly focused on the cost functions as the main method for determining the existence of economies of scale and scope. The measurement of economies of scale in a single product firm is relatively

straightforward. Within a single product context, economies of scale are obtained if average costs decline with increase in output levels.

Considering a simple single product firm, where total production costs is C and Y_1 = output of product 1 thus

$$C = C (Y_1) \quad (3.1)$$

Average cost for this single-product firm can be defined as:

$$AC = \frac{C (Y_1)}{(Y_1)} \quad (3.2)$$

and marginal cost is defined as:

$$MC = \frac{\partial C}{\partial Y_1} \quad (3.3)$$

Since average cost falls when the marginal cost is less than average cost, economies of scale are measured as

$$EOS = \frac{AC}{MC} = \frac{C(Y_1)}{Y_1(\partial C / \partial Y_1)} \quad (3.4)$$

However, within the multiproduct firm setting, the notion of average costs becomes ambiguous since we have multiple outputs, which combine to contribute to total costs. Therefore, Baumol, Panzar and Willig [10] propose the examination of *ray average costs* which describe the proportional increase in costs associated with a proportional increase in all outputs. From the production function perspective, ray economies of scale refer to the

proportional increase in outputs which result from proportional increases in the quantity used of all inputs. Ray average costs (RAC) are measured as:

$$\text{RAC}(\lambda Y, P) = \frac{C(\lambda Y, P)}{\lambda} \quad (3.5)$$

Where λ is the output expansion factor. At output level Y if we differentiate RAC with respect to λ then ray average costs are declining if

$$\sum_{i=1}^m Y_i C_i(Y, P) - C(Y, P) < 0 \quad (3.6)$$

Where $C_i = \delta C / \delta Y_i$ Economies of scale are obtained by:

$$\text{EOS} = \sum_{i=1}^m \frac{Y_i C_i(Y, P)}{C(Y, P)} \quad (3.7)$$

The basic method of measuring economies of scope involves directly estimating a specified cost function, and comparing the cost of producing multiple products jointly and the sum of the cost of producing all the products individually. Therefore economies of scope are said to exist if

$$\text{SCOPE} = \frac{C(Y_1, 0) + C(0, Y_2) - C(Y_1, Y_2)}{C(Y_1, Y_2)} > 0 \quad (3.8)$$

Although this is a simple measure of economies, a challenge arises in the application of the measure to real life data where there are zero levels of output for some output types. Baumol, Panzar and Willig [10] propose the use of *weak cost complementarities (WCC)* as a sufficient condition for the existence of economies of scopes when there are zero values for some output types. Weak cost complementarities exist if the expression

$$C_{ij} = \delta^2 C / \delta Y_i \delta Y_j \quad \text{is negative and } i \neq j \quad (3.9)$$

This can be alternatively stated as, there are economies of scope at Y if, for all outputs, the marginal costs of expanding the quantity of any given output is an increasing function of the levels of other output types.

3.4 Returns to scale

The concept of returns to scale has been misleadingly used interchangeably with the concept of economies of scale in the economics literature [60]. Although both refer to long-run concepts, economies of scale refer to changes in a firm's costs as output changes. On the other hand, returns to scale, which are solely related to the particular production technology, refer to the effect on output of a proportionate change in the level of all inputs.

A production process is characterized by constant, increasing and decreasing returns to scale. Returns to scale are constant if increasing all inputs by some proportion results in an increase in output by the same proportion. A production function is characterized by increasing (decreasing) returns to scale if an increase in all inputs results in an increase in output by a greater (lesser) proportion. A production function characterized by increasing returns to scale implies the presence of economies of scale. Similarly a decreasing returns to scale production function implies diseconomies of scale.

3.5 Production theory applied to health care delivery

The complex nature of health care organisations means that the production process is less clearly defined as organizations undertake numerous activities producing multiple outputs. In addition, health care organizations differ with respect to their production process as there is considerable variation in how and what range and mix of outputs are produced [61].

Within the health care context, resources are combined to produce health services, which are consumed by individuals to produce improvements in health status. Resources used in producing health services can be classified into three main categories: labour, capital and recurrent operating costs. Labour inputs generally refer to both skilled (doctors, nurses, technical staff) and unskilled staff (cleaners, administrative staff) and reflect the time spent providing care services. Labour inputs can either be measured by aggregation into a single measure such as costs or hours of labour or disaggregation by skill type where there is interest in the relationship between efficiency and the mix of labour inputs employed [58].

Measures of capital inputs include floor space and capital equipment such as hospital beds, which serve as proxies for physical capital resources. Labour and capital resources are therefore combined to produce health programmes, which are consumed by individuals to improve their health.

Output in many industry contexts refers to tangible goods. This however is not the case within the health care context where outputs can be classified into two

types: health service outputs and health outcomes. Health service outputs such as number of hospital visits, patient days, patients' treated and hospital discharges are intermediate outputs in the production of health. Health outcomes on the other hand refer to the impact of a specific health intervention on the health status of an individual and are usually measured as years of survival, reduction in disability (DALYs) or increments in health status measured in terms of quality adjusted life years gained (QALYs).

While it would be desirable to define outputs in terms of health outcomes the practical application of this presents numerous challenges. This includes the difficulty in measuring the conceptual output of improved health status given the difficulty in defining a direct relationship between inputs and health outcomes [62]. Furthermore, although practical for single applications such as cost effectiveness analysis, the use of outcome measures such as QALYs or DALYs in LMICs has proved challenging due to the large data requirements as outcome measures are not commonly collected through routine data collection systems.

Although health service outputs have the disadvantage of not incorporating the quality of the service, the use of health outputs is conceptually less troublesome and robust measures of health output can be adjust for quality of services.

Chapter 4 Review of methods for measuring efficiency in the health sector

4.1 Introduction

Following the overview of the economic theory of production and its application to health care delivery, this chapter begins with an overview of the concepts of efficiency in health care and then reviews the methodological as well as empirical literature on efficiency measurement in the health sector. In particular, it discusses the two main methods of efficiency measurement: parametric and non-parametric methods, highlighting their respective strengths and weaknesses. Finally it reviews applications of non-parametric data envelopment analysis (DEA) techniques in low and middle-income settings.

The review of applications of DEA in low and middle-income settings considers the methods used in relation to input and output variables selection; incorporation of environmental variables and quality measures and identifies the gaps in the literature with respect to the context of this thesis.

4.2 Concepts of efficiency in health care

Economic literature generally distinguishes between two types of efficiency measures: technical and allocative efficiency. Technical efficiency reflects the physical efficiency of transforming inputs into outputs and therefore implies the maximum possible output that can be produced from a given set of inputs. In relation to the production of health, technical efficiency may be defined as the

combination of inputs which maximize resource use for a given level of health status improvement or maximizing health gain for a given level of inputs [35].

Allocative efficiency is the capacity of a decision-making unit to choose an optimal set of inputs to produce a given amount of output given factor input prices. In the health care context, allocative efficiency therefore relates to the combination of inputs, which minimises the cost of producing a given level of health gain for given input prices. Allocative efficiency thus implies that the marginal cost per extra unit of health status improvement must be equal across all inputs [57].

Together, these two measures represent an overall efficiency measure referred to as cost or economic efficiency [63]. This thesis will subsequently focus on technical and cost efficiency in the provision of integrated HIV and SRH services.

4.3 Methods for measuring efficiency in the health sector

The methods used for measuring technical and cost efficiency are commonly referred to as frontier approaches. The underpinnings of efficiency measurement date back to the work of Debreu [64] and Farrell [65]. Farrell's notion of an efficient level of production provided a standard based on the best practice from which to compare the efficiency of a sample of firms. Farrell therefore suggested that one could analyse technical efficiency in terms of realized deviations from an idealized frontier isoquant.

Generally, empirical literature on technical and cost efficiency has estimated either a production function or a cost function. Following Farrell's [66]

pioneering work, two main analytical approaches have been used to estimate the production and cost functions and hence undertake comparative analysis of efficiency across organisations. These are parametric approaches and non-parametric methods.

Parametric methods include stochastic frontier analysis (SFA) as described by Aigner, Lovell and Schmidt [67], Meeusen and van den Broeck [68] and Battese and Cora [69] and the deterministic approach of Aigner and Chu [70]. Non-parametric methods include data envelopment analysis (DEA) techniques as introduced by Charnes, Cooper and Rhodes [71] and the Free Disposable Hull (FDH) approach used by Deprins, Simar and Tulkens [72].

4.3.1 Parametric approaches

Parametric methods for estimating production and cost functions use statistical methods to estimate an organisation's cost and production relationships. The main characteristics of these approaches are the requirement for the specification of a parametric functional form a priori, and strong distributional assumptions of the production function and the error term and the ability to use conventional hypothesis testing [57].

Parametric approaches include the simplest corrected ordinary least squares (COLS) and stochastic frontier analysis (SFA). The SFA model is the most common of these parametric approaches for estimating organisational efficiency. A shortcoming of the COLS based on OLS estimation is that it confounds inefficiency with statistical noise thereby classifying the entire

residual as inefficiency. However, the SFA technique is motivated by the idea that deviations from the production ‘frontier’ might not be entirely under the control of the firm being studied. Therefore, SFA models are preferred as they attribute part of the deviations to inefficiency and the other to random noise.

The stochastic frontier model of the production frontier is presented as:

$$Y_i = \alpha + \beta x_i + v_i + u_i \quad i=1, \dots, n. \quad (4.1)$$

Where y is the vector of either outputs (Y) or cost (C); i indicates the number of observations, $i=1, \dots, n$; α is a constant; x is a vector of inputs, and β is a vector of unknown parameters capturing the relationship between the dependent and explanatory variables. v_i represents the stochastic error term and u_i represents the measurement of technical efficiency of firm i .

A key consideration in a parametric empirical analysis is the choice of an appropriate functional form. Major factors to be taken into consideration when choosing an appropriate functional form are: flexibility, ease of computation and its ability to impose homogeneity [73]. A functional form is considered flexible if it can approximate any function at a point by an appropriate selection of values for the parameter of interest [74].

A variety of functional forms have been used in the hospital efficiency literature. These include linear, quadratic, cubic, Leontief, Cobb-Douglas and translog and their hybrids, which include variables to control for hospital heterogeneity. However, the Cobb-Douglas and translog functions dominate the applications literature in stochastic frontier and econometric efficiency estimation [75]. The

Cobb-Douglas function satisfies conditions of ease of computation and ability to impose homogeneity. However, it imposes strong assumptions on the underlying functional relationship, most notably that the elasticity of substitution¹ is always equal to one.

The translog functional form is considered the best choice because of its ability to approximate most types of functions. Generally, the translog functional form allows for the testing of a wide range of assumptions about the nature of the cost function and does not impose restrictive a priori assumptions on its functional form. However, the classical translog functional form is not without flaws. One of its disadvantages is the requirement for positive levels of all outputs, a requirement which is rarely met in the health care context as few facilities provide zero levels of certain outputs and fewer still produce only one output [76]. The standard translog is therefore generally unsuitable for estimating economies of scope when there are zero outputs since the logarithm of zero is undefined.

A number of solutions have been proposed to address this problem. These include estimating the costs with an arbitrarily small level of output e.g. 0.01 [77-79] replacing the zero values with the minimum value of each output within the sample under consideration or with a value equal to ten per cent of output at the sample means [80] or using the Box-Cox transformation on output variables[81, 82]. However, both approaches introduce an unknown bias to the estimates [83, 84].

¹ Elasticities of substitution measures the substitutability between inputs i.e. how easy it is to substitute one input for the other in a production process.

Baumol, Panzar and Willig [10] proposed the quadratic functional form which provides a direct and proper method to account for zero outputs in estimation and evaluation of economies of scope in multi-output context. The quadratic functional form overcomes the issue of bias arising from using the translog functional form and its alternative specifications. Furthermore, it allows for the identification of the fixed cost and cost complementary effects in the scope measures.

Apart from choice of a functional form, other considerations when estimating an efficiency model using SFA techniques include: whether to estimate a production or cost function, whether to transform variables; whether to estimate total or an average function, explanatory variables to include; how to model the residual and how to extract efficiency estimates [58].

4.3.2 Non parametric approaches

The non-parametric approaches include: Data envelopment analysis (DEA), Free Disposal Hull (FDH) and other traditional approaches including ratio analysis, and indices used as performance indicators. DEA, a linear programming methodology popularised by Charnes, Cooper and Rhodes [71], is the most widely used nonparametric methods for measuring organisational efficiency (and will be the subject of this thesis). The less frequently used FDH differs from the DEA in that it does not impose the convexity² assumption [85].

² A production function is convex if the mean of any two combinations that can be produced, can itself be produced.

Within the DEA framework, the focus of efficiency measurement is an organisational locus of production referred to as a decision making unit (DMU) which is the unit of analysis [58]. Essentially, a DMU refers to the organisation under study and may include banks, hospitals, schools etc.

A basic DEA model assesses the efficiency of an organisation or DMU in two stages. First, a frontier is defined based on those organisations providing the highest output mix given their input mix. Each organisation is then assigned an efficiency score by comparing its output-input combination to that of the efficient organisations on the efficient production frontier. The efficiency of an organisation is therefore expressed as the distance from the efficient production frontier – defined as the maximum extent by which an organisation can improve its outputs given its input levels. The resulting efficiency scores range between zero and one and represent the degree of a DMU's efficiency.

Following Charnes et al [71] the technical efficiency of an organisation is obtained as the ratio of the weighted sum of outputs divided by the weighted sum of inputs. Initial DEA models by Charnes et al assumed constant returns to scale (CRS), which assumes a production process in which the optimal mix of inputs and outputs is independent of the scale of operation. The formulation of the CRS model is:

$$\text{Max } h_0 = \frac{\sum_{s=1}^S u_s y_{s0}}{\sum_{m=1}^M v_m x_{m0}}$$

Subject to:

$$\frac{\sum_{s=1}^S u_s y_{s1}}{\sum_{m=1}^M v_m x_{m1}} \leq 1 \quad i = 1, \dots, I \quad (4.2)$$

Where the sub index 0 represents the DMU for which technical efficiency is being calculated; y_{s0} is the quantity of output s for DMU₀; x_{m0} is the quantity of input m for DMU₀; u_s and v_m are the weights attached to the outputs and inputs respectively. Technical efficiency is calculated by solving the linear programming constrained maximization problem.

Banker, Charnes and Cooper's [86] further extended this model to accommodate variable returns to scale (VRS), when not all organisations can be considered to be operating at an optimal scale. The VRS DEA model makes it possible to determine the impact of an organisations scale/size on their technical efficiency by allowing the decomposition of technical efficiency into scale and pure technical efficiencies.

DEA models are broadly divided into output and input oriented models. Output oriented models determine the degree to which a firm can expand its output without changing its inputs. In contrast, input oriented models represent the degree to which a firm can reduce its input use without altering its outputs. Choice of the orientation model depends on the focus of the particular study and the extent to which a firm has control on its inputs and outputs. The output oriented model is suited for firms that have flexibility to alter their level of output while the input oriented approach is more appropriate for firms that can alter their use of inputs but have less flexibility to change their outputs.

Empirically, the technical efficiency scores relate to the distance of a firm's production point from its respective benchmarking frontier. The exact interpretation is specific to the model of orientation. For the output-oriented model, the efficiency scores measure the volume of output that a firm is currently producing, relative to the maximum volume it could potentially produce from its current inputs. For the input oriented model, the efficiency scores represent the proportion by which a firm exceeds the minimum volume of inputs required to produce its current output level [87].

4.3.3 Comparing parametric and non-parametric techniques

The main differences between SFA and DEA lie in assumptions concerning stochastic behaviour and the nature of the production/cost frontier. While SFA models are stochastic allowing for random error, DEA is a non-stochastic approach, which does not allow for measurement error.

Secondly, being a parametric approach, SFA requires specification of the functional form a priori. SFA models are therefore sensitive to model specification and are prone to specification error. In contrast, DEA is non parametric and therefore has no requirements for strong distributional assumptions and specification of a functional form. DEA requires only an assumption of convexity of the production possibility set [88]. A third difference is, DEA gives an estimate of the extent of inefficiency of a given organisation, relative to the best performing organisation within the same industry whereas parametric approaches determine the absolute level of an organisation's

efficiency against an imposed benchmark [89]. A summary of the efficiency techniques and their pros and cons is provided in Table 4-1.

Table 4-1: Summary of the efficiency measurement techniques

Technique	Pros	Cons
SFA	<ul style="list-style-type: none"> • Allows for the separation of random shocks and measurement error from technical inefficiency • Able to generate estimates of input elasticity of the production frontier in addition to efficiency scores • Permits the estimation of marginal cost of production and the efficient rates of substitution among inputs. 	<ul style="list-style-type: none"> • Requires specification of the functional form a priori • Sensitive to model specification and are prone to specification error • Requires large samples making it an inappropriate technique where samples are small • Requires aggregation of outputs into a single index thereby restricting estimation of a production function.
DEA	<ul style="list-style-type: none"> • Useful in complex multiple-input/output production situations • Appropriate where classical economic assumptions of cost minimising behaviour are questionable • Allows for the examination of production characteristics such as returns to scale. 	<ul style="list-style-type: none"> • Does not make allowance for statistical noise and measurement error • Sensitive to outliers in the sample data • Inability to use conventional hypothesis testing • Sensitive to the number of inputs and output variables used in the analysis • No standard accepted statistically based criteria to guide model selection.

A number of studies have made comparisons between efficiency estimates obtained by the two different frontier efficiency measurement techniques. For example, Gonzalez Lopez-Valcarcel and Perez [90] used both DEA and SFA to estimate efficiency scores for a panel of 73 Spanish hospitals between 1991 and 1993 following a change in the model of financing reflected in program

contracts and conclude that the choice of approach did not significantly influence the results. Similarly, Linna and Häkkinen [91] examined DEA and SFA estimates of cost efficiency in 48 Finnish acute care hospitals in 1994 finding scores within a similar range between 0.86 and 0.93 and DEA scores of between 0.84 and 0.89.

On the other hand, Jacobs [92] compared the efficiency scores from OLS with those obtained using DEA and SFA techniques. Applying these techniques on 232 UK NHS hospital trusts, the study found inconsistency of efficiency scores across the different techniques. The study concluded that differences may be as a result of the fact that each method potentially measures different aspects of efficiency that is, DEA addresses the issue of technical efficiency while the inefficiency measured by SFA may be a combination of technical and allocative efficiency given that prices are included in the cost function.

While there is no clear consensus on the best method to measure technical efficiency, DEA presents a number of advantages over SFA. DEA approaches are particularly useful in complex multiple-input, multiple-output production situations where classical economic assumptions of cost minimising behaviour are questionable such as the public health sector [85]. Within the health sector, studies from low-income countries have pointed out the better suitability of DEA for contexts where there is insufficient health sector information and particularly when the economic data on prices is missing [93, 94]. In addition, SFA techniques require large samples therefore making the use of SFA challenging where samples are small as this may introduce measurement error

and bias in inefficiency estimates through the inappropriate aggregation of inputs and outputs [57].

However, despite its appealing characteristics, DEA has several limitations. The most cited limitations are its sensitivity to outliers in the sample data and inability to use conventional hypothesis testing as used in parametric approaches [95]. As a data driven deterministic technique, the production frontier may be influenced by organisations with unusual production patterns resulting in these organisations being on the efficiency frontier.

Third, DEA is sensitive to the number of inputs and output variables used in the analysis. A higher number of variables relative to the number of organisations measured could result in overestimates of efficiency scores [57]. In addition the distribution of efficiency is likely to be affected by the definition of outputs and the number of inputs and outputs included, therefore careful selection of inputs and outputs is required. The more input and output dimensions included in a given model, the greater the bias.

Fourth, DEA is a non-parametric method with no standard accepted statistically based criteria to guide model selection. However, in recent years, there has been an increase in hypothesis testing and statistical precision in the context of non-parametric efficiency and productivity measurement. For example, analysts have employed sensitivity analyses to test the robustness of the results to changes in methods and data used [57]. Recent contributions in this regard have used techniques such as bootstrapping [96]. The bootstrap introduced by Efron, 1979 [97] is based on the idea of repeatedly simulating the data generating

process through resampling, and applying the original estimator to each simulated sample so that resulting estimates mimic the sampling distribution of the original estimator [98].

Fifth, DEA provides a relative measure of efficiency and therefore even those organisations that appear to be efficient may in actual fact be inefficient in absolute terms. In addition, DEA measures an organisation's efficiency relative to the best practice within organisations in a particular sample. Therefore, it is not possible to compare similar organisations across regions with respect to technical efficiency.

4.4 Methodological considerations in DEA

4.4.1 Input and output selection

Careful consideration of inputs and outputs is required within a DEA efficiency measurement model. The attention to variable selection is crucial since the greater the number of input and output variables, the less discerning the DEA results are [99]. This is largely because an increase in the number of variables increases the dimensions of DEA's assessment of DMUs. The challenge is therefore finding a parsimonious model using as many input and output variables as needed but as few as possible [100]. As a guideline, the total number of input and output variables should be less than one third of the number of DMUs in the analysis: $(m+s) < n/3$. [101, 102]. A large number of variables will tend to shift the compared units closer to the efficiency frontier resulting in a relatively large number of units with high efficiency scores [103].

Several approaches have been suggested for identifying variables to be included in a DEA model. A commonly used approach is the application of regression and correlation analysis. This approach is based on the premise that a high statistical correlation between input and output variables is an indicator that a variable influences a firm's efficiency. Variables that are highly correlated with other variables in the model are therefore considered redundant and should be omitted from the model [100]. The removal of variables with little or no explanatory power is assumed to improve the discrimination of efficient and inefficient DMUs [104].

While this approach has been widely used, Dyson et al [105], showed that omission of variables purely on grounds of correlation could have a major influence of the computed efficiency scores. Hence an analysis of simple correlation is insufficient in identifying unimportant variables. Instead, regression and correlation analysis should not be regarded as strict reliable rule for eliminating variables but rather an indicator for a need to examine some of the variables more closely [106].

Other approaches examine the effects of changes in input and output variables on the efficiency scores. Rather than looking simply at the correlation matrix Jenkins and Anderson [99] developed a statistical method using partial covariance analysis to determine which variables could be omitted from the analysis without losing information. Wagner and Shimshak [100] proposed a stepwise approach using the backwards approach for selecting variables for a DEA model. This approach starts by considering all possible input and output variables in the DEA model and at each step dropping one variable from the

model by analysing the efficiency scores of the DMUs until only one input and output variable remains in the model.

4.4.2 Incorporating environment variables

Empirical work on organisational efficiency highlights the significance of a number of environmental factors, which could influence efficiency of a DMU. These variables are considered to be non-traditional inputs into the production process and may include various characteristics of organisations. Jacobs et al [58] have broadly classified these factors into internal factors which are at the discretion of the hospital management and external factors that are beyond their control. Some of the factors highlighted in the literature include ownership (government/private), location (urban/rural), catchment population, teaching status, hospital size, health care financing (health insurance/private out of pocket), level or degree of specialisation/integration and institutional constraints such as access to capital resources [107-111].

There have been developments of different approaches to incorporate the effect of exogenous variables into DEA models estimating efficiency. Jacobs, Smith and Street [58], note three ways in which exogenous factors can be taken into account in efficiency analyses. The first approach involves restricting comparison to units with similar constraints or operating in the same environment. Jacobs, Smith and Street [58] note that if the sample can be divided into distinct groups or sub samples on the basis of an environmental variable such as public vs. private ownership, then the approach proposed by Charnes, Cooper and Rhodes [112] can be used. In this approach, cluster

analysis techniques are used to cluster organisations into similar groupings with the intention to compare very similar organisations [92]. Separate DEAs are undertaken for each sub sample and separate efficiency frontiers estimated for each. A single DEA is then undertaken using the projected points to assess any differences in the mean efficiency of the two sub samples [58].

An alternative approach to this involves the inclusion of environmental variables as one of the inputs in the production process. This approach restricts comparison of DMUs to those operating under the same environmental conditions [58].

A second and more commonly used approach for incorporating environmental variable within efficiency measurement models involves a two-stage semi-parametric analysis. This involves computing efficiency scores for each DMU using a standard DEA model based on the traditional (physical and/or financial) inputs and outputs, in the first stage. In the second stage, the efficiency scores are regressed against specific environmental variables that are hypothesized to influence the efficiency of a DMU. This approach is likely to provide valuable insights into the causes of efficiency differentials across organisations. Although widely used there are three potential problems with this approach.

First, the two-stage approach uses estimates of the efficiency scores as the dependant variable in the second stage. While DEA estimators are consistent, they have very low rates of convergence, which implies that in small samples the resulting efficiency estimates are biased. In this case, efficiency estimates may be overestimated. The small sample bias is related to (i) the number of

observations in the sample; (ii) the number of inputs and outputs used in the model; and (iii) the density of observations around the frontier [113].

Second, the individual efficiency scores depend on other observations on the frontier and therefore the dependent variable is serially correlated in an unknown way. In addition, the efficiency scores are not independent since the inputs and outputs used to generate them are correlated with the environmental variables, and thus the error term of the second stage regression is correlated with the environmental variables as well. While both correlations disappear asymptotically, the slow rate of convergence makes conventional inference invalid in small samples.

Third, most applications of the two-stage approaches have relied on censored Tobit regressions. The Tobit model is a statistical model used to describe the relationship between a non-negative dependent variable y_i and an independent variable (or vector) x_i . The model supposes that there is an unobservable variable y_i^* , which is linearly dependent on x_i . The observable variable y_i is defined as equal to the unobservable variable whenever the unobservable variable is above zero and zero otherwise.

$$y_i = \begin{cases} y_i^* & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0 \end{cases} \quad (4.3)$$

While this approach has been a popular technique for analysing determinants of efficiency, Hoff [114] shows that the Tobit estimator is not an appropriate estimator since the efficiency scores are not censored or corner solution data. DEA generates a production frontier using the DMUs input-output data which

results in fractional data with the scores bound between 0-1 hence there is only a positive probability to attain one of the two corner values. Simar and Wilson [115] show that the truncated regressions may therefore be more appropriate.

To overcome these issues, Simar and Wilson [116] proposed the use of two rigorous bootstrap³ procedures which permit valid inference. The first bootstrap procedure is applied in the first step to arrive at bias corrected efficiency estimates. The bootstrap in the second stage is used to overcome problems with the standard estimation procedures and improve the statistical efficiency of estimates in the second-stage regression.

A third but less common method of incorporating environmental variables is the risk adjustment technique, which adjust outputs for differences in circumstances before they are used in the efficiency model. Rather than using environmental factors as a general adjustment for all outputs, risk adjustment allows for the adjustment of each output for only those factors that specifically apply to it [58]. Examples of risk adjustment include the standardised mortality rates routinely used in population outcome studies [92] which adjust observed mortality rates for the demographic structure of the population.

4.4.3 Accounting for quality of care in efficiency measurement

Although there is consensus about the importance of evaluating quality particularly in health care, only a few studies in the health sector have

³ Boot strap is a computer intensive technique essentially based on the basic idea of approximating the unknown statistic's sampling distribution of interest (confidence intervals and by extensively resampling from an original sample, and then using this simulated sampling distribution to make population inferences.

attempted to incorporate quality measures within efficiency measurement frameworks [117-122]. This is largely because incorporating quality measures within efficiency measurement has posed a number of significant challenges. Challenges have not only been with the selection of quality output measures but also with how to incorporate these measures into the efficiency measurement models.

In terms of the selection of quality measures, quality of care within health has been assessed from the point of view of users (perceived quality), or using technical standards as defined by professionals [123]. A standard framework for quality of care assessment in health care was first proposed by Donabedian [124] who conceptualised three quality of care dimensions: structural, process and outcomes. Donabedian's commentary on structure focussed on attributes of the health care setting including physical structure, organisational structure, human resource capacity and qualifications. These provide an overall assessment of the health facility's ability to provide health services. Process denotes what is provided and received within the context of health care delivery. Process indicators may include quality of clinical care provided and range of services received. More specifically within the health care context, structure and process aspects of quality care are based on the assumption that resources and practice patterns always contribute to health improvements.

Outcome indicators focus on the impacts of care on the health status of patients and the general population. Key outcome measures that include patient perceived quality aspects include reductions in client wait times, improvement in service provider interpersonal relations, clients' choice and knowledge,

changes in behaviour, increase in uptake of a service, patient satisfaction, and continuity of care. Due to the challenges associated with measuring outcomes, most studies assessing quality of care have focused on structural and process attributes which are easier to assess [125].

While other frameworks for evaluating quality of care exist, the Donabedian provides a framework that is intuitive and flexible and therefore applicable in a variety of contexts. Furthermore, the framework does not account for patient, economic or social factors beyond the health care delivery system and focuses solely on what is under the control of the health provider and affects patient outcomes.

Three main approaches to incorporating quality measures into efficiency evaluation have been identified in the literature. A popular approach used in DEA has been to add quality measures into the DEA model as outputs [117, 118, 120, 126, 127] in a combined quality and efficiency model. However, a potential problem arises with this approach as DEA can assign low weights to some inputs or outputs so that the quality output variables are ignored. In this case, some units may achieve high efficiency scores despite having poor quality scores because a zero weight is assigned to the quality variable. Secondly, the number of efficient units increases artificially with the addition of variables making the DEA less discriminatory.

To overcome these limitations three alternative approaches of placing restrictions on the weights of the output measures used in the analysis, have been proposed. These include: 1) direct restrictions on weights, which involves

adding additional constraints involving the weights to the existing DEA model; 2) adjusting the observed input-output levels to simulate weight restrictions using cone-ratios or ordinal relations; 3) restricting the virtual inputs and outputs by placing restrictions on the importance attached to a particular output by a DMU [128]. Shimshak et al [129] use a combined quality and efficiency model that incorporates weight restrictions on the output measures determined by value judgments from nursing home managers.

Other researchers have attempted to use a two-model approach with separate quality and efficiency models. The quality model used quality measures as outputs and the second efficiency model used quantity outputs. In their study of productivity of US banks, Sherman and Zhu [130] looked at two separate models of operating efficiency and quality, introducing a method called “quality adjusted DEA (Q-DEA)”. The Q-DEA model graphs the sample units into four quadrants: 1) High quality, high efficiency (HQ-HE); 2) Low quality, high efficiency (LQ-HE); 3) Low quality, low efficiency (LQ-LE); and 4) high quality, low efficiency (HQ-LE). Units with low quality and high efficiency (LQ-HE) were removed from the sample and the DEA run again to overcome misleading benchmarking due to the assumed trade-off between efficiency and quality [131]. A drawback of this approach is that the evaluation of the set of units is incomplete as some units are removed from the sample.

An alternative approach to incorporating quality directly into the DEA model is employing a two-stage estimation procedure where DEA scores from the first stage are regressed against a set of explanatory variables that include a measure of quality [132]. This approach effectively assumes that quality indicators

influence the efficiency with which inputs are transformed into outputs but does not influence the process itself. However, as Lovell [133] notes this formulation is flawed as not only are the technical efficiency estimates from the first stage biased but quality is correlated with inputs and therefore estimates of coefficients from the second stage analysis will also be biased.

4.5 Applications of efficiency measurement techniques in LMICs

This section presents the methods used to search and review the literature on applications of parametric and non-parametric DEA techniques in LMIC and the results of the review. A discussion of the methods used in relation to the output measurement, incorporation of environmental variables and quality measures in the efficiency measurement is also included. Given the variability in choice of input and output variables, model specifications, and estimation techniques, results from the different studies are not comparable and therefore no attempt is made to meta analyse the findings.

4.5.1 Methods

A comprehensive review of published literature was conducted to identify applications of parametric and non-parametric measurement techniques of health service efficiency in general and HIV and reproductive health services in particular in LMIC. Studies were appraised to determine the inputs and outputs considered; analysis of exogenous factors and incorporation of quality of care in order to better inform subsequent parametric and non-parametric analysis in chapters 8 and 9.

4.5.1.1 Literature search

The search strategy involved conducting a search of published and grey literature on EconLit, Global Health, PubMed, Cochrane Library and JSTOR databases using the following key terms and/or their combinations: “efficiency” “inefficiency” AND “integration” OR “economies of scope AND scale” AND “health care” OR “sexual reproductive health” OR “family planning” AND “HIV” OR “sexually transmitted infections” AND “cost efficiency” AND/OR “technical efficiency” OR “data envelopment analysis”, “DEA”.

The literature search conducted between October 2011 and April 2012 and then updated in December 2013 also included a manual search of organisational websites such as the World Bank - www.worldbank.org, UNAIDS – www.unaids.org and a review of bibliographies of papers generated from previous search strategies.

4.5.1.2 Study eligibility

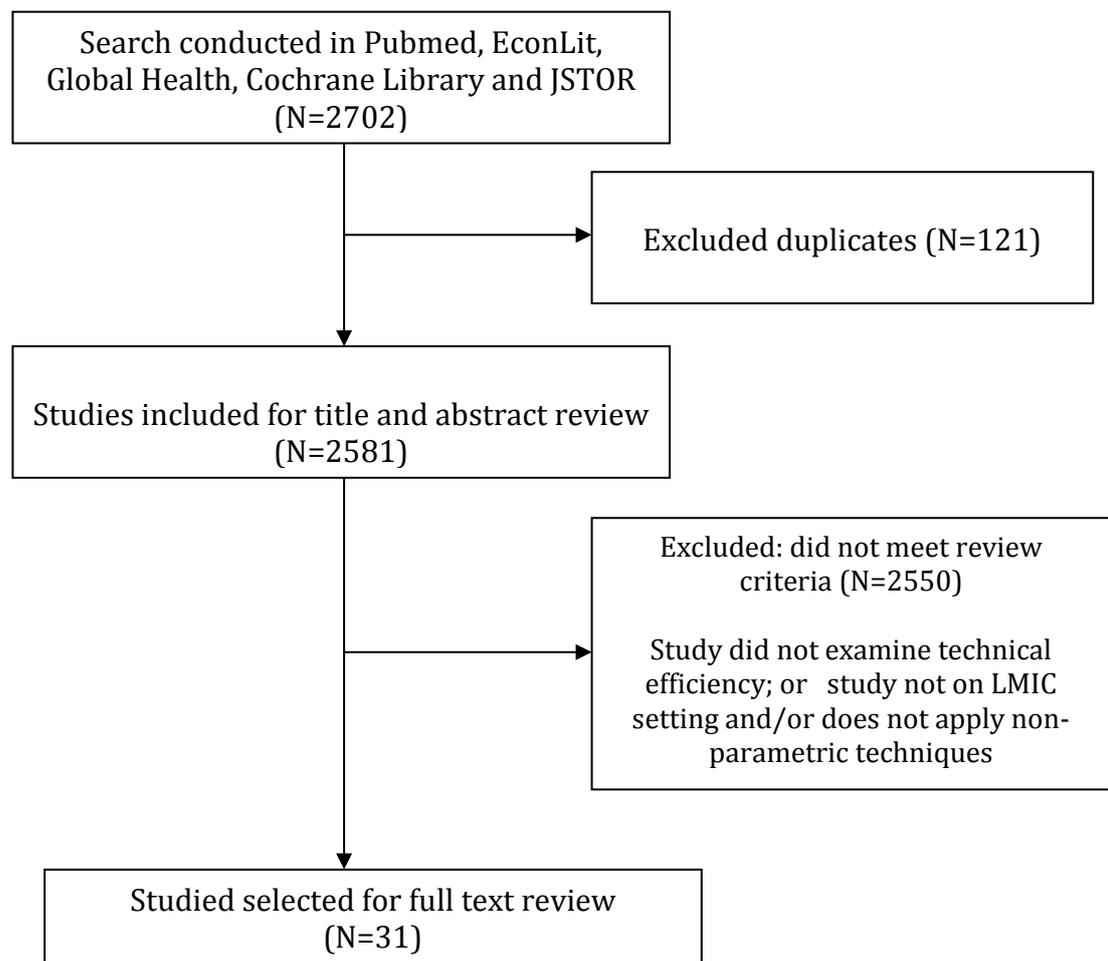
The review only included studies published in the English language and no limitation regarding publishing date was used. The review focused only on low and middle-income countries therefore excluding studies from high-income countries. The World Bank’s Atlas classification method of economies, which uses gross national income (GNI) per capita is used in this review. According to 2012 GNI per capita, these groups are: low income, \$1,035 or less; lower middle income, \$1,036 - \$4,085; upper middle income, \$4,086 - \$12,615; and high

income, \$12,616 or more [52]. In order to be eligible for inclusion in the review, the published study had to present empirical information on cost or technical efficiency measurement and apply SFA and non-parametric (DEA) efficiency measurement techniques.

4.5.2 Results

The initial search resulted in 2702 papers. After excluding duplicates and studies that did not fit the criteria on review of titles and abstracts, 31 papers were selected for full text reviewed. Figure 4-1 shows the process of study selection.

Figure 4-1: Flow diagram of literature search



4.5.2.1 General characteristics

Parametric studies

Although parametric techniques have received considerable attention within the literature, very few studies in low and middle-income have incorporated these techniques. Data deficiencies have been identified as the main constraint. The few studies identified have all used this technique to evaluate cost efficiency. Among general hospital efficiency studies recent contributions include Weaver and Deolalikar [134] who estimated a multiproduct cost function to examine economies of scope and scale in Vietnamese hospitals.

Within the HIV context, Marseille et al [135] used regression techniques to examine the association between scale and efficiency using data from 206 HIV prevention programs of six types in six countries (India, Mexico, Russia (2), South Africa and Uganda. Guinness et al [125] estimated two hybrid translog-cost functions to explore the impact of scale, target group, institutional history and price on costs of 78 state-funded HIV prevention projects in Andhra Pradesh, India.

Non-parametric studies

A number of studies have employed non-parametric DEA techniques to measure efficiency within the health care sector, since its first application to study hospital production by Banker, Conrad and Straus [88] in 1986 and then Grosskopf and Valdmanis [136] in 1987. While the literature has been

predominately concerned with efficiency measurement in developed countries, increasingly applications of DEA techniques have been made to LMICs.

A total of 33 studies met the inclusion criteria [94, 111, 137-159]. The studies covered 24 countries; with half of the studies set in Sub-Saharan Africa. The majority of the published literature was related to the production of hospital and primary health care services. In addition three studies analysed administrative units (states and health districts) [155, 157, 160]. Excluding the health system wide analysis, the sample sizes of units analysed in the studies ranged from 10 to 210 with a mean of 55.

A summary of the study characteristics and methods used in the DEA studies identified are provided in Table 4-2.

4.5.2.2 Methodological considerations

Input and output measures

The typical input variables across studies were counts of physical resources and the costs of inputs. Physical resources included numbers of clinical and non-clinical staff (doctors, nurses, technologists, technicians, other health staff and administrative staff) and capital employed (space measured in sq. m, beds and equipment). Financial or cost measures included recurrent expenditures on drugs and supplies.

In terms of output variables, a common feature of the identified studies is the use of throughput measures as proxies of health outcomes. None of the studies

included outcome measures which examine changes in health status of individuals. Typical health service throughput measures were outpatient visits, number of procedures, inpatient bed days and inpatient discharges. The use of health service measures assumes that health services lead to health outcomes and no difference exists between health facilities in providing health services.

The selection of input and output variables was rarely justified.

Analysis of exogenous variables

A small subset of studies (n=9) attempted to incorporate an analysis of the operating environment into the DEA measure of efficiency [93, 140, 150, 159-165]. The other 23 studies did not attempt to perform an analysis to explain variation in efficiency across units examined. The exogenous variables considered were ownership type (public/private/NGO); type of contracting; facility type (hospital/health centre); geographic location; region/state; population intensity; demand for services (measured by the ratio of populations aged 0-14 and above 65 years); price of hospital services; ratio of outpatient department visits to inpatient days; bed occupancy; average length of stay; population and numbers of household members; distance to the next health centre; and values of durable goods and personal animal ownership. Religion and ethnic groups were also used as explanatory variables.

Three of the published studies used conventional tests to test for efficiency differences between different groups/characteristics to determine the impact of ownership type and geographical location on efficiency [93, 140, 163]. The

other studies (n=6) used two-stage DEA methods, where the efficiency (inefficiency) scores estimated using a standard DEA were regressed against the set of explanatory variables, to analyse the impact of institutional and exogenous variables on technical efficiency. Four of these estimated truncated or Tobit regressions [111, 150, 159, 160, 164].

Zere et al [164] estimated a censored tobit regression to identify factors that influence inefficiency in 55 level 1 hospitals. The explanatory variables included occupancy rate (a composite index that incorporated inpatient admissions, the average length of stay and number of beds); and outpatient visits as a proportion of inpatient days. Similarly, Kirigia et al [111] estimate a censored Tobit model to determine the impact of the average length of stay, ratio of outpatient department visits to inpatient days, region population and geographical location on the efficiency of secondary public community hospitals in Eritrea. Blaakman et al, [159] estimate a truncated regression model to examine the effects of contracting type, security of location, distance from the urban centres and a composite facility quality measure on the technical efficiency of 144 basic health centres and comprehensive health centres in Afghanistan. Hu et al [160] also estimate a Tobit model to examine the effects of population intensity, hospital treatment demand, ownership type, price of hospital services, geographic location, medical reforms and government subsidies on regional hospital efficiency.

Marschall and Flessa [150] estimated both normal censored Tobit and truncated regressions to examine the effects of distance to the next health centre, no of household members, value of personal animal ownership at

individual and household level, value of animal ownership at household level per capita; value of durable household goods at the personal and household levels, value of durable household goods at household level, value of durable household goods at household level per capita and religion and ethnic group, finding similar results using both methods. Akazili et al [165] on the other hand estimate a logistic regression to find out how various economic, structural and demographic factors affect the technical efficiency of 113 health centres in Ghana. These factors included age of the health centre, the response of the district health management team (DHMT) to the needs of the health centre, availability of means of transport, level of infrastructure, presence of a health committee and incentives received from the DHMT.

Chaabouni and Abednnadher [161] estimated a bootstrapped truncated regression to examine the effect of hospital expenditures, bed occupancy ratio, gross product per capita, length of hospital stay and various contextual variables affecting the efficiency of Tunisian hospitals.

Incorporation of quality

The majority of the studies reviewed assumed that output quality did not vary across facilities. Only one study [150] recognises the lack of consideration of quality aspects of health care provision within the efficiency measurement model as a limitation of the study. Two studies attempted to incorporate quality measures into the efficiency model. Hu et al [160] used the proportion of third class (the highest class) hospitals to the total number of hospitals as a proxy for input quality as an explanatory variable in the second stage analysis of the

effects of health insurance reform in China. Blaakman et al [159] in their study of the effects of contracting out to deliver the basic package of health services in Afghan provinces, use a facility composite quality measure. However, no details are provided of how the composite quality measure is generated.

Table 4-2: Summary of non-parametric efficiency measurement studies in LMIC reviewed

Study samples and characteristics				Methods and control variables			
Author	Country	Years	Sample size	Methods used to determine efficiency	Inputs	Outputs	Contextual variables
Abbas et al 2011	Pakistan	2010	116 Basic BHUs	DEA (one-stage)	(4) Number of medical staff; paramedical staff; lady health workers; other staff	(4) Number of outpatient visits; children immunized; family planning visits; first antenatal care visits	-
Akazili et al, 2008	Ghana	2005	89	DEA (one stage) – technical efficiency. returns to scale	(4) Number of non-clinical staff; number of clinical staff; number of beds and cots; expenditure on drugs and supplies.	(5) General outpatient visits; number of antenatal care visits; number of deliveries; number of children immunised; number of family planning visits	-
Al-Shammari, 1999	Jordan	1991-1993	15	DEA (one stage) – productive efficiency	(3) Number of bed days, number of physicians, and number of health personnel.	(3) Number of patient days, number of minor operations, and number of major operations	-
Blaakman et al, 2013	Afghanistan	2009	144 basic health centres and comprehensive health centres	Cost and technical efficiency (two – stage DEA)	(4) Number of clinical staff; administrative staff; level of available drugs/medicines; and number of beds	(8) ANC visits, DPT 3 annual visits; annual deliveries, family planning visits, OPD visits, nutrition visits, TB pos annual visits; and TT2 visits	Type of contracting, distance to health facility, quality of care

Table 4-2: Continued

Study samples and characteristic				Methods and control variables			
Author	Country	Years	Sample size	Methods used to determine efficiency	Inputs	Outputs	Contextual variables
Chaabouni & Abednnadher, 2012	Tunisia	2000-2007	10	Two stage DEA – technical efficiency	(5) No of beds, physicians; nurses; dentists and pharmacist; other personnel	(3) Number of outpatient visits; admissions; and post –admission days	Hospital expenditures, bed occupancy ratio; Gross product per capita and length of stay
Dash et al, 2010	India	2004-2005	29 district hospitals	Input oriented (one stage) DEA – technical efficiency	(3) Number of beds, number of nursing staff, assistant surgeons employed, and number of civil surgeons employed.	(5) Number of inpatients, outpatients, number of surgeries undertaken, emergency cases handled and deliveries	-
Hu et al, 2012	China	2002-2008	210 hospitals from 30 provinces	Input oriented (two stage DEA) – technical efficiency	(5) Number of doctors; medical technicians; other staff; hospital beds; fixed assets.	(3) Number of outpatient and emergency room visits; inpatient days; and patient mortality.	Population intensity; demand; price of hospital services; ownership; input quality; region
Ichoku et al, 2011	Nigeria	2009	200 hospitals	DEA (one stage) – technical and scale efficiencies	(7) Number of different categories of staff doctors, nurses; pharmacists and other staff; number of beds and recurrent costs of services and capital costs (Equipment and Electricity)	(4) Number of admissions, number of outpatients, number of X-rays conducted and number of lab tests.	Ownership type, geographic location and state.

Table 4-2: Continued

Study samples and characteristic				Methods and control variables			
Author	Country	Years	Sample size	Methods used to determine efficiency	Inputs	Outputs	Contextual variables
Ismail, 2010	Sudan	2007	15 states	DEA (one stage) – technical, scale efficiency and returns to scale.	(5) Number of hospitals; number of health centres (primary health care units, dressing stations, dispensaries and health centres); number of beds; number of physicians and ancillary medical staff (pharmacists, midwives, nurses, medical assistants, technicians, and others).	(2) Number of inpatient and outpatient visits.	-
Jat and San Sebastian, 2013	India	2010	40 district hospitals	DEA (one stage) Input oriented	(3): Number of doctors (specialists and primary care physicians); number of nurses; and number of beds.	(8): Number of women with three completed antenatal check-ups; number of deliveries; number of caesarean-section deliveries; number of women receiving post-natal care within 48 hours of delivery (PNCs); number of medical terminations of pregnancy (MTPs); number of male and female sterilizations; number of inpatient (IPD) admissions; and number of outpatient (OPD) consultations.	-

Table 4-2: Continued

Study samples and characteristic				Methods and control variables			
Author	Country	Years	Sample size	Methods used to determine efficiency	Inputs	Outputs	Contextual variables
Kirigia et al, 2001	South Africa	1996	155 primary health care clinics	Input and output oriented DEA (one stage) – technical efficiency	(2) Number of nurses and number of general support staff	(8) Visits for antenatal care, child delivery, child health, dental care, family planning, psychiatry services, sexually transmitted diseases and tuberculosis treatment.	-
Kirigia, Emrouznej, Sambo et al, 2004	Kenya	-	32 public health centres	DEA (one stage) to estimate technical efficiency	(6) Clinical officers and nurses; physiotherapists, occupational therapists, public health officers, dental technologist, laboratory technicians and laboratory technologists; administrative staff; non-wage expenditures; and beds.	(4) Visits for diarrhoea, malaria, sexually transmitted infections, urinary tract infections, intestinal worms and respiratory disease; visits for antenatal care and family planning; immunizations; and other general outpatient visits.	-
Kirigia et al, 2008	Angola	2000–2002	28 hospitals	Output oriented DEA (one stage) and malmquist technical and scale efficiency/ Productivity.	(3) Number of doctors plus nurses; expenditures on pharmaceutical and non-pharmaceutical supplies; and beds	(2) Outpatient department visits; and inpatient department admissions	-

Table4-2: Continued

Study samples and characteristic				Methods and control variables			
Author	Country	Years	Sample size	Methods used to determine efficiency	Inputs	Outputs	Contextual variables
Kirigia et al, 2010	Benin	2003-2007	23 hospitals	DEA (one stage) to estimate technical and scale efficiency	(4) total number of doctor/physician hours; total number of other staff (nurses, midwives, laboratory technicians, radiologists, anaesthetist, paramedical assistants) hours; non-salary running costs, and number of beds	(2) Outpatients visits; and number of hospital admissions	-
Kirigia et al, 2011	Sierra Leone	2008	36 MCH posts, 22 health centres and 21 health posts	Output oriented DEA (one stage) - technical and scale efficiency.	(2) Number of community health officers, MCH aides and state enrolled community health nurses; and the number of support staff.	(3) Number of outpatient, maternal, child health and family planning visits, plus immunization visits; the number of vector control activities; and the number of health education sessions.	-
Kirigia and Asbu, 2013	Eritrea	2007	19 secondary public community hospitals	Output oriented two stage DEA - technical and scale efficiency computed.	(4) Number of physicians (doctors); number of nurses and midwives; number of laboratory technicians; and number of operational beds and cots	(2) Number of outpatient department visits; number of inpatient department discharges	Ratio of outpatient department visits to inpatient days; ALOS; population and geographical region

Table 4-2: Continued

Study samples and characteristic				Methods and control variables			
Author	Country	Years	Sample size	Methods used to determine efficiency	Inputs	Outputs	Contextual variables
Lavado RF et al, 2010	Philippines	2009	77 Public Health units	DEA (input & output oriented)	(3) Health unit budget per capita, number of doctors and midwives per 100,000 population and the percentage of rural health units accredited by the Philippines Health Insurance Corporation.	(4) Percentage of the prevalence of contraceptive use; no of fully immunised children for maternal and child health care programs; the percentage of people who have access to portable water and sanitary toilets	-
Marschall and Flessa, 2011	Burkina Faso	2005	24 primary care facilities	Output oriented DEA (two stage) – technical efficiency	(4) Personnel costs in 2005, CSPA building area [m ²], depreciation of CSPA equipment in 2005 and Vaccination costs in 2005.	(4) General consultation and nursing care; deliveries; immunisation, and special services, e.g. family planning, Prenatal and postnatal consultations.	Distance to the next health centre; no of household members; value of personal animal ownership; value of animal ownership at household level per capita; value of durable household goods at personal level; value of durable household goods at household level; value of durable household goods at household level per capita; religion ethnic group.

Table 4-2: Continued

Study samples and characteristic				Methods and control variables			
Author	Country	Years	Sample size	Methods used to determine efficiency	Inputs	Outputs	Contextual variables
Masiye, 2007	Zambia	2003	30 hospitals	Input oriented DEA (one stage) – technical, scale and congestion efficiency	(4) Total non-labour Cost; number of medical doctors; number of nursing and other clinical staff; and number of nonclinical staff	(5) No of Ambulatory care visits; No of inpatient bed days; No of deliveries; No. of visits; No of Lab tests + X rays + Theatre operations.	-
Osei et al, 2005	Ghana	2000	17 district hospitals and 17 health centres	Input and output oriented DEA (one stage). Two separate DEA models for the hospital and health centre	Hospital DEA model Number of medical officers; technical staff (including nurses); subordinate staff; hospital beds Health Centre model Number of technical staff (medical assistants, paramedical staff and nurses); and support staff	Hospital DEA model Number of maternal and child health care visits; deliveries; inpatient discharges Health Centre model Number of child deliveries; fully immunised children under the age of 5 years; other maternal and childcare (nutritional/child growth monitoring) visits; and outpatient curative visits.	Health facility type

Table 4-2: Continued

Study samples and characteristic			Methods and control variables				
Author	Country	Years	Sample size	Methods used to determine efficiency	Inputs	Outputs	Contextual variables
Ramathan, Chandra and Thupeng, 2003	Botswana	1997	22 health districts	Output oriented DEA	(7) hospitals in the district; clinics in the district; health posts in the hospitals; beds; doctors; nurses; other health staff	(15) Number of outpatients in 12 disease groups; number of all other outpatients; number of new births discharged alive; number of inpatients discharged alive; number of patient days	-
Renner et al, 2005	Sierra Leone	2000	37 public health units	Output oriented DEA (one stage) – technical and scale efficiency	(2) Technical staff (community health nurse, vaccinators and maternal and child health aides) and subordinate staff	(6) Antenatal and postnatal visits; child deliveries; nutritional /child growth monitoring visits; family planning visits; immunized children under five years and pregnant women immunized with tetanus toxoid; and total health education sessions conducted through home visits, public meetings, school lectures.	-

Table 4-2: Continued

Study samples and characteristic				Methods and control variables			
Author	Country	Years	Sample size	Methods used to determine efficiency	Inputs	Outputs	Contextual variables
Shahhoseini et al, 2011	Iran	2008	12 Provincial hospitals	Input oriented DEA (one stage) – technical efficiency	(4) Number of active beds, number of other professionals, number of nurses and number of physicians.	(5) Number of operations, number of outpatient visits, bed occupancy rate, average length of stay and inpatient bed days	-
Sebastian and Lemma, 2010	Ethiopia	2007-2008	7 health districts	Output oriented DEA (one stage) – technical efficiency	(2) Number of health extension workers and number of voluntary health workers (traditional birth attendants, community health workers).	(8) Number of health education sessions given by HEWs; number of completed antenatal care visits; number of child deliveries; number of persons that repeatedly visit the family planning service; number of diarrheal cases treated in children under-five; number of visits carried out by the community health workers; number of total new patients attended and number of malaria cases treated.	-

Table 4.2 Continued

Study samples and characteristic				Methods and control variables			
Author	Country	Years	Sample size	Methods used to determine efficiency	Inputs	Outputs	Contextual variables
Tlotlego et al, 2010	Botswana	2006-2008	21 non-teaching hospitals	Output oriented Malmquist DEA-technical efficiency and productivity change.	(2) Number of clinical staff (physicians, nursing and midwifery personnel, dentistry personnel, other technical health service providers); and the number of hospital beds.	(2) Number of outpatient department visits, and number of Inpatient days.	-
Valdmanis et al, 2004	Thailand	1999	68 hospitals	DEA (one stage)	(7) Number of beds, doctors, nurses, and other staff, and allowance expenditures, drug expenditures and other operating expenditures	(4) Number of outpatient visits for poor patients; number of outpatient visits for non-poor patients; total inpatient cases adjusted with average (DRG) weighting for poor patients, and total inpatient cases adjusted with average DRG weighting for non-poor patients	Level of hospital and region of hospitals
Yawe, 2010	Uganda	1999-2003	25 district referral hospitals	Input oriented standard and super efficiency DEA model (one stage) – technical efficiency.	(4) Doctors, nurses, other staff, and hospital beds.	(4) Admissions, deliveries, operations, and outpatient department attendances.	-

Table4.2 Continued

Study samples and characteristic				Methods and control variables			
Author	Country	Years	Sample size	Methods used to determine efficiency	Inputs	Outputs	Contextual variables
Yusefzadeh et al, 2013	Iran	2009	23 hospitals affiliated with Urmia University of Medical Sciences	DEA (one stage) technical, scale efficiency	(3) Number of active beds; doctors and other personnel	(3) Outpatients, admissions and occupied bed days	-
Zere et al, 2000	South Africa, Western Cape Province	1992/93 to 1997/98	10 acute care hospitals	Malmquist DEA (one stage) – to assess productivity changes	(2) Recurrent expenditures and patient beds	(2) Outpatient visits and inpatient days	-
Zere et al, 2001	South Africa	1992/93	86 hospitals	DEA (two stage and malmquist productivity index	(2) Recurrent expenditures and number of beds	(2) Outpatient visits and inpatient days	Occupation rate; average length of stay; outpatient visits as a proportion of inpatient days and location
Zere et al, 2006	Namibia	1997/98 to 2000/2001	30 hospitals	DEA (one stage) and hospital capacity utilisation ratios.	(3) Recurrent expenditures; beds; and nursing staff.	(2) Outpatient visits and inpatient days	-

4.5.3 Research gaps

The review has drawn attention to a number of content and methodological gaps in the health care efficiency measurement literature in LMIC settings.

In terms of content gaps, efficiency measurement studies in LMIC settings have either focused on cost or technical efficiency. No study identified considered both technical and cost efficiency simultaneously, although this has important implications for policy makers and health planners. Effective policies on health service delivery require reliable assessments not only of the technical efficiency of health service delivery but also scale and scope economies to allow for optimum organisation of service delivery.

Second, much of the economic literature in LMICs has focused on efficiency measurement at the hospital level. Previous studies have suggested that department or speciality level analysis are preferable to hospital level analysis as it is more likely that there is greater homogeneity between patients as well as greater standardisation in the production process [166]. However, few studies have focused on efficiency measurement at the department or specialty level. This may be attributed largely to lack of data. Lack of good data sets and reliable estimates of outputs and unit costs sets within LMICs has been cited as one of the main constraints [26, 27].

Third, while the use of DEA techniques within the wider health care sector has been prolific, no particular study has been identified estimating technical efficiency within the SRH/HIV context at the health facility level. The only

exception within the HIV area is a recent study by Zeng et al [167] which uses DEA to evaluate efficiency of national HIV/AIDS programs at the macro level in transforming funding into services.

Furthermore, despite the high expenditures on HIV services and widespread adoption of integration policies within high HIV prevalence Sub-Saharan African countries as a means to achieve efficiency gains, no study to date has investigated the technical and cost efficiency associated with integrating HIV and SRH services. Evidence of technical and cost efficiency of integrated HIV and SRH services would inform future roll out of integrated HIV services.

Several methodological gaps were identified. First where cost efficiency of HIV services has been analysed, much of the existing literature on efficiency in the general health care context has concentrated only on economies of scale despite the establishment of theoretical foundations of measuring economies of scope. There has been less effort in estimating economies of scope with no studies within LMICs in particular identified as focusing on this.

Second, output quality is critical within the health sector, and concerns over the lack of quality measures within efficiency measurement have been acknowledged in a number of studies. Moreover, it is a well-acknowledged fact that excluding quality from efficiency analyses can result in adopting perceived best practices that improve efficiency at the expense of quality. However, there have been no successful attempts to incorporate quality measures within the efficiency measurement literature in LMIC settings identified.

There therefore remains a considerable gap in the efficiency measurement literature in LMICs particularly for lower levels of the health service where primary data scarcity is acute. Given the high level of current policy interest in improving the efficiency of health service delivery worldwide, but the lack of knowledge in this area, filling this gap should have important public health consequences.

4.6 Conclusion

The preceding methodological and empirical review of efficiency measurement techniques has provided a summary of the measurement techniques and key methodological considerations in health care efficiency measurement. While parametric methods will be used to assess the cost efficiency of health facilities, the DEA technique suitable in contexts with insufficient information will be used to examine the technical efficiency of health facilities providing integrated HIV and SRH services in Kenya and Swaziland.

Chapter 5 Methods

5.1 Introduction

This chapter describes the conceptual framework, the data used in the thesis and methods used to collect data for the analysis of cost and technical efficiency. Detailed methods on applying non-parametric and parametric techniques for estimating technical and cost efficiency will be provided in individual results chapters.

5.2 Conceptual framework

As discussed in chapter 3, economic theory represents production as a constrained optimization problem where producers optimize their objectives subject to constraints imposed by the production technology. Theoretically, firms choose a set of inputs and outputs that maximise output while minimising costs. Standard economic theory of the firm therefore posits a production function, in which a production process transforms inputs into outputs, and assumes that, for any given set of input prices, the firm chooses the set of inputs that will maximise output while minimising cost. The output maximisation objective is associated with technical efficiency while the cost minimising objective is associated with cost efficiency.

The central concept in the economic theory of production and the fundamental building block of cost and technical efficiency measurement in any sector is the production function. The generic production function measures the amount of

output produced from a given set of inputs, taking the production process as a given.

An important assumption of the standard efficiency measurement model is that production units operate within homogeneous environments. However, this assumption is not valid, as the efficiency of health care delivery is influenced by factors associated with the production environment that are beyond managerial control. These factors include ownership type, geographic location, facility size/capacity and institutional constraints e.g. access to capital resources, drug supply systems, human resource planning and referral mechanisms at the institutional level. Observed output is therefore a factor of a number of contextual factors that play an important role in the facilities' decisions.

The empirical analysis of efficiency of integrated HIV and SRH services is therefore based on a conceptual framework that specifies a production function and a set of factors both within and outside the control of the organisation that are expected to influence the level of efficiency.

In the context of this research, the focus of efficiency analysis is the maternal and child health/public health and HIV departments within health facilities where sexual and reproductive health and HIV services are mainly delivered. The health facilities use inputs, such as doctors, nurses, buildings and equipment, to provide a given amount of health care output.

The choice of inputs employed by the health facilities is influenced by overarching system constraints and demand factors. The health system

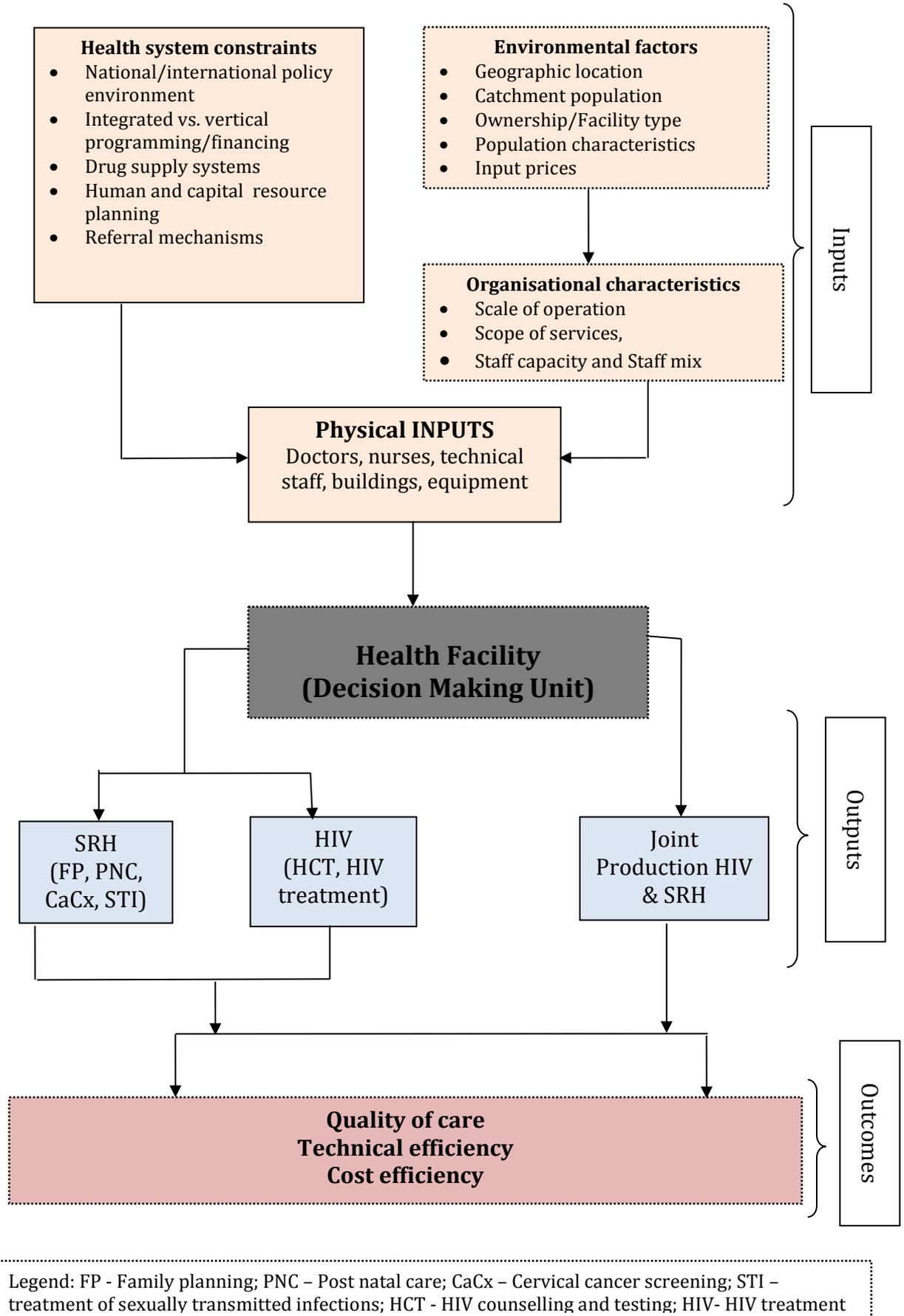
constraints include the international and national policy environment, integrated vs. vertical funding mechanisms; national drug supply systems, human resource and capital planning at the central planning level as well as referral mechanisms within institutions. The factors that affect demand of health care services include geographic location, ownership and facility type, population characteristics and input prices all of which are beyond the control of management. These factors in turn affect the scale of operations, scope of services provided and the staff capacity and choice of staff mix.

Output measures focus on intermediate outputs and represent the general areas of services provided within these departments. These include SRH services - family planning (FP), postnatal care (PNC), screening for cervical cancer (Ca Cx), Treatment and management of sexually transmitted infections (STI); other MCH services - antenatal care (ANC) and child welfare (CWC); and HIV services - HIV counselling and testing (HCT) and HIV treatment and care.

This conceptual framework posits that the ultimate goal in the production process is the achievement of technical and cost efficiency. However, as we strive to improve efficiency, another important element in health care service delivery, is the quality of care of services provided. The relationship between efficiency and quality is complex and it remains unclear whether the goals of quality improvement and efficiency improvement/cost reduction are complementary or are mutually exclusive. However, the basic premise is that managers attempt to minimise the use of inputs and maximise quality for a given level of output. Presuming that the quality of health outputs varies across facilities, structural and process measures of quality of care are chosen and

incorporated into the efficiency measurement framework. Figure 5-1 illustrates the conceptual framework used in this analysis.

Figure 5-1: Conceptual framework



5.3 Study sample

This study uses data collected as part of a larger evaluation study on “Assessing the benefits of integrated HIV and SRH services in Kenya, Swaziland and Malawi” known as the Integra Initiative [168].

In Kenya, the research study was conducted in 24 public health facilities and 6 IPPF affiliated SRH clinics located in urban and rural settings. The public health facilities included a provincial general hospital, 5 district hospitals, 5 sub-district hospitals and 13 health centres, selected from two provinces: Central and Eastern Province and six districts: Thika, Muranga, Nyeri, Nyandarua, Kitui and Makeni districts.

In Swaziland, the study was conducted in 8 public health facilities, two IPPF affiliated SRH clinics. The public health facilities included a government/mission district hospital, a hospital, two public health units, and four rural health centres. The facilities were selected from four regions in Swaziland: Manzini, Shiselweni, Lubombo and Hhohho regions. A summary of the health facilities included in the study is provided in Annex 1.

The study sites were purposefully chosen from six priority regions with established programming based on previous operational research relationships between one of the partners in the larger Integra project (the Population Council) and the Ministries of Health in Swaziland and Kenya. Site selection was based on a controlled pre-post design where several intervention sites were compared with selected comparison sites. Intervention sites were selected from

sites that had performed well in the previous study on “feasibility of integrating HIV counselling and testing into family planning services” [169], and had a high through put of FP clients of 100 or more per month. To match these sites, randomized pair-wise matching was used to select comparison sites based on a number of criteria. These criteria included high client load, a minimum of two family planning providers qualified and currently providing FP services, availability of a range of HIV and SRH services (FP, PNC, HCT, Ca Cx, STI treatment, HIV treatment). Within the provinces, districts were chosen and matched by approximate facility client load and level of service integration.

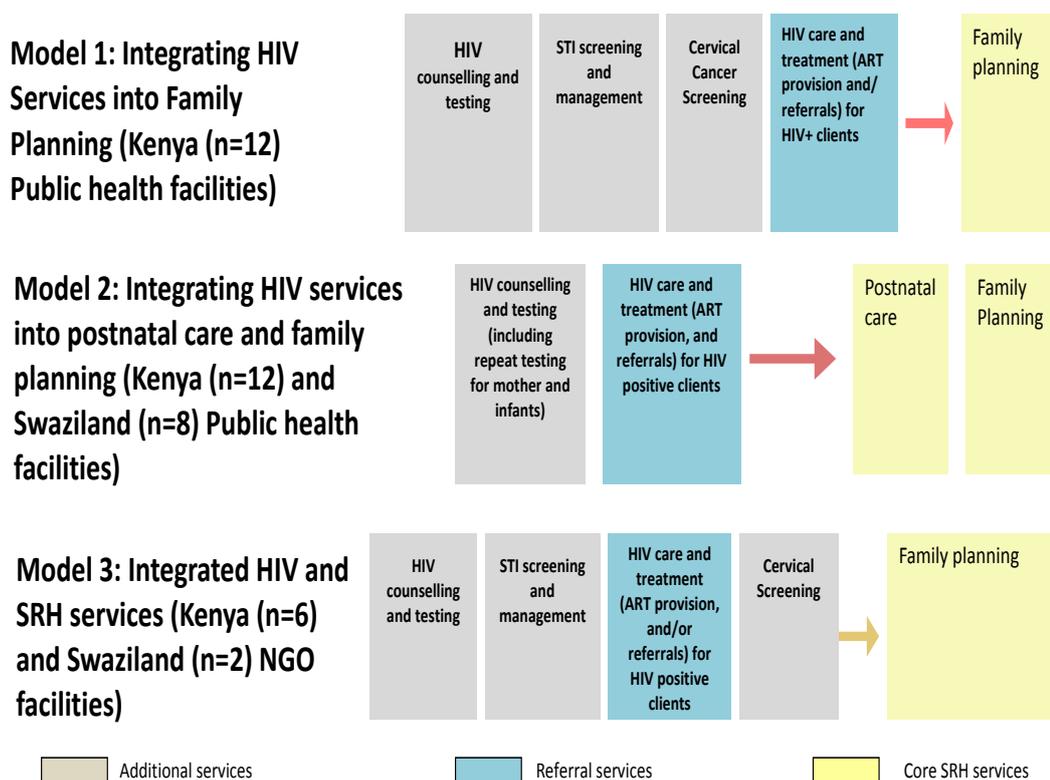
Although the Integra study set out to evaluate three different models for delivering HIV services in 40 public and NGO affiliated SRH clinics, the subsequent analysis in this thesis does not take into account the different models of integration given the small sample sizes. Figure 5-2 presents a summary of the three models of integration evaluated.

Model 1 involves the provision of HIV counselling and testing, screening for and management of other STIs and cervical cancer screening in core family planning services provided within maternal and child health units in public health facilities. This model also includes the referral for HIV care and treatment for HIV positive family planning clients.

Model 2 represents the provision of HIV counselling and testing and referral for HIV treatment and care for clients seeking core family planning and postnatal care services.

Model 3 represents the provision of HIV counselling and testing, screening for and management of other STIs, cervical cancer screening and referral for HIV treatment and care services within family planning clinics.

Figure 5-2: Summary of models of integration evaluated



5.4 Development of activity review questionnaire and costing tool

Prior to cost data collection, a periodic activity review (PAR) tool was developed to document the nature, range and methods of delivery of HIV and sexual reproductive health services in each health facility. The PAR questionnaire was developed based on a literature review of integration of HIV and SRH services, facility visits, feedback from study partners and pilot testing of the tool.

Specifically, the PAR was intended to provide an understanding of how resources are combined to produce integrated HIV and SRH services in the study sites. To achieve this aim, the PAR tool included questions on facility characteristics, staffing types and levels, scope and number of services offered, descriptions of client flow, and overall description of how integration of services works from the provider's perspective.

The PAR was also used to inform the development of the Excel costing tool which was based on the *Costing Guidelines for HIV Prevention Strategies* [170].

The PAR questionnaire is included as Appendix 2.

5.5 Data collection

5.5.1 Cost data

Data collection was conducted during visits to the sites in the maternal and child health (MCH) or public health unit (PHU), STI clinic, the voluntary counselling and testing unit, the comprehensive care centres (CCC)/HIV units, laboratory and pharmacies (if available within the study sites). Where referrals for any service were provided outside the facility, data collection was not conducted in the referral sites.

Following the periodic activity review conducted for the period July 2008 – June 2009 and April 2008 – March 2009 in Kenya and Swaziland respectively, cost and output data were collected retrospectively for the 2008/2009 financial year. Baseline data collection was conducted during visits to all 40-health facilities between July 2009 and November 2010. A subsequent round of data

collection was conducted between May 2011 and June 2012 for the financial year 2010/2011.

Costs collected included capital and recurrent costs incurred at the facility level in the delivery of HIV and SRH services. Capital costs included buildings, equipment, and training costs. The facilities were measured in square metres and the rooms valued using estimates on rental costs per square meter obtained from a rental survey of the adjacent area. Equipment and furniture inventories were developed during visits at each study site and subsequently valued using the purchase price as recorded in expenditure statements or receipts held at the facility while economic costs are valued using local market prices collected from local retailers.

Recurrent costs included building maintenance, staff salaries, drugs, diagnostics, medical and non- medical supplies and transport costs. Data on recurrent costs were obtained from health facility records at the central administration in each facility.

A full cost analysis taking into account overhead costs was conducted from the health service provider's perspective. The methodology followed was a combination of standard step-down and micro-costing (bottom-up costing) methods. The standard step-down methodology involves the allocation of total costs of running a health facility to the defined cost centres in the first step. This is followed in the second step by allocation of the indirect cost centres such as administration, cleaning and laundry to the remaining costs centres and in the

third step by allocation of support costs (pharmacy and laboratory) to the direct cost centres [26].

In this study, the bottom-up costing method which captures the costs of patient specific inputs collected primarily through health provider interviews is used to estimate the costs of drugs, medical supplies and diagnostic tests while the remaining cost categories are estimated using the step-down costing methodology.

This methodology would in principle enable the estimation of unit costs of all HIV and SRH services provided at the health facilities included in the study.

5.5.2 Scope and extent of integration

The scope and extent of integration of HIV and SRH services varied widely across health facilities. A number of measures were therefore used to describe the extent of integration at each health facility. First, the level of integration was measured using four individual measures of integration focused on four key attributes. These were total number of HIV and non-core SRH services provided within the entire facility; number of HIV and non-core SRH services provided in the MCH/FP unit; number of HIV and non-core RH services provided per clinical staff (human resource integration); and the number of non-core SRH services provided per clinical room (physical integration). HIV services included HIV counselling and testing, antiretroviral therapy treatment and CD4 count services. Non-core SRH services were defined as cervical cancer screening and

STI treatment services. The individual measures of integration are summarised in Table 5-1.

Data on the number of services provided within the facility and MCH units were collected from a combination of staff interviews and facility records review as part of the activity reviews conducted prior to cost data collection. The number of services provided per clinical staff and room, were calculated from data collected from routine monitoring data at the health facility.

Table 5-1: Description of individual measures of structural integration

Index measure	Definition	Mean	Min	Max
Service availability in facility	Number of total services available in the facility from the following list: 1) Antiretroviral therapy (ART), 2) Cervical cancer screening, 3) CD4 count services, 4) HIV/AIDS testing services, 5) STI treatment 6) FP, 7) PNC, 8) ANC	6.45	3	8
Service availability in MCH/FP Unit	Number of HIV & other non-core services available in the MCH/FP unit at each facility, from following list: 1) Antiretroviral therapy (ART), 2) Cervical cancer screening, 3) CD4 count services, 4) HIV/AIDS testing services, 5) STI treatment	2.26	0	4
Human resources integration	Number of non-core RH/HIV services provided per clinical staff member in MCH/FP unit (annual average) including: 1) ART, 2) cervical cancer screening, 3) CD4 count, 4) HIV counselling and testing, 5) STI treatment and counselling	1.72	0	4
Physical resources Integration	Number of non-core RH/HIV services that are provided in each consultation room in MCH/FP unit including: 1) ART, 2) cervical cancer screening, 3) CD4 count, 4) HIV counselling and testing, 5) STI treatment and counselling	1.26	0	4

Second, the level of integration was measured using two sub-indices of integration (structural and functional indices) generated using latent variable techniques incorporating expert knowledge [171] and developed by the larger

Integra project. The methods used to develop these indices are elaborated in Appendix 3.

The structural index of integration was developed using the four individual measures of integration described above and reflects the health facility's readiness to provide integrated HIV and SRH services. The functional index of integration focused on an assessment of service utilisation patterns in each of the study facilities. Specifically, the functional index of integration included data on whether HIV treatment was being offered on site (or referred for); the range of services provided across days of the week; the range of services provided in single consultations; and the range of services provided in single visits. These data were collected using a client flow tool which provided information on the range of services accessed to determine the service mix accessed by clients, administered as part of the larger Integra project.

5.5.3 Quality of care

There is no universally accepted view on how measures of the quality of HIV and SRH services delivered can be defined. However, this thesis chooses the Donabedian Framework [124], which provides a standard framework for measuring quality of care in the health care literature. Definitions of quality of care used in this study were therefore based on this framework and focused specifically on structural and process attributes of quality. The structural attributes of quality included infrastructure and equipment availability, availability of commodities and management practices (staff training on various services and availability of guidelines/standards and IEC materials).

The process attributes on the other hand included aspects of interpersonal aspects of patient engagement and technical aspects of service delivery. Interpersonal aspects of patient engagement included maintenance of privacy, confidentiality and provider's responding to clients' concerns. The technical aspects encompassed both the counselling process and the technical content of a consultation (history taking, physical examination, provision of essential information and its technical accuracy) [168]. The elements of structural and process attributes of quality are summarised in Table 5-2 and Table 5-3.

Table 5-2: Structural attributes of quality

Indicator	Definition of indicators
<u>Infrastructure and equipment</u>	
Physical infrastructure	Shaded waiting area, private space for FP examination, private space for ANC/PNC examination, source of clean water, electricity, clean toilets, reliable lighting, infection prevention buckets, heater, chlorine for processing equipment
Equipment availability	Spotlight or flashlight, exam couch, waste receptacle, sharps container, electric hand dryer or single use towels, blood pressure machine, stethoscope, weighing scale for babies, weighing scale for adults, speculum, tenaculum, uterine sound, autoclave/steriliser, cleaning solution, Trocar, Kidney dishes, sponge holding forceps, foetal scope.
<u>Commodities</u>	
FP commodities	Combined pill, progestin only, emergency contraceptive, injectables, female condoms, male condoms, IUCD, Cycle beads, hormonal implants, female sterilization, male sterilization.
Reagents	HIV-1 reagents, HIV-2 reagents, UNIGOLD, Determine, TB test, pregnancy tests.
General supplies	Needles and syringes, insecticide treated nets, specimen bottles for urine, specimen pots for sputum, blood specimen pots, slides for MPS, vinegar, Acetic acid, iodine, lugols, IV giving sets, blood giving sets, normal saline IV, Sodium lactate IV solution, Dextrose IV solution, Ringers lactate IV solution, Water for injection
<u>Management</u>	
Staff training	PMTCT, HIV counselling and testing, HIV rapid tests and controls, STI syndromic management, syphilis screening for RPR test, balanced counselling strategy plus, counselling for prevention of STIs, medical management of HIV infected clients, screening for TB in pregnancy, FANC, management of labour, basic care of new-borns, infant feeding counselling, family planning, contraceptive technology updates, IMCI, post natal care for baby, screening for cancer using VIA/VILLI.
IEC materials	FP methods, STIs, HIV/AIDS, PMTCT for HIV, balanced counselling strategy cards; condom model; FP posters, ANC posters, PNC posters, danger signs in postpartum period for mother and babies
Guidelines, policies and standards	FP policy, FANC orientation, essential obstetric care, standard maternity care, PNC guidelines, STI syndromic management guidelines, PMTCT guidelines, ART guidelines, clinical manual for ARV providers, HIV testing guidelines, pre/post counselling protocol for HIV and TB treatment protocol.

Table 5-3: Process attributes of quality

Indicator	Definition of indicators
PROCESS	
<u>Interpersonal</u>	
Privacy and Confidentiality assured	Does the provider see client in privacy and assure the client of confidentiality
Clients questions answered	Does the provider ask if client has understood information and encourage client to ask questions?
<u>Technical</u>	
Reproductive history	Provider discussed the following: age, marital status, pregnancy status, number of pregnancies, fertility desires, breastfeeding status, desired timing of next birth, date of last menses, previous use of FP, HIV serostatus, history of medical conditions
Family planning procedure	Does the provider discuss the following: explain how method works, advantages and disadvantages, how to use method, ensuring effectiveness, possible side effects, management of side effects, possibility of changing method, emergency contraception
HIV/STI Risk assessment	Does the provider discuss STIs and HIV risk factors with clients: multiple partners, STIs, unprotected sex, knowledge of partners' status and HIV counselling and testing?

These structural and process measures of quality were assessed through a health facility inventory assessment administered as part of the larger Integra Initiative [168]. Specifically, these data were derived from the facility inventory checklists of staff and resources available at each study site and observations of client provider interactions (the data collection tools are provided as appendices 4 and 5). The observations of client-provider interactions entailed a structured non-participatory observation of health consultations. This assessed how clients were treated and whether they actively participated in the consultation, the technical competence of providers, and accuracy of information and provision of essential information.

Development of quality of care index

Points were allocated to each of these characteristics, which allowed calculation of an overall score for each of the attributes. Principal components analysis (PCA) was then used to construct a quality index for each health facility combining the structural and process indicators of quality. PCA is a statistical technique used to reduce the number of variables in an analysis by describing a series of uncorrelated linear combinations of the variables that contain most of the variance [172]. This technique decomposes the original data with correlated values into a new set of uncorrelated (orthogonal) variables. The new variables created referred to as principal components or factors are therefore a linear combination of the standardised value of the original variables used for the definition of the index. The weights for each principal component - given by eigenvectors of the correlation matrix - corresponds to its statistical correlation with the latent dimension that the index attempts to measure [173]. The number of components derived depends on the correlation of the original variables. If they are strongly correlated, one factor will be sufficient to explain most of their variance.

Following this methodological approach, an index of quality of health service was constructed for each health facility with a mean equal to zero and a standard deviation equal to one. Table 5-4 presents a summary of the quality of care scores and results from the PCA by country. Generally, a variable with a positive score is associated with higher quality of care and therefore the higher the index score the higher the implied measure of quality of care of that facility.

These quality scores generated using PCA are used to account for quality in the efficiency measurement model in chapter 9.

Table 5-4: Summary of quality of care scores and results by country from principal components analysis

Variable description	Overall index	Kenya			Swaziland		
	Factor score	Mean	Std Dev.	Factor score	Mean	Std Dev.	Factor score
STRUCTURE							
Infrastructure and equipment							
Physical Infrastructure	<i>0.38</i>	5.3	5.61	<i>0.39</i>	6.7	1.03	<i>0.45</i>
Equipment availability	<i>0.31</i>	15.5	5.28	<i>0.33</i>	15.8	3.14	<i>0.43</i>
Commodities							
FP commodities	<i>0.34</i>	8.3	2.77	<i>0.37</i>	8.2	1.19	<i>-0.17</i>
Reagents	<i>0.23</i>	6.9	5.07	<i>0.25</i>	2.2	1.00	<i>-0.44</i>
General supplies	<i>0.29</i>	8.8	7.09	<i>0.30</i>	5.6	2.76	<i>0.45</i>
Management							
Staff training	<i>0.29</i>	9.3	7.36	<i>0.33</i>	11.3	3.84	<i>0.18</i>
IEC materials	<i>0.34</i>	7.0	8.61	<i>0.39</i>	12.1	6.43	<i>0.32</i>
Guidelines and standards	<i>0.38</i>	5.1	5.69	<i>0.42</i>	8.2	3.00	<i>0.22</i>
PROCESS							
Interpersonal							
Privacy/confidentiality	<i>0.23</i>	1.3	0.64	<i>0.42</i>	1.1	0.31	<i>-0.05</i>
Clients questions answered	<i>0.25</i>	1.3	0.64	<i>0.47</i>	1.3	0.47	<i>0.46</i>
Technical							
Reproductive history	<i>-0.03</i>	5.0	2.18	<i>0.41</i>	6.3	1.59	<i>0.48</i>
Family planning procedure	<i>0.19</i>	3.1	2.23	<i>0.49</i>	2.4	1.79	<i>0.53</i>
HIV/STI risk assessment	<i>0.05</i>	1.5	1.28	<i>0.44</i>	1.4	1.54	<i>0.52</i>

Chapter 6 Costs of integrated HIV and SRH services

6.1 Introduction

Chapter 5 presented the conceptual framework on which the empirical analysis in this thesis is based; described the data used and the methods used to collect the data. This chapter begins to fill in the gap in the literature on the cost of integrated HIV and SRH services. A descriptive analysis of the total and unit economic costs of delivering six integrated sexual reproductive health and HIV services in 40 public and non-government organisation facilities in Kenya and Swaziland is provided.

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Date: January 05, 2015

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6.2 Research paper 1

Title: The costs of delivering integrated HIV and sexual reproductive health services in Kenya and Swaziland: a descriptive analysis

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Keywords: Sexual and reproductive health, HIV, integration, costs and cost analysis, efficiency, economics

Abstract

Objective: To describe the costs of delivering six integrated sexual reproductive health and HIV services in a high and medium HIV prevalence setting, in order to support policy makers and planners scaling up these essential services.

Design: A retrospective facility based costing study conducted in 40 non-government organisation and public health facilities in Kenya and Swaziland.

Methods: Economic and financial costs were collected over two years, 2008/09 and 2010/11, from each study site with an aim to estimate the cost per visit of six integrated HIV and SRH services. A full cost analysis using a combination of bottom-up and step-down costing methods was conducted from the health provider's perspective. The main unit of analysis is the economic unit cost per visit for each service. Costs are converted to 2011 International dollars.

Results: The mean cost per visit for the HIV/SRH services ranged from Int\$9.23 (FP visit) to Int\$128.06 (HIV treatment visit) pre integration and from Int\$10.31 (PNC visit) to Int\$114.09 (HIV treatment visit) post integration. We found considerable variation in the unit costs per visit across settings with family planning services exhibiting the least variation (\$Int3.35-51.48) and STI treatment and HIV treatment visits exhibiting the highest variation in unit cost ranging from (\$Int2.50-267.96) and (\$Int\$0.05-880.14) respectively. Unit costs of visits were driven by fixed costs while variability in visit costs across facilities was explained mainly by technology used and service maturity.

Conclusion: For all services, variability in unit costs and cost components suggest that significant potential exists to reduce costs through better use of both human and capital resources, despite the high proportion of expenditure

on drugs and medical supplies. Further work is required to explore the key drivers of efficiency and interventions that may facilitate efficiency improvements.

6.2.1 Introduction

The debate concerning how to best organize sexual and reproductive health (SRH) and HIV services is long standing. The integration of SRH and HIV services evolved in the 1990s in response to the rapid rise in the HIV epidemic in sub Saharan Africa, which heightened global concerns about the relative lack of services to address broader SRH problems [1]. In more recent years, a number of global policies and high-level position papers [2-7] have called for integration of HIV and SRH services, with efforts focused on integrating the prevention and treatment of sexually transmitted infections (STI) including HIV, into family planning (FP) services.

The potential benefits of integrating these services in terms of increased access to HIV services and continuity of care have been well articulated. However, a number of reviews have highlighted the dearth of evidence on the costs of integrated SRH/HIV services [8-10]. The few studies evaluating integration from an economic perspective have evaluated only a small number of sites [11-13] and little is understood about how these costs vary across facilities and settings.

This paper therefore fills in the gap in knowledge and reports the unit costs and variation in the costs of delivering six integrated HIV and SRH services across 40 providers in Kenya and Swaziland. Empirical data on the costs of integrated services has a variety of uses. By illustrating how costs differ between sites and services, it can provide valuable information for national decision makers and those planning and budgeting for HIV/RH services. This data can also be used to

explore cost-effectiveness and may also contribute to efforts aimed at improving efficiency in service provision.

6.2.2 Methods

Study setting

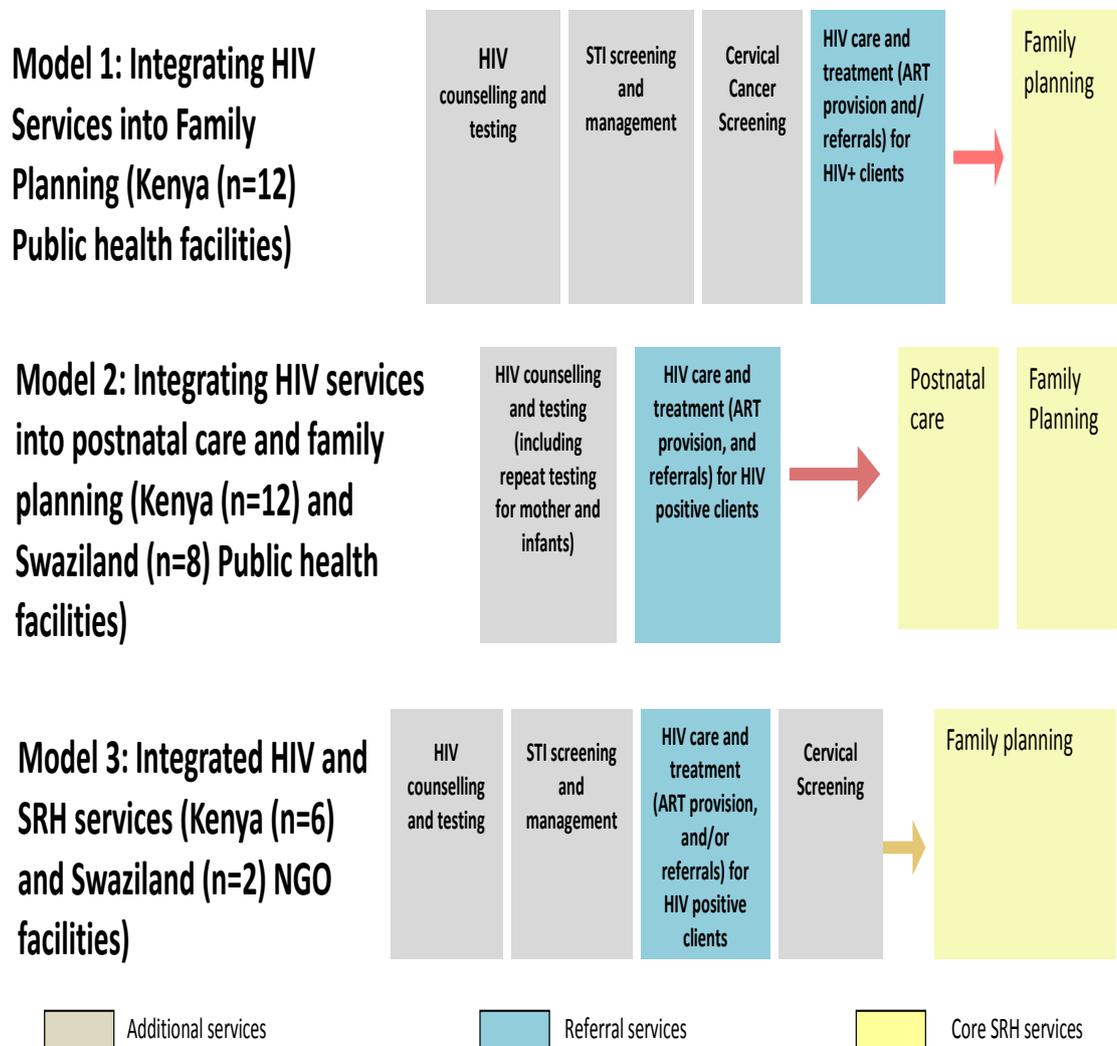
This study was conducted as part of the Integra initiative, a non-randomized trial aimed at evaluating the impact of different models of delivering integrated HIV and RH services on a range of health and service outcomes [14]. As part of this wider effort, the Integra Initiative sought to add to the limited evidence base on the economics of integration by estimating the costs of integrated HIV and SRH services in Kenya and Swaziland.

With national HIV prevalence rates of 26% [53] and 7.4% [47] among 15-49 year olds in Swaziland and Kenya respectively in 2007, Kenya and Swaziland considered integration of HIV and SRH services as critical to addressing the HIV crisis. Both countries formally adopted integration policies within their national HIV strategies [17, 18] in 2009, aimed at providing comprehensive HIV prevention, (counselling and testing), and treatment to clients seeking maternal and child health (MCH) and FP services. Although integration was formally introduced as a policy in 2009, a number of health facilities were already providing varying levels of integrated services.

To obtain an understanding of the costs of integrated HIV and SRH services, costing of integrated HIV and SRH services was carried out in 30 health facilities in Kenya and 10 health facilities in Swaziland. Broadly, the Integra initiative set

out to evaluate three different models of integrating HIV and SRH service in both countries. These were: integrated FP model which promoted the integration of HIV and STI services into existing FP services; integrated post natal care (PNC) model which promoted integration of HIV and STI services into PNC/FP services; and integrated HIV/STI services provided within SRH clinics [14]. A summary of the three different models of integration is presented in Figure 6-1.

Figure 6-1: Summary of models of integration evaluated



The study sites were purposefully chosen from six priority regions with established programming based on previous operational research relationships with the Ministries of Health in Swaziland and Kenya [14]. Study sites varied by setting, facility type, and ownership type. All sites costed exhibited different levels of service integration.

In Kenya, the sites included 24 public facilities and 6 non-government organisations (NGO) affiliated SRH clinics. The public facilities were selected from two provinces (Central and Eastern) and 6 districts (Nyeri, Nyandarua, Thika, Muranga, Kitui and Makueni) and included a provincial general hospital, 5 district hospitals, 5 sub-district hospitals and 13 health centres. In Swaziland, the sites included eight public facilities and two NGO affiliated SRH clinics. The public facilities were selected from four regions (Manzini, Lubombo, Sishelweni and Hhohho) and included a public/mission district hospital, four rural health centres and three public health units (PHU). The difference between rural health centres and public health units is that the health centres provide both outpatient and inpatient services while the public health units provide only outpatient services.

The study focused only on the MCH-FP and HIV units. HIV services evaluated in this study included treatment of STIs, counselling and testing for HIV (HCT) and HIV treatment (which included pre-antiretroviral therapy (ART), ART and treatment of opportunistic infections). SRH services included FP, PNC and cervical cancer (Ca Cx) screening routinely provided within the MCH-FP units. A detailed summary of the service descriptions is provided in Table 6-1.

Ethics statement

Ethics approval for the Integra study was obtained from the Ethical Committee at LSHTM (approval no. 5436), from the Population Council Review Board (protocol nos. 443 and 444), from the Kenya Medical Research Institute (approval no. KEMRI/RES/7/3/1, protocol no's SCC/113 and SCC/114) and the Swaziland Scientific and Ethics Committee (approval nos. MH/599B and MH/599C). Written informed consents were obtained for all Integra study activities.

Table 6-1: Description of SRH and HIV services included in the study

Output	Definition
Family planning (FP)	Family planning service includes counseling on FP methods and provision of FP methods such as oral contraceptives; injectables; and long term methods such as implant, intrauterine contraceptive devices (IUCD), vasectomy and bilateral tubal ligation.
Post-natal care (PNC)	PNC services include physical check for mother and infant at 48 hrs. 7 days, 6 weeks and 6 months; Counseling on and provision of FP methods at 6 weeks; Counseling for HIV; Testing/retesting for HIV; PCR Testing for infants at 6 weeks; Counseling on danger signs for mother and new borns; Infant immunizations up to 6 months.
Cervical cancer screening (Ca Cx Screening)	Cervical cancer screening involves either the use of pap smear (a laboratory diagnostic procedure) or VIA VILLI to screen for cervical cancer.
Screening and treatment of sexually transmitted infections (STI)	STI management includes counseling, advice on sexual behavior, basic diagnosis of syndromes, partner notification, condom distribution and treatment of infections
HIV counseling and testing (HCT)	HCT includes the provision of pre-test counseling, HIV rapid testing, and post-test counseling offered to clients who either voluntarily seek HIV testing services or who receive HIV counseling and testing within the context of another health visit.
HIV treatment and care	HIV treatment and care includes a combination of psychosocial support, nutritional counseling, ARV adherence counseling, information and education on prevention strategies for PLWHA, diagnostics, provision of ARVs and treatment for opportunistic infections.

Data collection

A retrospective costing study was undertaken from the health provider perspective using a combination of bottom-up and step-down costing methods [19]. The bottom up costing method or ingredients based costing requires the identification and specification of each component of resource used for delivering an individual service to arrive at a total unit cost. The step-down costing method is used to allocate overhead costs or resources that serve different programs and departments. Overhead costs are allocated in a step wise fashion to all the overhead departments and then to final cost centres in this case, final HIV and SRH services [20].

Both financial and economic costs were estimated. Financial costs represent actual expenditure on goods and services while economic costs include the value of all resources used to produce output including those for which there were no financial transactions such as volunteer human resources and donated goods.

Prior to cost data collection, a periodic activity review (PAR) tool was developed to document the nature, range and methods of delivery of HIV and SRH services in each health facility. Specifically, the PAR provided an understanding of how resources are combined to produce integrated HIV and SRH services. The PAR tool included questions on facility characteristics, staffing types and levels, scope and number of services offered, descriptions of client flow, and overall description of the integration of services. The PAR tool was implemented in all SRH/HIV clinics and laboratory and pharmacies (if available onsite) for the pre-

integration period July 2008 - June 2009 in Kenya and April 2008 – March 2009 in Swaziland and then repeated again for the post integration period 2010-2011 in both countries.

Following the PARs in each health facility, cost and output indicators were collected retrospectively for two financial years: 2008-2009 (considered pre-integration period) and 2010-2011 (post integration). Cost data were collected for the entire facility in the health centres, public health units and SRH clinics; while in the hospitals, cost data were collected for the MCH-FP/HIV departments only.

Costs were classified into two main categories: capital and recurrent costs. Capital costs considered included buildings, equipment and training costs. All capital costs were annualized and discounted at the standard rate of 3% [19]. The facilities and departments were measured in square meters and the rooms valued using estimates on annual rental costs per square meter obtained from a rental survey of the adjacent area. Equipment and furniture inventories were developed during visits at each study site and subsequently valued using the price lists from Kenya Medical Supplies Agency and the Swaziland Ministry of Health. Most equipment was assigned a life expectancy of 3-5 years and furniture was assumed to have a longer life expectancy of 10 years.

Training related to HIV/STI and SRH service delivery was identified through interviews with service providers. Training costs were then estimated from training facilitation costs, staff per diems and transport allowances received by the service provider.

Recurrent costs included building maintenance (including utility expenses), transport costs, staff salaries drugs, and diagnostics, medical and non-medical supplies. Utility expenses were obtained from the central administration expenditure records for each facility. Personnel costs including benefits and allowances were estimated for all staff working in the MCH/PHU, HCT, HIV, pharmacy and laboratory departments, on the basis of position and salary levels. Expenditures on the recurrent costs of drugs, diagnostics and supplies were obtained from requisition notes and records within the facilities.

Allocation of costs

Overhead and administrative costs associated with the different HIV/SRH services were allocated using the step-down costing approach. Room space was used to allocate utilities and building maintenance and staff numbers in each unit used to allocate management and administrative costs. Costs of drugs, diagnostics and supplies were allocated to each individual service based on actual resource usage. This was obtained through a combination of staff observations, staff interviews and patient records. In particular, staff time was allocated using a combination of an initial interview, followed by observations, followed by a week of timesheet reporting and then a follow-on interview to confirm allocations.

The same costing methods were used in all the 40 study sites. Two researchers collected data across sites and results were quality controlled by a third researcher. All costs were converted to standardized 2011 international dollar (Int\$2011) using the general purchasing power parity (PPP) index [21] rather than the official currency exchange rates. The PPP index is recommended for

comparing costs across countries as it adjusts for differences in relative prices between economies [22].

Estimation of unit costs of HIV and SRH services

The main unit of this analysis is the unit cost per visit for each service, calculated by dividing the total costs for each service by the number of client visits of the respective services. Data on HIV and SRH service utilization was collected from registers and monthly reports at the facility level. In a few instances where client registers were missing and service statistics were not kept, estimates of services provided were made through a review of the drug dispensing records and interviews with staff to determine average number of consultation visits made for a particular condition or need.

We present total and unit costs by country, provider type, provider ownership, and resource type, in order to illustrate the extent of variation in cost across a range of providers. Although the Integra study was initially intended to evaluate three different models of integration, it was difficult to make any meaningful comparisons between the three different models given that facilities exhibited different levels and extents of integration. Costs were further analysed and presented as fixed or variable costs. Variable costs include the costs of drugs, diagnostics and supplies, which vary with changes in output whereas fixed costs include capital, salaries, and other building maintenance costs that did not vary with output levels within the time period of a year.

6.2.3 Results

Total costs of HIV and SRH services

Table 6-2 presents the percentage breakdown of total outpatient HIV and visits and total economic costs for each of the six services by country, ownership, facility type and year. The corresponding amounts are provided in supplementary appendix Table S1. One striking feature of the breakdowns is the large proportion of facility costs incurred for HIV/STI counselling, testing, and treatment services in both settings. When taken together, these services account for 34% to 77% of total HIV/SRH costs in Kenya and 22% to 95% of total costs in Swaziland pre integration. In year two, these accounted for a lower proportion of economic costs in Kenya (23% to 74%) and a higher proportion of costs (30% to 96%) in Swaziland.

We also observed considerable variation in the relative proportions of visits and costs for the different services by health facility type. In Kenya, all the facility types provided more SRH services; compared to HIV services, with SRH services (FP, PNC, and Ca Cx) accounting for between 62% and 77% of total visits, but only accounting for 23% to 48% of total costs pre integration in 2008/09. In the post integration period, these SRH visits accounted for between 47% and 86% of visits and an increased proportion of total costs ranging from 26% to 77%.

In Swaziland, the proportion of SRH visits ranged between 14% and 75% and accounted for 6% and 78% of total costs. Similarly, in the post integration period, SRH visits accounted for 12% and 89% of total visits and accounted for 4% to 70% of total costs. The public health units and SRH clinics in Swaziland

provide more SRH visits compared to other health facility types and in these facilities, costs for these visits together accounted for >50% of HIV and SRH service costs. In contrast, the hospital and health centres provided fewer SRH visits where they only accounted for 6% to 9% of total service costs and 4% to 8% pre and post integration respectively.

Mean unit costs per visit

Table 6-3 presents mean economic unit costs (including drugs and supplies) per visit for each service type. In general, even after adjusting for price differentials using international dollars, unit costs were higher in Swaziland compared to Kenya. However, some exceptions occur, such as unit costs for STI treatment and HIV treatment visits pre integration, which are higher in Kenya than in Swaziland.

When costs were analysed by facility type, the NGO SRH clinics in Kenya consistently had the highest cost per visit for family planning services and the hospital in Swaziland consistently had the highest cost per visit for PNC services. However, beyond this we found few other consistent patterns in unit costs across types of facilities with no particular facility type having lower unit costs across all services than other facilities (see supplementary appendix figure S1).

Table 6-2: Breakdown of client visits and total costs by year, country, ownership, facility type and service (2008-09 and 2010-11)

Pre-integration																			
Country		Kenya										Swaziland							
Ownership		Public					NGO					Public				NGO			
Facility type		Hospital* (n=1)		DH* (n=5)		SDH* (n=6)		HC* (n=12)		SRH clinics (n=6)		Hospital* (n=1)		HC* (n=5)		PHU (n=2)		SRH (n=2)	
		Proportion of visits		Proportion of costs		Proportion of visits		Proportion of costs		Proportion of visits		Proportion of costs		Proportion of visits		Proportion of costs		Proportion of visits	
Service		visits	costs	visits	costs	visits	costs												
Ca Cx		3%	3%	1%	0.3%	0%	0.4%	1%	0.4%	10%	8%	0%	0.1%	0%	0.1%	0%	0.1%	6%	4%
FP		51%	45%	60%	22%	66%	27%	67%	37%	55%	36%	10%	2%	16%	7%	60%	39%	61%	71%
PNC		18%	0%	6%	1%	10%	3%	9%	5.8%	1%	1%	4%	3.3%	3%	2%	15%	11%	4%	3%
HCT		28%	52%	17%	11%	17%	13%	15%	11%	21%	14%	5%	2.7%	5%	1.7%	5%	3.3%	16%	14%
STI		0%	0.6%	1%	0.7%	1%	0.8%	2%	1%	5%	9%	0%	0%	1%	0.5%	8%	1.7%	11%	6%
HIV		0%	0.0%	15%	65%	6%	56%	6%	45%	8%	32%	81%	92%	75%	89%	12%	45%	2%	2%
Post integration																			
Country		Kenya										Swaziland							
Ownership		Public					NGO					Public				NGO			
Facility type		Hospital* (n=1)		DH* (n=5)		SDH* (n=6)		HC* (n=12)		SRH clinics (n=6)		Hospital* (n=1)		HC* (n=5)		PHU (n=2)		SRH (n=2)	
		Proportion of visits		Proportion of costs		Proportion of visits		Proportion of costs		Proportion of visits		Proportion of costs		Proportion of visits		Proportion of costs		Proportion of visits	
Service		visits	costs	visits	costs	visits	costs												
Ca Cx		7%	18%	2%	0.7%	1%	0.4%	2%	2%	9%	11%	1%	1%	0%	0%	0%	0%	2%	11%
FP		58%	57%	35%	25%	41%	22%	40%	30%	39%	29%	8%	4%	23%	3%	77%	37%	65%	58%
PNC		21%	2%	10%	4%	20%	3%	13%	6%	1%	0.5%	3%	3%	2%	0.6%	12%	15%	3%	1%
HCT		12%	18%	24%	11%	23%	7%	19%	7%	36%	15%	2%	2%	3%	0.6%	8%	4%	16%	8%
STI		1%	5%	1%	1%	0%	0.3%	0%	0.2%	5%	6%	0%	0%	3%	0.4%	1%	0.8%	13%	10%
HIV		0%	0%	27%	58%	15%	67%	25%	56%	10%	39%	86%	90%	69%	95%	2%	43%	1%	13%

Notes: Facility type: DH = District hospital; SDH =Sub district hospital; HC = Health centre; PHU = Public health unit

Services: Ca Cx = Cervical cancer screening; FP = Family planning; PNC = Postnatal care; HCT: HIV counselling and testing; STI= Sexually transmitted infections.

The mean unit cost per visit by facility or model type for each service disguises considerable variation found between individual health facilities across the two settings (see Figure 6-2, with corresponding amounts in supplementary appendix Table S2 and Table S3). The mean cost per visit across service type varied most for HIV treatment and STI services in both countries. In Kenya, the lowest absolute difference in costs was found for family planning services ranging from Int\$3.35-Int\$28.63 pre integration and Int\$7.18-Int\$46.45 post integration. In Swaziland, STI services had the least variation in absolute terms, pre integration (Int\$5.25-Int\$24.99); and post integration, family planning visits (Int\$12.85-49.67). Looking at mean unit cost per visit over time, mean costs per visit for all services in both countries increased after the integration policies were introduced with the exception of postnatal care and HIV treatment services in Kenya. The variation in mean unit costs per visit across service types also increased after integration.

Table 6-3: Mean cost per visit* (Int\$2011) by year, country, ownership, facility type and service (includes drugs and supplies)

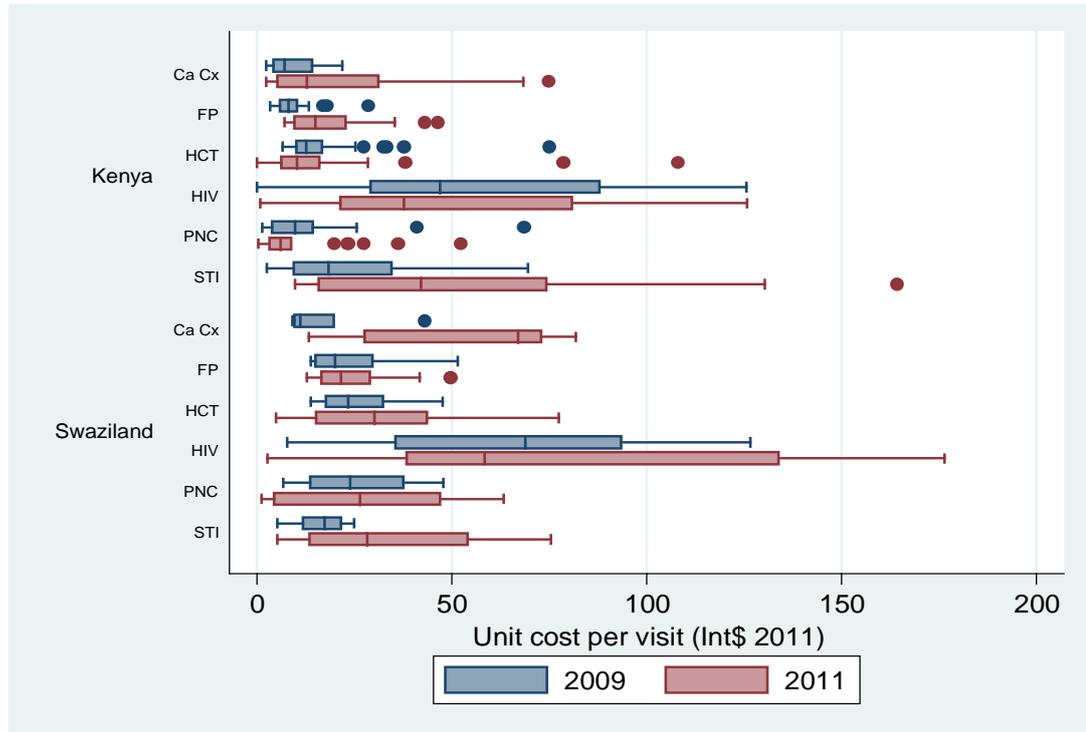
Pre integration											
Country	Kenya						Swaziland				
Ownership	All	Public				NGO	All	Public			NGO
Facility type^a	All	Hospital	DH	SDH	HC	SRH clinic	All	Hospital	HC	PHU	SRH
Service type^b											
Ca Cx Screening	9.55	13.03	4.24	5.23	4.12	16.34	18.54	9.66	43.06	9.09	15.44
FP	9.23	11.72	8.09	9.10	6.92	14.56	23.58	14.97	27.12	16.90	25.69
PNC	14.65	-	2.52	14.00	5.17	26.47	24.64	47.89	26.80	16.92	15.34
HCT	15.77	25.14	13.92	21.31	12.28	14.98	26.49	32.93	22.18	22.35	36.09
STI treatment	25.82	18.91	18.63	21.65	15.79	46.92	16.39	11.76	19.93	5.24	18.96
HIV treatment	128.04	-	194.04	95.84	233.57	51.82	67.90	68.90	79.44	102.47	21.27
2010/2011											
Country	Kenya						Swaziland				
Ownership	All	Public				NGO	All	Public			NGO
Facility type	All	Hospital	DH	SDH	HC	SRH clinic	All	Hospital	HC	PHU	SRH
Service type											
Ca Cx Screening	21.41	27.52	9.83	7.27	32.86	30.36	52.59	67.04	27.64	13.40	77.43
FP	17.70	10.41	16.49	13.95	17.48	24.13	25.47	29.18	20.48	15.80	45.73
PNC	10.31	1.02	7.21	14.8	8.02	15.66	26.67	49.27	26.85	22.63	18.95
HCT	14.81	14.01	19.25	11.69	14.13	15.04	32.43	42.76	32.83	46.92	19.20
STI treatment	55.67	66.48	72.91	116.26	13.76	39.14	60.07	44.41	41.62	136.57	28.29
HIV treatment	70.18	-	41.85	34.36	110.39	73.99	114.09	58.18	155.93	103.86	47.69

^a Facility type: DH = District hospital; SDH =Sub district hospital; HC = Health centre; PHU = Public Health unit

^b Service type: Ca Cx = Cervical cancer screening; FP = Family planning; PNC = Post natal care; HCT: HIV counselling and testing; STI= Sexually transmitted infections

*Mean cost per visit includes drugs, diagnostics and supplies.

Figure 6-2: Variation in mean cost per visit by service type (2008/09 and 2010/11)



Note: Ca Cx = Cervical cancer screening; FP = Family planning; PNC = Post natal care; HCT: HIV counselling and testing; STI= Sexually transmitted infections

Components of unit costs per visit

Table 6-4 and Table 6-5 provide breakdowns of the mean economic cost per visit for each of the six services by input category (fixed and variable costs) by country for pre and post integration, respectively. Two noticeable features of this breakdown are: the high proportion of fixed costs across all visit types with the exception of HIV treatment visits, due to the high proportion of human resource costs. The mean fixed cost per visit for the different services accounted for between 16% to 80% (Kenya) and 26% to 92% (Swaziland) of the total mean cost per visit for the different services. Of the total fixed costs, human resources costs accounted for the largest proportion of costs ranging from 56% to 81% (Kenya) and 33% to 86% (Swaziland).

Table 6-4: Distribution of unit costs by input type - Pre integration

2008/09	Ca Cx		Family planning		Post natal care		HIV C&T		STI Treatment		HIV Treatment	
	Cost per visit	% of total costs	Cost per visit	% of total costs	Cost per visit	% of total costs	Cost per visit	% of total costs	Cost per visit	% of total costs	Cost per visit	% of total costs
Kenya												
Fixed costs												
Capital costs	1.52	16%	0.73	8%	2.34	16%	1.30	8%	1.88	6%	2.59	2%
Salaries cost	4.37	46%	3.80	41%	6.91	47%	7.74	50%	8.35	26%	16.12	13%
Other costs	0.66	7%	0.19	2%	0.51	3%	0.48	3%	1.30	4%	1.39	1%
Sub total	6.55	69%	4.72	51%	9.76	67%	9.52	61%	11.53	36%	20.10	16%
Variable costs												
Drugs	-	0%	3.74	41%	4.20	29%	-	0%	13.29	42%	99.54	78%
Diagnostics	3.00	31%	0.78	8%	0.68	5%	5.99	39%	7.02	22%	8.40	7%
Sub total	3.00	31%	4.52	49%	4.88	33%	5.99	39%	20.31	64%	107.94	84%
Total	9.55	100%	9.24	100%	14.64	100%	15.51	100%	31.84	100%	128.04	100%
Swaziland												
Fixed costs												
Capital costs	1.40	8%	1.62	7%	3.19	13%	3.21	12%	1.46	9%	1.64	2%
Salaries cost	12.98	70%	11.01	47%	11.54	47%	8.61	33%	9.03	55%	15.16	22%
Other costs	2.65	14%	1.58	7%	1.76	7%	2.72	10%	0.54	3%	0.78	1%
Sub total	17.03	92%	14.21	60%	16.49	67%	14.54	55%	11.03	67%	17.58	26%
Variable costs												
Drugs	-	-	5.79	25%	7.72	31%	-	-	3.74	23%	40.42	60%
Diagnostics	1.49	0.08	3.56	15%	0.44	2%	11.95	45%	1.61	10%	9.88	15%
Sub total	1.49	8%	9.35	40%	8.16	33%	11.95	45%	5.35	33%	50.30	74%
Total	18.52	100%	23.56	100%	24.65	100%	26.49	100%	16.38	100%	67.88	100%

Table 6-5: Distribution of unit cost by input type – Post integration

2010-11	Ca Cx		Family planning		Post natal care		HIV C&T		STI Treatment		HIV Treatment	
	Cost per visit	% of total costs	Cost per visit	% of total costs	Cost per visit	% of total costs	Cost per visit	% of total costs	Cost per visit	% of total costs	Cost per visit	% of total costs
Kenya												
Fixed costs												
Capital costs	5.21	26%	1.72	10%	1.34	14%	1.77	13%	6.43	12%	3.58	5%
Salaries cost	7.70	39%	7.11	42%	5.91	62%	6.89	49%	11.02	21%	14.62	21%
Other costs	0.83	4%	0.52	3%	0.37	4%	0.95	7%	6.64	13%	1.54	2%
Sub total	13.74	69%	9.35	56%	7.62	80%	9.61	68%	24.09	46%	19.74	29%
Variable costs												
Drugs	-	0%	6.48	39%	-	0%	-	0%	22.82	43%	41.51	61%
Diagnostics	6.24	31%	0.92	5%	1.90	20%	4.45	32%	5.98	11%	6.91	10%
Sub total	6.24	31%	7.40	44%	1.90	20%	4.45	32%	28.80	54%	48.42	71%
Total	19.98	100%	16.75	100%	9.52	100%	14.06	100%	52.89	100%	68.16	100%
Swaziland												
Fixed costs												
Capital costs	6.79	14%	1.28	6%	4.36	23%	5.41	19%	16.67	31%	2.85	3%
Salaries cost	16.59	35%	10.45	45%	11.39	60%	12.63	45%	11.60	21%	23.42	22%
Other costs	3.30	7%	0.91	4%	1.08	6%	1.61	6%	6.39	12%	1.13	1%
Sub total	26.68	56%	12.64	55%	16.83	88%	19.65	70%	34.66	64%	27.40	26%
Variable costs												
Drugs	-	0%	6.86	0.30	1.47	8%	-	0%	16.45	30%	42.60	40%
Diagnostics	20.98	44%	3.63	0.16	0.82	4%	8.31	30%	3.03	6%	36.51	34%
Sub total	20.98	44%	10.49	45%	2.29	12%	8.31	30%	19.48	36%	79.11	74%
Total	47.66	100%	23.13	100%	19.12	100%	27.96	100%	54.14	100%	106.51	100%

When analysed by service type, postnatal care visits had the highest proportion of fixed costs in the pre integration period accounting for 80% to 88% of total mean cost per visit. In post integration period, cervical cancer screening visits had the highest proportion of fixed mean costs accounting for (69-92%) in both countries. In contrast, variable costs are the most expensive component of the mean unit cost per HIV treatment visit accounting for the 71% to 84% of the mean unit cost per visit.

6.2.4 Discussion

This is the first study to our knowledge to provide a detailed description of the resources used to deliver integrated HIV and SRH services across different settings. Our findings show that HCT and HIV treatment costs are increasingly accounting for a significant proportion of total health service costs. However, there remains considerable variation in the unit costs, levels of fixed costs and patterns of resource use in the provision of integrated HIV and SRH services between facilities suggesting considerable room to improve efficiency at both the facility and service level.

Our analysis showed that even after adjusting for differences in relative prices, there were still large disparities in unit costs between the two countries. Some variation in unit costs across the different services may be associated with site characteristics, although we found few consistent patterns across facility types. For example, in Kenya, the estimated unit costs of FP and PNC visits were consistently higher in the NGO SRH clinics compared to the other health facility types. The higher unit cost for these visits in the NGO clinics may be indicative

of provision of more complex FP methods such as intrauterine contraceptive devices, implants and bilateral tubal ligations which require more equipment and staff time.

There are also service specific explanations for the differences in costs between facilities. Some of these can be explained by the technology used. For example the wide range in unit costs per family planning and cervical cancer screening visits result from the wide variation in methods provided within the facilities. The underlying data confirm that facilities providing more long term FP methods and pap smears for cervical cancer screening as opposed to visual inspection had higher unit cost per visit.

Besides the method mix, most of the variability in costs stemmed from the variability in the level of fixed rather than variable unit costs. The high proportion of fixed costs as a proportion of total unit costs, suggests that there is a mismatch between planning of fixed resources and the demand for services. It should also be noted that, despite the fact that HIV care and treatment has the highest proportional mean unit variable cost per visit, it has one of the highest absolute level of fixed unit cost per visit. From an HIV programme perspective drugs and variables costs may be of most concern to planners. However, given the overall percentage of HIV care and treatment related visits particularly in the higher level facilities in Swaziland costed, HIV care and treatment related fixed costs may be key to the planning of fixed resources at the facility level.

Another explanation for service specific variation may also be service maturity [23]. This may explain why well-established services, such as FP, exhibited less

variation than new services such as HIV and STI treatment that may not yet have achieved high levels of visits. It also may in part explain why integration has not been successful in ironing out cost variation as when new services are first added, service volumes may be low in a facility and hence result in higher unit costs since fixed costs are spread across few units of output. This may resolve itself in time, but it may still be necessary to examine more closely the assumptions made, if any, about the implicit level of demand for integrated services.

Mean unit costs estimated in our study for HCT and HIV treatment visits in Kenya and Swaziland did not differ greatly from costs estimated in previous studies within sub Saharan Africa [24-26] from smaller and less integrated settings. However, care should be taken in comparing costs across studies, as costs vary considerably over time, due to changes in input costs. In relation to cost structures, the results of this study are also consistent with other studies, which found high fixed costs as a proportion of total costs for most HIV and SRH services [25-28]. In a South African study of 4 sites, Rosen et al, [27] estimated that fixed costs accounted for 25% to 46% of outpatient HIV treatment costs. Similarly, in a Zambian study of HIV services in 12 health centres and hospitals, Bratt et al, [26] estimated that fixed costs accounted for 13% -62% of total costs across the different services.

Some limitations of this analysis should be noted. While the study incorporates high quality micro-costing methods rarely used in low and middle income countries, where available, routine monitoring data was used to estimate the unit costs. Although this was partially validated through comparison with other

study instruments from the broader study, it is likely that the use of routine services will bias our results. There may be an incentive for example to over-report visits that may result in lower unit costs; or alternatively reporting may be incomplete, that would result in an over-estimation of unit costs. This reporting may also vary by service. A particular concern is the reporting of STI visits, which were not uniformly recorded across sites resulting in higher unit costs estimated for these services.

Secondly, this analysis excludes the above service delivery costs or costs incurred at the administrative level outside the point of service delivery which may comprise an important component of costs, particularly fixed costs [29]. Such costs would provide valuable insights into approaches for optimizing resource management and health system costs. Given that above service level activities can contribute substantially to overall costs of services and are likely to provide opportunities for sharing of fixed costs in the process of integration (e.g. integrated management of information systems), future cost studies should focus specifically on these costs.

Notwithstanding these limitations, the findings of this study yield important policy and practice implications regarding the optimization of health resources to improve efficiency at the health facility level. First, this study indicates that the current level of efficiency of integrated HIV and SRH services can still be improved. Second, the study findings suggest that on its own, integration does not resolve the issue of cost variation between services, although more work is required to isolate the specific impact of integration efforts. However, given that fixed costs account for a significant proportion of unit costs particularly for SRH

services, and vary considerably between sites, integrated delivery of HIV and SRH services still offers the potential for better use of resources. It also suggests that in some settings, the fixed capacity exists to absorb this extra demand, but it is also clear that even when a policy of integration has been adopted this is not always achieved in practice. Further guidance is therefore required for facility managers on staffing services, not solely from a clinical perspective, but also taking into account the staff workloads and local demand for different HIV/SRH services.

Finally our findings highlight the complexity of the factors that may influence costs. Many of these issues are hard to address at the national level, yet managers at the facility and district level rarely have access to data on the underlying costs of the inputs and outputs they provide. Despite the fact significant investments have been made in decentralizing health systems, it is still difficult to find the necessary data to conduct and interpret even the simplest costing at the local level; and without this, it is unreasonable to expect that managers integrating services are able to move towards the lowest cost model. Policy makers and planners should therefore focus on strengthening simple information systems that match cost with financial information which would help managers identify local solutions that fully reflect the range of factors driving inefficiencies.

6.2.5 Conclusion

This study provides the most complete evidence to date on the unit costs of HIV and SRH services, in a variety of facilities, across a medium and high HIV

prevalence setting including a unique description of the cost breakdowns for each visit type. The considerable variation in unit costs of integrated HIV and SRH services found suggests a potential to improve efficiency. Given the large proportion of fixed costs for most of the services, if potential efficiency gains are to be realized, better use of existing human resources at the facility level should be advocated alongside integration policies and generation of demand for services. Finally, while this study has provided an important characterization of the costs of different HIV and SRH services in multiple sites, further research and analysis of these data is required to examine the determinants of costs, including whether the extent of integration has an impact on costs.

List of abbreviations

ART	Antiretroviral therapy
Ca Cx	Cervical cancer screening
FP	Family planning
HCT	HIV counselling and testing
MCH	Maternal and child health
PAR	Periodic activity review
PHU	Public health unit
PNC	Post natal care
PPP	Purchasing power parity
SRH	Sexual and reproductive health
STI	Sexually transmitted infections

Author's contribution

All authors provided editorial input and contributed to subsequent drafts of the manuscript and reviewed the final version prior to submission. CDO drafted the manuscript and was involved in all aspects of study design, data collection, analysis and interpretation of data. AV supervised the cost analysis, assisted in interpretation of the study results and contributed to the drafting of the manuscript. CMI contributed to the study design, and was also involved in the data collection. SS was involved in the data collection and assisted in data analysis. VD was involved in data collection. FTP contributed to the study design. LG contributed to the drafting of the manuscript. EM and ZN contributed to the implementation of the study. CEW, SM and CW were involved in the overall conceptual design and implementation of the project and contributed to the overall revision of this manuscript. All authors read and approved the final manuscript.

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References

1. Lush, L., *Service integration: an overview of policy development*. Issues in Perspective, 2002. **28**(2): p. 71-76.
2. UNGASS, *Declaration of commitment on HIV/AIDS*. 2001, UNITED NATIONS GENERAL ASSEMBLY SPECIAL SESSION ON HIV/AIDS 25-27 JUNE 2001: New York.
3. UNFPA, *The Glion Call to Action on Family Planning and HIV/AIDS in Women and Children, 3- 5 May 2004*. 2004, United Nations Population Fund: New York, NY.
4. UNFPA, *The New York Call to Commitment: Linking HIV/AIDS and Sexual Reproductive Health*. 2004.
5. Gleneagles, G., *The Gleneagles Comminique on Africa*. 2005.
6. UNGASS, *Resolution 60/262. Political Declaration on HIV/AIDS 2006*: New York, NY.
7. UNGASS, *Resolution 65/277. Political Declaration on HIV and AIDS: Intensifying Our Efforts to Eliminate HIV and AIDS*. 2011.
8. Sweeney, S., et al., *Costs and efficiency of integrating HIV/AIDS services with other health services: a systematic review of evidence and experience*. Sexually Transmitted Infections, 2011.
9. Askew, I. and M. Berer, *The Contribution of Sexual and Reproductive Health Services to the Fight against HIV/AIDS: A Review*. Reproductive Health Matters, 2003. **11**(22): p. 51-73.
10. Church, K. and S.H. Mayhew, *Integration of STI and HIV Prevention, Care, and Treatment into Family Planning Services: A Review of the Literature*. Studies in Family Planning, 2009. **40**(3): p. 171-186.
11. Das, R., et al., *Strengthening Financial Sustainability through Integration of Voluntary Counseling and Testing Services with Other Reproductive Health Services*. 2007, Population Council: Washington DC.
12. Liambila, W., et al., *Feasibility, acceptability, effect and cost of integrating counseling and testing for HIV within family planning services in Kenya*. 2008, Population Council: Washington DC.
13. Homan, R., et al., *Cost of introducing two different models of integrating VCT for HIV within family planning clinics in South Africa*, in *Linking Reproductive Health, Family Planning, and HIV/AIDS in Africa, 9 -10 October*. 2006: Addis Ababa.
14. Warren, C., et al., *Study protocol for the Integra Initiative to assess the benefits and costs of integrating sexual and reproductive health and HIV services in Kenya and Swaziland*. BMC Public Health, 2012. **12**(1): p. 973.
15. CSO, *Swaziland Demographic and Health Survey 2006-07*, C.S. Office, Editor. 2007, Central Statistical Office Mbabane, Swaziland.
16. NASCOP, *2007 Kenya AIDS Indicator Survey: Final Report*. 2009, NASCOP: Nairobi, Kenya.
17. GOK, *National Reproductive Health and HIV and AIDS Integration Strategy*. 2009, Government of Kenya: Nairobi, Kenya.
18. Swaziland, G.o., *National Strategic Framework (NSF) on HIV and AIDS for 2009 -2014*. 2009: Mbabane, Swaziland.
19. Drummond, M., et al., *Methods for the economic evaluation of healthcare programmes*. Third ed. 2005, Oxford: Oxford University Press.

20. Conteh, L. and D. Walker, *Cost and unit cost calculations using step-down accounting*. Health Policy and Planning, 2004. **19**(2): p. 127-135.
21. World Bank. *PPP conversion factor, GDP (LCU per international \$)*. Available from: <http://data.worldbank.org/indicator/PA.NUS.PPP>.
22. Kanavos, P. and E. Mossialos, *International Comparisons of Health Care Expenditures: What We Know and What We Do not Know*. Journal of Health Services Research & Policy, 1999. **4**(2): p. 122-126.
23. Menzies, N.A., A.A. Berruti, and J.M. Blandford, *The Determinants of HIV Treatment Costs in Resource Limited Settings*. PLoS ONE, 2012. **7**(11): p. e48726.
24. Cleary, S., D. McIntyre, and A. Boulle, *The cost-effectiveness of Antiretroviral Treatment in Khayelitsha, South Africa - a primary data analysis*. Cost Effectiveness and Resource Allocation, 2006. **4**(1): p. 20.
25. Bikilla, A., et al., *Cost estimates of HIV care and treatment with and without anti-retroviral therapy at Arba Minch Hospital in southern Ethiopia*. Cost Effectiveness and Resource Allocation, 2009. **7**(1): p. 6.
26. Bratt, J.H., et al., *Costs of HIV/AIDS outpatient services delivered through Zambian public health facilities*. Tropical Medicine & International Health, 2011. **16**(1): p. 110-118.
27. Rosen, S., L. Long, and I. Sanne, *The outcomes and outpatient costs of different models of antiretroviral treatment delivery in South Africa*. Tropical Medicine & International Health, 2008. **13**(8): p. 1005-1015.
28. Martinson, N., et al., *Costs of Providing Care for HIV-Infected Adults in an Urban HIV Clinic in Soweto, South Africa*. JAIDS Journal of Acquired Immune Deficiency Syndromes, 2009. **50**(3).
29. Johns, B., R. Baltussen, and R. Hutubessy, *Programme costs in the economic evaluation of health interventions*. Cost Effectiveness and Resource Allocation, 2003. **1**(1): p. 1.

Supplementary Appendix

Table S1: Breakdown of total HIV and SRH Service visits and costs (Int\$ 2011)

Year	Pre integration																			
	Kenya									Swaziland										
Country	Public Hospital (n=1)				DH (n=5)		SDH (n=6)		HC (n=12)		NGO SRH clinic (n=6)		Public Hospital (n=1)		HC (n=5)		PHU (n=2)		NGO SRH (n=2)	
Ownership	Visits	Costs	Visits	Costs	Visits	Costs	Visits	Costs	Visits	Costs	Visits	Costs	Visits	Costs	Visits	Costs	Visits	Costs	Visits	Costs
Facility type																				
Ca Cx	340	1,996	138	293	10	97	27	50	608	4,517	188	932	25	548	55	256	528	4,161		
FP	5,630	29,724	6,350	22,410	1,974	7,118	1,483	4,917	3,389	20,739	4,746	31,585	2,412	32,802	12,634	110,997	5,388	71,403		
PNC	0	0	600	1,135	294	907	201	773	67	780	1,985	48,769	485	10,846	3,193	32,300	361	3,174		
HCT	3,068	34,593	1,756	11,785	498	3,357	320	1,495	1,302	7,778	2,238	39,752	784	8,213	978	9,576	1,369	14,678		
STI treatment	47	400	125	768	32	212	45	151	279	5,156	15	90	223	2,412	1,771	4,767	978	5,960		
HIV treatment	-	0	1,565	66,848	171	15,144	125	5,973	490	18,122	38,772	1,348,943	11,479	421,131	2,439	128,196	200	1,547		

Table S1: Continued

Year Country Ownership Facility type	Post integration																	
	Kenya									Swaziland								
	Public				NGO					Public				NGO				
	Hospital (n=1)		DH (n=5)		SDH (n=6)		HC (n=12)		SRH (n=6)		Hospital (n=1)		HC (n=5)		PHU (n=2)		SRH (n=2)	
	Visits	Costs	Visits	Costs	Visits	Costs	Visits	Costs	Visits	Costs	Visits	Costs	Visits	Costs	Visits	Costs	Visits	Costs
Ca Cx	806	10211	265	1,045	71	241	54	607	852	12542	756	26,574	13	101	10	79	302	36,518
FP	6,636	31799	5,438	39925	2,386	12214	1,448	10681	3,500	32527	6,379	97,603	4,645	41,845	16,314	135872	11,042	198250
PNC	2,436	1,145	1,541	5,554	1,166	1,843	483	1,923	73	511	2,319	59,915	455	8,135	2,524	54,545	463	3,448
HCT	1,421	9,894	3,739	17621	1,323	3,942	679	2,391	3,298	16328	1,947	43,181	591	7,993	1,600	16,281	2,698	25,847
STI																		
treatment	93	2,846	224	2,224	5	163	12	75	465	6,317	15	349	669	5,128	214	2,945	2,284	35,013
HIV																		
treatment	-	0	4,164	91061	867	37239	905	19535	867	44021	70605	2154085	14203	1305580	457	161,066	231	42,821

Table S2: Mean and range of unit cost per visit by service type and country

Service Type	2008-2009		2010-2011	
	Mean [SD]	Range	Mean [SD]	Range
Kenya				
Ca Cx Screening	9.56 [6.48]	2.33-21.95	21.41 [20.79]	2.36-74.96
Family planning	9.24 [5.09]	3.35-28.63	17.71 [9.96]	7.18-46.45
Post natal care	14.65 [17.58]	1.46-68.58	10.31 [12.37]	0.43-52.45
STI treatment	25.82 [20.37]	2.50-69.53	55.67 [49.65]	9.87-164.27
HCT	15.77 [11.06]	6.57-75.11	14.81 [17.95]	0.12 -108.14
HIV treatment	128.06 [217.64]	0.05-880.14	70.18 [97.91]	0.89 -460.67
Swaziland				
Ca Cx Screening	18.54 [14.37]	9.09-43.06	52.59 [30.16]	13.40-81.79
Family planning	23.57 [11.40]	13.83-51.48	25.47 [11.98]	12.85-49.67
Post natal care	24.64 [14.03]	6.73-47.89	26.67 [22.65]	1.25-63.30
STI treatment	16.39 [6.77]	5.25-24.99	60.07 [81.48]	5.18-267.96
HCT	26.49 [10.66]	13.88-47.75	32.43 [21.03]	4.85-77.45
HIV treatment	67.89 [38.24]	7.84-126.63	114.09 [94.28]	2.78-299.42

Table S3: Mean of unit cost per visit by country, model and service type

Year of costs	2008/2009						
Country	Kenya				Swaziland		
Model type ^a	All	FP	PNC	SRH	All	PNC	SRH
Service type ^b	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Ca Cx Screening	9.55 (6.48)	5.65 (3.37)	4.00 (-)	16.33 (4.38)	18.54 (14.37)	20.60 (19.45)	15.44 (6.14)
FP	9.23 (5.09)	8.67 (2.17)	7.15 (2.50)	14.56 (8.99)	23.58 (11.40)	23.05 (12.69)	25.69 (5.53)
PNC	14.65 (17.59)	-	7.56 (7.27)	26.47 (23.75)	24.64 (14.03)	26.97 (14.18)	15.34 (12.17)
HCT	15.77 (11.06)	14.12 (6.64)	18.90 (17.87)	14.98 (4.67)	26.49 (10.66)	23.75 (8.65)	36.09 (12.72)
STI treatment	25.82 (20.37)	12.97 (8.92)	26.07 (21.66)	46.92 (15.97)	16.39 (6.71)	15.36 (7.93)	18.96 (2.15)
HIV treatment	128.04 (217.63)	0.05 (-)	201.23(284.12)	51.82 (28.12)	67.90 (38.24)	81.22 (30.96)	21.27 (18.99)
Year of costs	2010/2011						
Country	Kenya				Swaziland		
Model type ^a	All	FP	PNC	SRH	All	PNC	SRH
Service type ^b	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Ca Cx Screening	21.41 (20.79)	19.23 (15.97)	16.45 (25.74)	30.36 (24.37)	52.59 (30.16)	36.03 (27.78)	77.43 (6.17)
FP	17.70 (9.96)	17.75 (10.99)	14.45 (6.44)	24.10 (12.01)	25.47 (11.99)	20.39 (5.79)	45.73 (5.55)
PNC	10.31 (12.37)	10.52 (10.95)	7.48 (8.73)	15.64 (19.57)	26.67 (22.65)	28.59 (24.05)	18.96 (20.49)
HCT	14.81 (17.95)	16.95 (21.69)	12.03 (17.67)	15.02 (9.57)	32.43 (21.03)	36.83 (21.77)	19.21 (12.76)
STI treatment	55.67 (47.80)	54.52 (58.32)	-	35.18 (26.21)	60.07 (81.48)	69.15 (91.75)	28.29 (2.16)
HIV treatment	70.18 (97.91)	18.07 (18.58)	82.31 (129.02)	73.93 (32.16)	114.09(94.28)	130.69(96.32)	47.69 (63.51)

^a Model type: FP= Family Planning model (HIV/STI integrated into FP Services); PNC = Post natal care (HIV/STI services integrated into PNC services); SRH = SRH model (HIV.STI services integrated into SRH clinics)

^b Service type: Ca Cx = Cervical cancer screening; FP = Family planning; PNC = Post natal care; HCT: HIV counselling and testing; STI= Sexually transmitted infections

*Mean cost per visit includes drugs, diagnostics and supplies.

Chapter 7 Comparison of economic costs of integrated HCT and stand-alone VCT services

7.1 Introduction

Chapter 6 presented a descriptive analysis of the total and unit economic costs of delivering six integrated sexual and reproductive health and HIV services in 40 public and non-government organisation facilities in Kenya and Swaziland.

This chapter presents a comparison of the economic costs of delivering HCT services through PITC and VCT at 28 health facilities in Kenya and Swaziland. The emphasis on integration of HIV and SRH services has been driven largely by the need to address the HIV epidemic and contain costs of HIV service delivery. Although costs of treatment of HIV is a major issue in discussions, proponents of integration in this context have argued that providing HCT within family planning and SRH settings is not only critical for reducing HIV infection hence future treatment costs by increasing access to both types of services but also makes for efficient use of resources. This analysis therefore attempts to establish whether integrated HIV counselling and testing services are more cost efficient compared to stand alone counselling and testing services.

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7.2 Research paper 2



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PROGRAMME SCIENCE

Optimising the cost and delivery of HIV counselling and testing services in Kenya and Swaziland

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► An additional appendix is published online only. To view this file please visit the journal online (<http://dx.doi.org/10.1136/sextrans-2012-050544>).

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ABSTRACT

Background Approaches to HIV counselling and testing (HCT) within low-resource high HIV prevalence settings have shifted over the years from primarily client-initiated approaches to provider initiated. As part of an ongoing programme science research agenda, we examine the relative costs of provider-initiated testing and counselling (PITC) services compared with voluntary counselling and testing (VCT) services in the same health facilities in two low-resource settings: Kenya and Swaziland.

Methods Annual financial and economic costs and output measures were collected retrospectively from 28 health facilities. Total annual costs and average costs per client counselled and tested (C&T), and HIV-positive clients identified, were estimated.

Results VCT remains the predominant mode of HCT service delivery across both countries. However, unit cost per client C&T and per person testing HIV positive is lower for PITC than VCT across all facility types in Kenya, but the picture is mixed in Swaziland. Average cost per client C&T ranged from US\$4.81 to US\$6.11 in Kenya, US\$6.92 to US\$13.51 in Swaziland for PITC, and from US\$5.05 to US\$16.05 and US\$8.68 to US\$19.32 for VCT in Kenya and Swaziland, respectively.

Conclusions In the context of significant policy interest in optimising scarce HIV resources, this study demonstrates that there may be potential for substantial gains in efficiency in the provision of HCT services in both Kenya and Swaziland. However, considerations of how to deliver services efficiently need to be informed by local contextual factors, such as prevalence, service demand and availability of human resources.

INTRODUCTION

Despite significant progress, sub-Saharan Africa (SSA) continues to have the highest global burden of HIV infection.¹ With the roll out of antiretroviral treatment, and recognition that early HIV treatment may also impact on future HIV transmission, HIV counselling and testing (HCT) is an important cornerstone of HIV programming.²⁻⁶ The early investment in stand-alone voluntary counselling and testing (VCT) was supported by research findings suggesting that the provision of VCT is cost-effective.⁷ However, using the VCT model, the uptake of HCT in many high HIV prevalence countries in SSA remained low, with the poor uptake being due to both demand factors (such as fear of stigma associated with accessing stand-alone

HIV services); and supply factors (including the limited availability of testing centres in many settings).⁵⁻⁹ Many SSA countries are, therefore, currently exploring and scaling up alternative approaches to HCT to encourage uptake of HIV testing to population groups with limited access to existing services.

In addition, amidst the current economic crisis, there is a renewed interest in achieving 'value for money', with policy makers focusing on the most efficient way of delivering key HIV services without compromising quality. For countries seeking to expand HCT coverage, integrating HCT services into existing services, using a provider-initiated testing and counselling (PITC) approach, offers the potential to reduce HIV-related service costs. This study seeks to add to the evidence on the efficiency of delivering HCT services in low-resource settings by comparing the economic costs of delivering HCT services through PITC and VCT at 28 health facilities in Kenya and Swaziland, as part of a larger project, Integra Initiative.

Drawing on key programme science principles,¹⁰ this joint project between researchers and implementers supports the planning and delivery of integrated HIV and sexual reproductive health (SRH) services; from programme design to assessing the impact of integration key outcomes and service delivery goals, including the assessment of the efficiency of SRH and HIV services (<http://www.integrainitiative.org>).

STUDY SETTING

Kenya has a generalised HIV epidemic with a prevalence rate of 7.1%, according to the last Kenya AIDS Indicator Survey (2007).¹¹ On the other hand, with an estimated adult HIV prevalence of 26%, Swaziland has the world's most severe generalised HIV epidemic.¹² HCT is central to both Kenya and Swaziland's national response to HIV. However, despite the increasing availability of VCT centres, knowledge of HIV status remains low.¹³⁻¹⁴ In a bid to encourage HCT uptake to population groups with limited access to existing services, the Ministries of Health of both Kenya and Swaziland mandated PITC throughout the health sector in 2008. The Integra Initiative further strengthened this effort by providing staff training, equipment, supplies and supportive supervision to improve delivery of HCT services within SRH services.

VCT and PITC Provision

VCT refers to the client-initiated counselling and testing for HIV through VCT centres, while PITC involves the incorporation of HCT into routine healthcare, including general primary care, maternal and child healthcare, care for sexually transmitted infections and inpatient services. Both VCT and PITC services are offered in Kenya and Swaziland, and follow similar testing procedures in both countries.

There are, however, several differences between the PITC and VCT models, which have associated resource implications. While PITC services are routinely offered to all clients attending services, regardless of their reason for accessing services, VCT is dependent upon clients seeking testing. Within VCT, counselling and testing is provided by a lay VCT counsellor or a nurse. For PITC, pre- and post-test counselling is provided by a nurse, and testing is conducted either by the same nurse or provided by a laboratory technologist or a lay counsellor. VCT generally involves one-on-one or couples counselling, while for PITC pre-test counselling may be provided to groups. PITC may also involve much less post-test counselling than VCT, and thus, requires a shorter length of staff time for each visit.

Study sites

The study was conducted in a total of 41 health facilities in Kenya and Swaziland. Of the 41 sites, only 28 provided both PITC and VCT services within the same facility. Facilities were purposively selected to represent different locations (urban and rural), different ownership types (government and private not-for-profit) and different types of facilities (hospitals, district hospitals, sub-district hospitals, health centres, general clinics and International Planned Parenthood Federation affiliated SRH clinics). An overview of the study sites, and their size, in terms of staffing numbers and overall outpatient visits, is provided in the online appendix. Ethics approval for the larger Integra Initiative was obtained from the Kenya Medical Research Institute National Ethical Review Committee, and the Swaziland Scientific Review Board.

METHODOLOGICAL APPROACH

Cost and output data for both services were collected retrospectively at the facility level for the 2008–2009 fiscal year from

financial records and routine monitoring data. A combination of standard step-down and micro-costing methods was used to estimate the financial and economic costs of providing HCT services from a health provider perspective. (Financial costs represent actual expenditures on goods and services purchased, while economic costs include the estimated value of all resources, including donated or subsidised goods and services). Costs were classified as capital or recurrent costs.

Capital costs included costs of space, furniture and equipment and staff training. Equipment and furniture replacement value was obtained from the Ministry of Health for the public facilities, and retail sellers for the private health facilities, and costs were annuitised using a discount rate of 3%.¹⁵

Recurrent costs included staff costs, building maintenance, communications and stationery, diagnostics and supply. Where staff were shared across different activities, time usage was measured by a combination of observation, interviews with staff and their managers, and was confirmed by examining records on clients seen. Other items were measured through a combination of observation of resource use and supplies, and expenditure records.

Unit costs were obtained by dividing total costs by the relevant output indicators. Local currencies were converted to US dollars (\$) using an exchange rate of 78.79 Kenyan shillings per US dollar (\$), and 7.85 Swaziland emalangi per US dollar.¹⁶ All costs are presented in US dollar rates prevailing in 2009. Data analysis was conducted using Microsoft Excel 2007 and Stata (V.11.0: Stata Corporation).

RESULTS

The provision of HCT services varies considerably across facilities in both countries. Table 1 presents the summary of service outputs by facility type in Kenya and Swaziland. In Kenya, VCT was found to be the predominant mode of delivery of HCT, particularly at the district hospital and private SRH clinics. In Swaziland, the picture was mixed. The public facilities recorded higher proportions of VCT clients, whereas, the private SRH clinics reported more people accessing PITC services.

The proportion of clients seeking counselling, who then received a test, was almost 100% for both VCT and PITC services in both countries; except for PITC at the private SRH clinics. Only

Table 1 Average (mean) outputs for each facility type in Kenya and Swaziland

Kenya (N = 20)	Provincial hospital (n = 1)	District hospital (n = 5)	Sub-District hospital (n = 5)	Health centre (n = 4)	Private SRH clinic (n = 5)
PITC					
Clients counselled only	3094	942	419	779	562
Clients C&T (% of total counselled)	3094 (100)	934 (99)	418 (99)	771 (99)	269 (48)
Clients HIV positive (% of total C&T)	488 (16)	145 (15)	42 (10)	105 (14)	Not available
VCT					
Clients counselled only	3042	2416	664	519	2374
Clients C&T (% of total counselled)	3042 (100)	2411 (99)	664 (100)	514 (99)	2374 (100)
Clients HIV positive (% of total C&T)	913 (30)	193 (8)	64 (10)	73 (14)	284 (12)
Swaziland (N = 8)	Hospital (n = 1)	Health centre (n = 4)	Public health unit (n = 1)	Private SRH clinic (n = 2)	
PITC					
Clients counselled only	1657	303	1976	2134	
Clients C&T (% of total counselled)	1657 (100)	303 (100)	1976 (100)	936 (44)	
Clients HIV positive (% of total C&T)	867 (52)	174 (57)	675 (34)	135 (14)	
VCT					
Clients counselled only	2818	1291	1357	605	
Clients C&T (% of total counselled)	2818 (100)	1289 (99)	1357 (100)	597 (99)	
Clients HIV positive (% of total C&T)	1200 (43)	523 (41)	887 (65)	88 (15)	

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44%–48% of clients counselled through PITC were also tested in the SRH clinic. The proportion testing positive was found to be particularly high for VCT at the provincial hospital in Kenya, and for all HCT in Swaziland throughout the public facilities.

The total annual facility average costs of delivering HCT services and cost profiles across all facility types are summarised in table 2. In Kenya, the average total annual costs ranged between US\$1863 in the SRH clinics and US\$16723 in the provincial hospital for PITC; and US\$2768 in the sub-district hospitals and US\$48836 in the provincial hospital for VCT services. The largest components of costs for PITC across facility types were personnel costs (35%–49%) and recurrent supplies costs (which include diagnostics and supplies) (44%–62%). Similarly for VCT, the main cost component across facility types was personnel (41%–64%) and recurrent supplies (32%–53%). For both PITC and VCT services, capital and other recurrent costs were low.

In Swaziland, the average total annual costs ranged between US\$3233 in the health centres and US\$22362 in the hospital for PITC. For VCT, the average total annual costs ranged from US\$9767 in the SRH clinics to US\$54414 in the hospital. As with Kenya, the major cost components for HCT services across all facility types were recurrent supplies costs (39%–87% for PITC and 28%–70% for VCT) and personnel costs (11%–60% for PITC and 13%–70% for VCT).

Table 3 presents a breakdown of average cost per PITC and VCT client counselled and tested (C&T), and the average cost per HIV-positive diagnosis. The average cost per client C&T (including diagnostics and supplies) through PITC ranged from US\$4.81 in the health centres to US\$6.11 in the SRH clinics in Kenya, and from US\$6.92 in the PHU to US\$13.51 in the SRH clinic in Swaziland. Average costs per client C&T through VCT

ranged from US\$5.05 in the health centres to US\$16.05 in the provincial hospital, and from US\$8.68 in the PHU to US\$19.32 in the hospital in Kenya and Swaziland, respectively.

Figure 1 shows the comparison of unit costs by HCT service and facility type in both Kenya and Swaziland. Costs per client C&T through VCT are generally higher than cost per PITC client C&T across the different facility types in Kenya. In contrast in Swaziland, the unit costs per PITC were higher than unit costs per VCT client C&T in three of the health centres and the SRH clinics.

The cost per HIV-positive client identified ranges from US\$34.27 to US\$140.55 in Kenya, and US\$13.28 and US\$126.88 in Swaziland (table 3). In Kenya, the cost per client diagnosed as HIV positive through PITC and VCT was lowest at the provincial hospital. In Swaziland, the cost per client diagnosed as HIV positive through both PITC and VCT approaches was lowest in the PHU at US\$20.26 and US\$13.28, respectively.

Aside from capital costs in health centres in Swaziland, most of the variation in average costs per client C&T is driven by costs of human resources. We found little variation in salaries costs (including cadre of staff used). To explain the variation in personnel costs between facilities and different approaches to HCT, staff workload was measured by the number of clients C&T per staff full-time equivalency. A correlation analysis across both countries between the unit salaries cost per HCT visit, and this measure of staff workload shows a negative coefficient (0.39631) with a p value of (0.0025).

DISCUSSION

Our findings suggest that in Kenya and Swaziland, PITC services compare favourably with VCT in terms of cost per client C&T

Table 2 Annual economic cost of delivering VCT and PITC services for each facility type (US\$ rates in 2009)

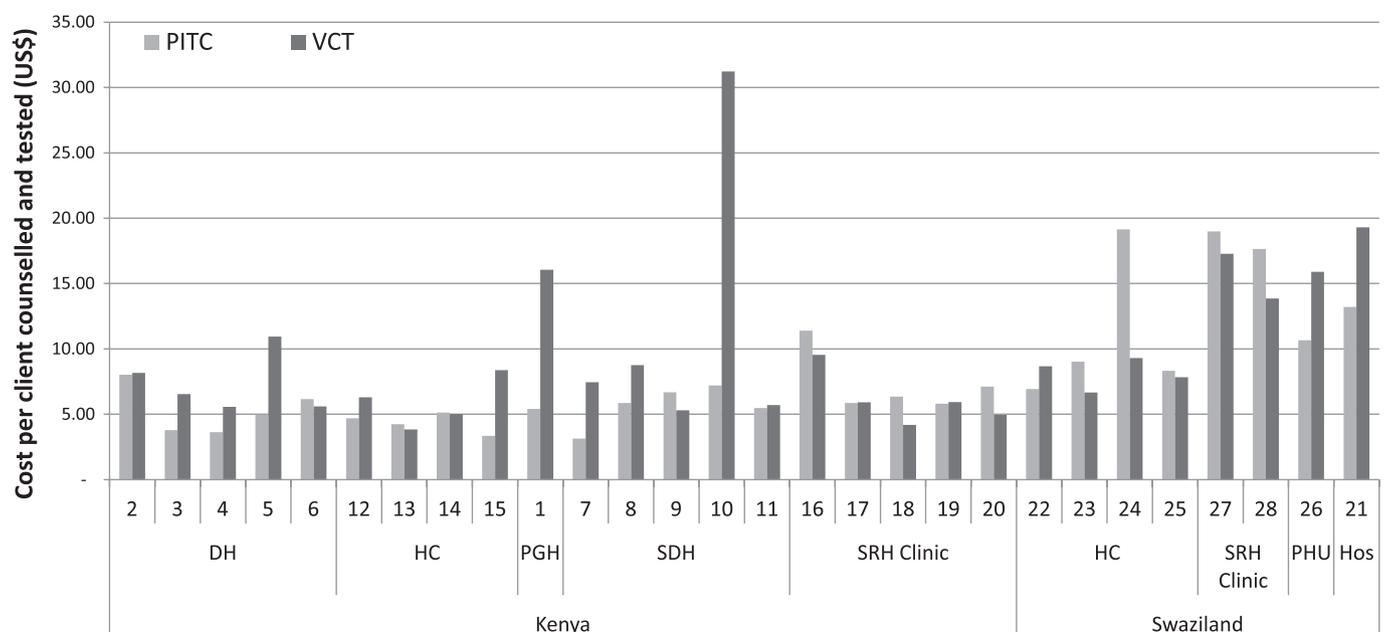
Type of cost (Average, US\$)	Provincial hospital (n=1)	District hospital (n=5)	Sub-district hospital (n=5)	Health centre (n=4)	Private SRH clinic (n=5)	Average
Kenya						
PITC Service						
Annual economic cost	16 723	5182	1854	3004	1863	3721
Capital cost (% of total cost)	126 (1)	91 (2)	54 (2)	118 (3)	152 (8)	104 (3)
Personnel cost (% of total cost)	8066 (48)	2533 (49)	568 (35)	1096 (35)	793 (43)	1624 (44)
Recurrent supplies (% of total cost)	7911 (47)	2416 (47)	1106 (62)	2081 (61)	821 (44)	1898 (51)
Other recurrent (% of total cost)	620 (4)	142 (2)	9 (1)	20 (1)	97 (5)	94 (3)
VCT Service						
Annual economic cost	48836	16341	5699	2768	13086	11969
Capital cost (% of total cost)	276 (1)	125 (1)	86 (2)	87 (3)	1159 (9)	374 (3)
Personnel cost (% of total cost)	29093 (59)	10398 (59)	3285 (64)	1200 (42)	5435 (41)	6474 (54)
Recurrent supplies (% of total cost)	16675 (34)	6590 (37)	1633 (32)	1511 (53)	5232 (40)	4500 (38)
Other recurrent (% of total cost)	2791 (6)	540 (3)	78.53 (2)	58 (2)	1260 (10)	621 (5)
Type of cost (Average, US\$)	Hospital (n=1)	Health centre (n=4)	PHU (n=1)	Private SRH clinic (n=2)	Average	
Swaziland						
PITC Service						
Annual economic cost	22 362	3233	13 674	17 385	10 407	
Capital cost (% of total cost)	57 (0.3)	504 (16)	93 (1)	318 (2)	351 (3)	
Personnel cost (% of total cost)	13073 (60)	1137 (35)	1451 (11)	3658 (21)	3299 (32)	
Recurrent supplies (% of total cost)	8582 (39)	1539 (48)	12055 (87)	8411 (48)	5452 (52)	
Other recurrent (% of total cost)	181 (0.8)	52 (2)	74 (1)	4992 (29)	1306 (13)	
VCT Service						
Annual economic cost	54 414	12 003	11 777	9767	16 716	
Capital cost (% of total cost)	242 (0.4)	113 (1)	598 (5)	89 (1)	184 (1)	
Personnel cost (% of total cost)	38032 (70)	4609 (38)	2674 (23)	1282 (13)	7713 (46)	
Recurrent supplies (% of total cost)	15366 (28)	6585 (55)	8314 (70)	4713 (48)	7431 (44)	
Other recurrent (% of total cost)	773 (1)	696 (6)	191 (2)	3681 (38)	1389 (8)	

Table 3 Average unit cost per person counselled and tested, breakdown of unit cost by input type and cost per person testing positive (US\$ rates in 2009)

Facility type/type of cost	Provincial hospital (n=1)	District hospital (n=5)	Sub-district hospital (n=5)	Health centre (n=4)	Private SRH clinic (n=5)	Average
Kenya						
PITC						
Capital	0.04	0.06 (0.01–0.19)	0.42 (0.05–1.27)	0.26 (0.06–0.48)	0.51 (0.36–0.65)	0.30
Personnel	2.61	2.22 (0.97–5.30)	2.40 (0.75–3.85)	1.41 (0.82–2.06)	2.60 (1.64–4.08)	2.22
Other recurrent	2.76	2.60 (2.42–2.95)	3.03 (2.37–4.01)	2.68 (2.45–2.98)	3.00 (2.15–4.23)	2.83
Mean cost per client C&T	5.41	4.92	5.82	4.81	6.11	5.71
Mean cost per client diagnosed HIV positive	34.27	47.02	45.65	110.40	(Not available)	46.96
VCT						
Capital	0.09	0.07 (0.01–0.17)	0.31 (0.07–0.56)	0.20 (0.01–0.38)	0.50 (0.31–0.81)	0.26
Personnel	9.56	4.39 (1.91–8.88)	9.8.41 (0.92–27.66)	2.55 (0.04–4.87)	2.83 (1.51–5.40)	4.89
Other recurrent	6.40	3.01 (2.60–2.61)	2.97 (2.50–4.32)	3.04 (2.72–3.74)	4.01 (2.97–5.34)	3.42
Mean cost per client C&T	16.05	11.86	11.69	5.05	7.34	8.27
Mean cost per client diagnosed HIV positive	53.49	97.97	140.55	123.64	93.15	110.32
Facility type/type of cost	Hospital (n=1)	Health centre (n=4)	PHU (n=1)	Private SRH clinic (n=2)	Average	
Swaziland						
PITC						
Capital	0.03	3.17 (0.01–12.38)	0.05	0.29 (0.23–0.35)	1.67	
Personnel	7.89	3.40 (1.65–4.95)	0.73	2.06 (0.86–3.25)	3.29	
Other recurrent	5.29	5.22 (5.08–5.54)	6.14	11.16 (11.03–11.30)	6.83	
Mean cost per client C&T	13.21	11.79	6.92	13.51	7.79	
Mean cost per client diagnosed HIV positive	25.25	20.88	20.26	126.88	47.85	
VCT						
Capital	0.09	0.09 (0.04–0.16)	0.44	0.14 (0.07–0.22)	0.15	
Personnel	13.50	4.17 (1.32–10.13)	1.97	0.96 (0.80–1.12)	4.26	
Other recurrent	5.73	5.65 (5.23–6.23)	6.27	10.60 (9.82–11.37)	6.98	
Mean cost per client C&T	19.32	9.91	8.68	11.70	9.44	
Mean cost per client diagnosed HIV positive	45.35	24.52	13.28	103.87	45.56	

and cost per client diagnosed as HIV positive. In Kenya, we find that VCT at hospitals tends to identify proportionally more clients who are diagnosed as HIV positive than PITC. However, the picture is slightly different in Swaziland, where all levels of publicly owned services find high proportions of HIV positives

among those tested (34%–65%). The exceptions to this are the private SRH clinics. The private clinics also have a much lower proportion of those receiving counselling than going onto being tested; possibly revealing the more voluntary nature of their provider initiative testing. Unfortunately, we were not able to

**Figure 1** Variation in cost per client counselled and tested in Kenya and Swaziland (US\$ rates in 2009). DH, District hospital; HC, Health centre; PGH, Provincial general hospital; SDH, Sub-district hospital; PHU, Public health unit; Hos, Hospital.

confirm in either setting whether positive tests were the first or a repeat result and, thus, draw conclusions about cost-effectiveness in terms of identifying new cases of HIV.

Our cost results are consistent with findings from other studies. A recent review of the efficiency gains of integrating HIV services into general health services identified a number of studies suggesting that the cost of integrated HCT in general health services is lower than that in VCT centres.¹⁷ However, all these were of a considerably smaller size than this study (1–4 sites),^{18–20} so no firm conclusion was possible.

Overall, the variation in unit costs between sites of a similar level suggests that there is considerable room for efficiency gain in HCT services. A substantial element of cost variation is accounted for by differences in personnel costs across settings. While there were some salary differentials between sites within each country, these were relatively minor, so the main driver of personnel costs was staff workload. Differences in staff workload can be partly explained by differences in model (such as group counselling) and, in part, by the organisation of service delivery, where staff are used for multiple purposes, and thus, are busier. However, it should be noted that in several of the facilities, the low costs of PITC are, in part, achieved by some staff facing exceptionally high workloads and, therefore, the 'efficiency' observed may come at a price of decreasing staff morale, possibly leading to services of poorer quality.

Not all VCTs, however, had a higher cost than PITC at the same site. The fact that some VCTs achieve a high workload demonstrates that there is nothing inherent in the VCT model that makes it less efficient in this regard. However, where VCT workloads are low, a stand-alone organisational structure, and limited training of counsellors may inhibit the efficient use of staff as they cannot be shared with other services. For this reason, more attention needs to be given to either better location or promoting VCT services in order that they are fully utilised; or to adding more services to VCT sites, to ensure that staff are used to a maximum to meet the needs of their clients. Recent efforts to include both TB-intensified case finding and the provision of FP through VCTs,^{21–23} thus offer feasible ways to improve the efficiency of these services.

A simple reading of our results would suggest that policy makers wishing to maximise the number of HIV-positive clients identified under budget constraints, should prioritise PITC. However, this would be incorrect, as our results also suggest the factors that drive efficiency (the demand for services, HIV prevalence and staffing) are context specific. Moreover, PITC and VCT services are not perfect substitutes for one another in all settings. Clientele attending VCT may be different from those accessing PITC. In particular, while integrated HCT within maternal and child health units is largely targeted at women of reproductive age, VCT services may be more able to meet the needs of other segments of the population, including adult men and adolescents. VCT may also be a better venue for activities, such as couple counselling, and may also be preferred by some people for other reasons, such as providing more specialised HIV services, and being better able to connect clients who test positive for HIV to services and peer-support groups. This suggests that while there is room for substantial improvement in efficiency in HCT services through the shared and integrated use of resources, this needs to be balanced with other programme objectives.

Finally, this study has a number of limitations that should be taken into account when interpreting our findings. First, the unit cost analysis was conducted retrospectively, which meant that staff observation could only be done at the end of the period for which we had full financial data. Second, we used

Key messages

- ▶ PITC compares favourably with VCT in terms of cost per client C&T and cost per client diagnosed as HIV positive in Kenya and Swaziland.
- ▶ Overall, the variation in unit costs between sites of similar levels suggests that there is considerable room for efficiency gain in HCT services.
- ▶ Considerations of how to deliver services efficiently need to be informed by local contextual factors, including HIV prevalence, service demand and human resource availability.
- ▶ Quality of HCT services should not be compromised either by overstressing providers or by undermining important considerations regarding consent, confidentiality and client rights.

routine monitoring data on service statistics to estimate unit costs. Variations in the completeness of monitoring data compiled may, therefore, have contributed to the variation in unit costs documented. Third, our sample only included 28 health facilities in Kenya and Swaziland. While this is much larger than previous studies, it remains insufficient for a full econometric analysis to quantitatively assess the influence of the different cost drivers. However, a second round of costing is currently underway to help further investigate cost drivers by examining changes over time. Fourth, our analysis does not include comparisons with other forms of HCT, such as home-based HCT. Lastly, the study did not measure the client costs incurred in accessing HCT services. The exclusion of these costs underestimates the true health systems and societal costs of accessing these services.

CONCLUSIONS

In the context of significant policy interest in optimising scarce HIV resources, this study demonstrates that there may be potential for substantial gains in efficiency in the provision of HCT services in both Kenya and Swaziland. The results can be used by those planning and providing both SRH and HIV services to improve programme efficiency and performance.

Our research highlights the importance of a programme science approach where planners and implementers jointly develop an intervention, and focus on operational research to strengthen the evidence base on how to improve the use of resources for HIV services. This model also provides important opportunities for the academic and international HIV community to systematically learn from large-scale HIV programme investments about how to efficiently deliver HIV programmes at scale.

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Correction notice This article has been corrected since it was published Online First. The sentence 'In a twice-daily bid to encourage HCT uptake to population groups with

limited access to existing services, the Ministries of Health of both Kenya and Swaziland mandated PITC throughout the health sector in 2008.' has been updated to read 'In a bid to encourage HCT uptake to population groups with limited access to existing services, the Ministries of Health of both Kenya and Swaziland mandated PITC throughout the health sector in 2008.' Also, the repeat of the following sentence has been deleted "Financial costs represent actual expenditures on goods and services purchased, while economic costs include the estimated value of all resources, including donated or subsidised goods and services."

Competing interests None.

Ethics approval Ethics approval was provided by London School of Hygiene and Tropical Medicine; Population Council Institutional Review Board; Kenya Medical Research Institute National Ethical Review Committee; Swaziland Scientific Review Board.

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REFERENCES

1. **UNAIDS.** *UNAIDS Report on the Global AIDS Epidemic.* Geneva: UNAIDS, 2010.
2. **De Cock KM,** Brunnel R, Mermin J. Unfinished business—expanding HIV testing in developing countries. *N Engl J Med* 2006;**354**:440–2.
3. **UNAIDS, World Health Organisation.** *UNAIDS/WHO Policy Statement on HIV Testing.* Geneva: UNAIDS, 2004. http://www.who.int/rpc/research_ethics/hivtestingpolicy_en_pdf.pdf (accessed 4 Jan 2011).
4. **Bwambale FM,** Ssali SN, Byaruhanga S, *et al.* Voluntary HIV counselling and testing among men in rural western Uganda: Implications for HIV prevention. *BMC Public Health* 2008;**8**:263.
5. **Helleringer S,** Kohler HP, Frimpong JA, *et al.* Increasing uptake of HIV testing and counselling among the poorest in sub-Saharan countries through home-based service provision. *J Acquir Immune Defic Syndr* 2009;**51**:185–93.
6. **Kalichman SC,** Simbaya LC. HIV testing attitudes, AIDS stigma, and voluntary HIV counselling and testing in a black township in Cape Town, South Africa. *Sex Transm Infect* 2003;**79**:442–7.
7. **Sweat M,** Gregorich S, Sangiwa G, *et al.* Cost-effectiveness of voluntary HIV-1 counselling and testing in reducing sexual transmission of HIV-1 in Kenya and Tanzania. *Lancet* 2000;**356**:113–21.
8. **Obermeyer CM,** Osborn M. The utilization of testing and counselling for HIV: a review of the social and behavioral evidence. *Am J Public Health* 2007;**97**:1762–74.
9. **WHO, UNAIDS, UNICEF.** *Towards universal access: scaling up priority HIV/AIDS interventions in the health sector. Progress Report.* Geneva: WHO, UNAIDS and UNICEF, 2007 (accessed 6 Oct 2011).
10. **Blanchard JF,** Aral SO. Programme Science: an initiative to improve the planning, implementation and evaluation of HIV/sexually transmitted infection prevention programmes. *Sex Transm Infect* 2011;**87**:2–3.
11. **National AIDS Control Council.** *Kenya AIDS Indicator Survey 2007. Final Report.* Kenya: NACC, 2009.
12. **Central Statistical Office Swaziland.** *2006-2007 Swaziland Demographic Health Survey.* Swaziland: Government of Swaziland, 2007.
13. **National AIDS Control Council.** *Kenya National AIDS Strategic Plan 2009/10 – 2012/13: Delivering on Universal Access to Services.* Nairobi, Kenya: NACC, 2009.
14. **Government of the Kingdom of Swaziland.** *Monitoring the declaration of commitment on HIV/AIDS (UNGASS) Swaziland country report.* Swaziland: UNAIDS, 2010.
15. **Drummond MF,** Sculpher MJ, Torrance GW, *et al.* *Methods for the Economic Evaluation of Health Care Programs.* 2nd edn. New York: Oxford University Press, 2005.
16. **Oanda.com.** *Currency Converter.* <http://www.oanda.com/>
17. **Sweeney S,** Obure CD, Maier CB, *et al.* Costs and efficiency of integrating HIV/AIDS services with other health services: a systematic review of evidence and experience. *Sex Transm Infect* 2012;**88**:85–99.
18. **Twahir A,** Maggwa B, Askew I. *Integration of STI and HIV/AIDS services with MCH-FP services: A case study of the Mkomani Clinic Society in Mombasa, Kenya.* Kenya: Population Council, 1996.
19. **Liambila W,** Askew I, Mwangi J, *et al.* Feasibility and effectiveness of integrating provider-initiated testing and counselling within family planning services in Kenya. *AIDS* 2009;**23**:S115–21.
20. **Menzies N,** Abang B, Wanyenze R, *et al.* The costs and effectiveness of four HIV counselling and testing strategies in Uganda. *AIDS* 2009;**23**:395–401.
21. **Reynolds H,** Beaton-Blaakman A, Burke H, *et al.* *Integrating Family Planning Services into Voluntary Counselling and Testing Centres in Kenya.* 2006:1–42. <http://www.fhi360.org/NR/rdonlyres/evdwnqrtaijj2jvzwdqom6xonyiurackisa57r3hakj4es4droeu fsknbpfitvplbc4wvj2jh3wmsh/FPVCTintegKenyaOR1.pdf> (accessed 24 Jan 2012).
22. **Gillespie D,** Bradley H, Woldegiorgis M, *et al.* Integrating family planning into Ethiopian Voluntary testing and counselling programmes. *Bull World Health Organ* 2009;**87**:866–70.
23. **Terris-Prestholt F,** Kumaranayake L, Ginwalla R, *et al.* Integrating tuberculosis and HIV services for people living with HIV: costs of the Zambian ProTEST Initiative. *Cost Eff Resour Alloc* 2008;**6**:2.



Optimising the cost and delivery of HIV counselling and testing services in Kenya and Swaziland

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Chapter 8 Technical efficiency of integrated HIV and SRH facilities

8.1 Introduction

Chapter 6 presented the findings from a descriptive analysis of costs of integrated HIV and SRH service. The results highlighted variability in unit costs and cost components suggesting that significant potential exists to reduce costs through better use of both human and capital resources.

Chapter 7 presented a comparison of the economic costs of integrated HCT and stand-alone VCT services in 28 health facilities in Kenya and Swaziland. Similarly, the results of the analysis demonstrated the potential for substantial gains in efficiency in the provision of integrated HCT services in both Kenya and Swaziland. Building on the analysis in chapters 6 and 7, this chapter presents the analysis of technical efficiency of the facilities providing integrated HIV and SRH services in order to understand the factors that drive technical efficiency of HIV and SRH service delivery. The analysis further extends the literature on efficiency measurement in low and middle income settings by considering two particularly relevant aspects of health care provision: quality of care and the effect of organisational and contextual factors.

Even though both chapter 6 and 7 showed that drugs and diagnostics contributed a significant proportion of costs, the analysis of technical efficiency is focused on fixed capital and human resources as these are the areas that are expected to be impacted by integration.

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The candidate conceived the research question, collected the data, developed the methodological framework, and the quality of care index using data obtained from the larger Integra Initiative trial, performed data entry, cleaning and analysis of primary data to estimate technical efficiency, and analysing the determinants of technical efficiency. The candidate prepared the manuscript. Rowena Jacobs provided technical advice on the methodological framework. Susannah Mayhew provided advice on the quality of care aspect. Anna Vassall and Lorna Guinness assisted in the interpretation of the results and discussion of the findings.

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Date : January 05, 2015

SUPERVISOR/SENIOR AUTHOR'S SIGNATURE (3 above)



8.2 Research Paper 3

Does integration of HIV and sexual reproductive health (SRH) services increase health facility technical efficiency? An application of a two-stage semi-parametric approach incorporating quality measures.

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Keywords: Technical efficiency, HIV, SRH, DEA, Bootstrap, Semi-parametric, Truncated regression, Sub- Saharan Africa, Kenya, Swaziland, Quality of care

Abstract

Background: Despite the extensive evidence on the clinical benefits of integrating HIV and sexual and reproductive health (SRH) services, there is a dearth of evidence on the impact of integration of HIV and SRH services on technical efficiency of health facilities. Even when technical efficiency has been assessed within the general health care literature, the existence of a trade-off between efficiency and quality has hardly been explored.

Methods: Using a two-stage semi-parametric double bootstrapped procedure, we estimate the technical efficiency and explore the determinants of efficiency of a sample of health facilities providing integrated HIV and SRH services in Kenya and Swaziland. Incorporating a measure of quality into the analysis of technical efficiency, we first estimate the technical efficiency of the health facilities using a bootstrapped non-parametric data envelopment analysis (DEA) approach. In the second stage, the impact of integration and other environmental factors on technical efficiency are explored using a bootstrapped truncated regression

Results: The results of the first stage DEA indicate that mean bias corrected technical efficiency taking quality into consideration varied between 49% and 65% depending on the DEA model specification. The number of additional HIV services in the MCH, public ownership and facility type, have a positive significant effect on technical efficiency. However, number of HIV and SRH services provided in the same clinical room, proportion of clinical staff to

overall staff, proportion of HIV services provided, and rural location had negative significant effects on technical efficiency.

Conclusions: The low estimates of technical efficiency and mixed effects of the measures of integration on efficiency challenge the notion that integration of HIV and SRH services may in itself substantially improve the technical efficiency of health facilities. Nevertheless the results show that integration has not had a detrimental effect on technical efficiency and suggests that technical efficiency may be achieved without sacrificing quality.

8.2.1 Introduction

The efficiency of HIV prevention and treatment strategies continues to be the subject of interest in resource constrained, high HIV prevalence settings [1-5]. The uncertainty about the ability of developed countries to meet their commitments to fund health programs in developing countries [6], have intensified interest in integration of HIV with SRH services as a means to improve the efficiency and quality of both services. Many countries in sub-Saharan Africa are therefore focused on addressing integration in their national health strategic plans [7].

In this context, integration is defined as the provision of two or more services at the same facility, with the service provider actively encouraging clients to use the other services in the same facility during the same visit. The rationale for integrating HIV and SRH services stemmed from both theoretical considerations and empirical findings on its benefits on efficiency and effectiveness [8]. The most compelling reason cited for integrating these services has been that the majority of HIV infections are sexually transmitted or are associated with pregnancy, childbirth and breastfeeding [9]. Expected benefits of such integration have included expanded HIV/STI service delivery to reach non-traditional clients, reduced STI morbidity, reduced HIV/STI related stigma, and increased client satisfaction [1, 5, 10-13]. More importantly, integration has been promoted as a means to ensuring early diagnosis and management of HIV and meeting the reproductive health needs of people living with HIV [14-15].

In addition to improving behavioural, health and social outcomes, integration of HIV and SRH services holds the promise of increasing the efficiency of service delivery and thereby maximising the use of health care resources [16]. Indeed, economic theory suggests several potential efficiency advantages at various levels from the integration of HIV and SRH services [17]. However, it is also important to note that integration may have negative impacts on efficiency as a result of low staff morale, added complexity of services delivered and lack of management capacity to properly allocate resources across services.

While improving efficiency remains important, ensuring quality of care is also critical. Even though quality is a key element of performance within the health sector, there have been no previous attempts to incorporate quality measures within efficiency measurement models in low and middle-income (LMIC) contexts. This is in part due to significant methodological challenges, not only related to the selection of quality measures but also how to incorporate aspects of quality of care into the efficiency measurement framework [18].

In light of the above discussion, the objectives of this paper are threefold. First, it aims to use recent methodological advancements in hospital efficiency measurement to estimate technical efficiency and determine the impact of integration on technical efficiency of health facilities. Particularly, a two stage semi-parametric approach with double bootstrap procedures is implemented. In the first stage, data envelopment analysis (DEA) - a non-parametric technique employed widely in efficiency measurement - is used to estimate technical efficiency of health facilities while controlling for quality of the health services. We measure quality of the health services using structural, technical and

interpersonal aspects of quality of care. These quality dimensions ascertain the functional ability of facilities to provide services of acceptable standards, how well knowledge is applied to the diagnosis and treatment of medical problems, and the interaction between the provider and the client.

In the second stage, the efficiency scores are regressed against a set of explanatory variables, which we expect (based on theory) to influence efficiency of health facilities. This formulation assumes that the explanatory variables influence the efficiency with which inputs generate outputs but do not influence the production process itself [19]. Although the two-stage double bootstrap procedure has become an increasingly popular technique to correct for both sampling bias and serial correlation of efficiency scores [20], to date only two studies have applied this procedure to analyse technical efficiency in the health sector in the sub-Saharan African context [21-22]. In this respect, the paper provides a valuable contribution to the literature on efficiency measurement in LMIC and offers policy lessons that may be useful for resource constrained high HIV prevalence settings.

Second, we explore alternative treatments of the quality measures as input or output variables incorporated into the standard efficiency measurement model. A critical consideration of DEA is the incorporation of variables as either inputs or outputs. While there is general consensus that efficiency estimates are sensitive to the model specification [23-24], guidelines on how one might decide whether a particular variable is an input, output or environmental variable do not exist. The results of the different models are therefore assessed to

determine how model specification impacts the estimated technical efficiency of health facilities.

Third, previous studies have suggested the existence of a potential trade-off between quality and efficiency when quality measures are included within the standard DEA model [25]. To assess the existence of this potential trade off, quality is also considered as a separate dimension independent from efficiency. With the increasing emphasis on improving value for money particularly for HIV prevention interventions, the examination of quality of health services and efficiency as separate dimensions of performance ensures that practices resulting in efficiency gains at the expense of quality are not adopted.

The paper is organised as follows. First we provide an analytical framework for analysing efficiency and quality. Second, we describe the data available and the variables used in the study. Third, the methodological approach employed to incorporate quality and explanatory variables into the efficiency measurement framework is outlined. Finally, the results and a discussion of the results as well as some policy and practice implications are presented.

8.2.2 Methods

Analytical framework

Data envelopment analysis (DEA) a linear programming methodology introduced by Charnes, Cooper and Rhodes [26], assesses the efficiency of a decision-making unit (DMU) in two stages. First, a frontier is derived based on those DMUs providing the highest output mix given their input mix using

mathematical programming techniques. The efficiency of each DMU is then determined relative to the frontier constructed from the observations in the sample and is expressed as the distance from the efficient production frontier.

The DEA approach has several valuable properties that make it amenable to this analysis. First, DEA has the advantage of being able to handle multiple-input and output production situations. Second, in contrast to parametric approaches that require a specification of a functional form a priori, and distributional assumptions about the production function, DEA requires only an assumption of convexity of the production possibility set [27]. The assumption of full convexity of a production technology means that the production patterns, which include all inputs and outputs, of different DMUs can be combined in any proportion. Practically, McFadden [28] notes that “convexity holds if production activities can be operated side by side (or sequentially) without interfering with each other”. A convex combination of two different DMUs 1 and 2 may therefore be thought of as a DMU, which performs a certain part of its operations like DMU 1 and the other part, like DMU 2.

Despite its widely recognized advantages, DEA has been criticised for its deterministic nature in that it does not impose the error term in the efficiency model and therefore vulnerable to measurement error. In addition, DEA results are sensitive to model selection particularly in small sample sizes [29].

Efficiency and quality

Broadly, two main approaches have been used to incorporate service quality into efficiency evaluation in the literature. First, quality measures have been included as exogenous variable in the second stage analysis [30]. The main limitation with this approach is that quality is assumed to only influence the efficiency with which inputs generate outputs and not the transformation process itself. This however, is a tenuous assumption given that the level of quality achieved is dependent on the quantity and form of inputs employed [19].

An alternative approach within the efficiency measurement literature has been to incorporate quality measures directly into the standard DEA model as an additional output [31-36]. The problem with this approach is that the addition of a variable into the DEA results in an increase in the number of efficient units due to the loss of DEAs discrimination power. The increase in efficiency estimates from the inclusion of an extra variable highlights a fundamental problem, which stems from DEA's flexibility on choice of weights for inputs and outputs. The strength of the original DEA model developed by Charnes, Cooper and Rhodes [37] lied in its ability to have flexible weights which maximize the output-input ratio in order to portray the DMU in the "best light possible" [38]. Basically DEA may assign high weights to the inputs and outputs for which a DMU is particularly very efficient but low weights or effectively zero weight to the other inputs or outputs on which it performs poorly [39]. Therefore, DMUs may achieve high efficiency scores even when they perform poorly in terms of quality because DEA assigns a zero weight to the variable.

To make models more discriminating in assessing the performance of DMUs, extensions to the original DEA models that allow the user to restrict weight flexibility have been proposed [40]. These include the use of absolute weight restrictions and relative weights. Including weight restrictions reduces the regions of search for the weights ensuring that efficiency scores cannot increase but may decrease relative to efficiency estimates obtained from unconstrained DEA models [39]. A detailed survey of the different types of weight restrictions that can be specified in DEA models is provided by Allen et al [41].

However, the incorporation of weight restrictions itself into the DEA model can introduce numerous pitfalls. First, the use of weight restrictions requires value judgements that reflect the relative importance of inputs and outputs, which may be difficult to justify. Secondly while absolute weight bounds may appear to be the simplest form of weight restriction, Dyson et al [40] show that only in a few cases does there exist a satisfactory procedure that can be used for their evaluation. Difficulties in evaluating the weight bounds are further aggravated by the fact that such bounds are specific to the unit under assessment making the exercise computationally expensive.

Given the challenges and pitfalls related to restricting weights in the standard DEA models, this thesis did not consider weight restrictions. Rather to assess the existence of a potential trade-off between quality and efficiency, quality is considered as a separate dimension, independent from efficiency. In this approach, the health facilities are mapped in terms of efficiency and quality and the bias corrected efficiency estimates from the standard DEA model without quality are considered against the composite quality scores developed. The

graph is separated in four segments to reflect the ways in which quality and efficiency may be defined - high quality and high efficiency facilities (HQ-HE); high quality and low efficiency facilities (HQ-LE); low quality and low efficiency facilities (LQ-LE); and low quality and high efficiency facilities (LQ-HE). The best practice is defined as high quality, high efficiency (HQ-HE).

8.2.3 Data

Data used in this analysis were collected as part of a large non-randomised trial (Integra Initiative - ClinicalTrials.gov identifier: NCT01694862) from 40 health facilities in Kenya and Swaziland. The Integra Initiative was aimed at strengthening the evidence base on the impact of integrating HIV and SRH services on a number of health outcomes and service costs [42]. The sample consisted of two provincial hospitals, five district hospitals, six sub district hospitals, 17 health centres, two public health units and eight sexual reproductive health clinics. The units of analysis are the HIV and SRH/maternal and child health (MCH)/public health unit (PHU) departments within health facilities.

DEA Variables

The choice of inputs and outputs for this analysis was guided by previous published efficiency literature, in which throughput measures are frequently used as proxies of health outcomes and focus on human, capital and consumable resources as input variables [43]. The production process of SRH and HIV

services is characterised by labour and capital as inputs used to produce HIV and SRH visits as outputs.

Labour inputs were disaggregated into full time equivalents (FTE) for clinical staff and FTE for technical staff. Clinical staff included doctors, clinical officers and all cadres of nurses – senior nursing officer, nursing officer, registered nurses, enrolled nurses and nursing assistants. Technical staff included laboratory technologists and technicians, and pharmaceutical technologists and technicians, lay HIV counsellors, peer educators and expert clients. Given that the exclusion of only salaried staff would underestimate the labour components of the health facilities, both labour categories included volunteer staff. Building space available for HIV and SRH services was used as a measure of capital input since HIV and SRH services required very minimal equipment and because a reliable measure of the value of the equipment stock was rarely available.

The outputs used in this analysis represent the general services provided within the MCH/SRH and HIV units. These included: number of outpatient visits for family planning (FP), cervical cancer (Ca Cx) screening, postnatal care (PNC), other MCH, HIV counselling and testing (HCT), treatment of sexually transmitted infections (STI), and HIV treatment and care services.

Quality of health service

The measurement of quality of health service was based on the standard framework provided by Donabedian [44] and incorporates structural, interpersonal and technical attributes of quality. The structural attributes of

quality assessed included availability of infrastructure and equipment, commodities and management practices (availability of guidelines/standards and IEC materials). These were assessed through a health facility inventory assessment administered at each study facility and were used to ascertain the availability of the appropriate inputs. The interpersonal and technical aspects of quality were assessed through observations of the client-provider interactions at each health facility [42]. Interpersonal aspects of quality refer to the interaction between the patient and the health provider while the technical aspects refer to how well medical knowledge is applied to diagnosis and treatment of the medical problem.

Points were allocated to each of these aspects, which allowed for the construction of a composite quality score for each health facility using principal components analysis (PCA). PCA is a statistical technique, which decomposes data with correlated values into a set of uncorrelated (orthogonal) variables [45]. The uncorrelated variables are referred to as principal components or factors and are a linear combination of the standardised values of the original variables used in the definition of the index. The weight given to each of the components corresponds to its statistical correlation with the latent dimension that the index is measuring. An index of quality of health service was constructed for each health facility with a mean equal to zero and a standard deviation equal to one, using the factor scores from the first principal component as weights.

Second stage explanatory variables

Empirical work on hospital efficiency measurement highlights the significance of organisational characteristics and differences in the production environments, which could influence efficiency of a firm. Some of the explanatory variables used in this analysis that reflect the structural differences in provision of health services, economic incentives and geographic and demographic factors include: the extent of integration, labour input mix, catchment population, facility ownership, geographic location, facility type and demographic factors such as demand for integrated SRH and HIV services.

Although integration has been a national policy in both Kenya and Swaziland, the extent of integration varies widely across facilities. Previous literature on the challenges of integration have noted that the extent of integration is dependent upon many factors that are beyond the control of the health facility such as staffing levels/labour input mix as well as population dynamics [13, 46]. As such, in this analysis, integration is considered as a non-discretionary input rather than an input or output measure within the standard production model.

The extent of facility integration was measured using two different measures structural measures and a functional integration (FUNINT) index), developed using latent variable techniques incorporating expert opinions. The structural measures of integration included four simple measures: number of HIV/STI services available within the entire facility; number of HIV/STI services available within the MCH/PHU; number of services provided per clinical staff; and the number of services provided in each consultation room.

The functional index focused on an assessment of service utilisation patterns in each of the study facilities. The index was developed using data on whether HIV treatment was being offered on site (or referred for); the range of services provided across days of the week; the range of services provided in single consultations; and the range of services provided in single visits. Further details on the development of the functional index of integration are provided in Mayhew et al [47]. Data used to develop this index were obtained from facility register data, other records review and observations of staff, as part of the larger Integra Initiative [42].

Given that the rationale for integrating HIV and SRH services has been to improve the efficiency of delivering these services; we would therefore expect a positive relationship between the extent of integration and the technical efficiency.

Differences in labour input mix were measured by the percentage of clinical staff FTEs to the other FTEs of other personnel (PROPCLS). We expect that the larger the proportion of clinical staff in a health facility the less efficient on average that health facility would be.

We expect that the scale of operations is positively associated with technical efficiency and therefore used the catchment population to control for scale of operations. Agency and property rights theories both posit that private facilities would be more efficient than government facilities due to differences in objectives, economic incentives, and control mechanisms [48]. However, the empirical literature on the impact of ownership on hospital efficiency has

reported mixed findings [48-52]. Although the NGO facilities included in this study have no profit motive, following agency and property right theories, we expect that they would be more efficient than public facilities. A dummy variable $OWN = 1$ if facility is a NGO clinic, is therefore used to test whether indeed public health facilities were less efficient compared to the NGO facilities. A binary variable $HOSP = 1$ if facility was a hospital, was used to control for the facility type and test whether hospitals have efficiency advantages compared to smaller health facilities in the provision of integrated HIV and SRH services. Health facilities were classified as hospitals (including provincial, district and sub district hospitals) and other health facilities (including health centres, public health units and SRH clinics). Assuming that facilities that operate at a large scale can realize greater efficiency due to positive economies of scale, we would expect that hospitals would be more technically efficient than the smaller health centres and SRH clinics.

The location of a facility can be an important determinant of its efficiency. Facilities located in urban areas were hypothesized to be more efficient than their rural counterparts due to higher client volumes. A dummy variable $LOC = 1$ if a facility was located in an urban area, was used to test whether the urban facilities were more efficient than their rural counterparts.

To control for differences in demand for different integrated services, we include the proportion of HIV related visits ($PROPHIV$) (total HIV visits/total HIV & SRH visits x 100). We expect that there will be an incentive for facilities with higher proportion of HIV visits to integrate services and therefore will be more technically efficient than facilities with fewer HIV visits. Finally a dummy

variable for 2010/2011 (YEARDUMMY) is used to control for the effects of time. A summary of definitions and descriptive statistics of input, outputs, and environmental variables are provided in Table 8-1.

Table 8-1: Definition and summary statistics of variables used in the study for 2008-09 and 2010-11

Variable	Definition/measurement	2008-09 (n=40) Mean [SD]	2010-11 (n=40) Mean [SD]	2008-2011 (n=80) Mean [SD]
<u>Inputs</u>				
Clinical FTE	Number of clinical staff FTEs	8 (5.38)	10 (7.04)	9 (6.35)
Non clinical FTE	Number of technical and admin staff FTEs	8 (5.63)	11 (6.12)	9 (6.01)
Unit size	Square footage available for HIV and SRH services	194.20 (147.61)	214.00 (158.26)	204 (152.39)
<u>Outputs</u>				
Ca Cx visits	Total annual visits for cervical cancer screening	163 (277.34)	244 (430.89)	203 (362.31)
FP visits	Total annual visits for family planning	3505 (2949.04)	4270 (4140.37)	3887 (3592.31)
PNC visits	Total annual visits for post natal care	527 (812.87)	848 (900.27)	687 (867.39)
HCT visits	Total annual visits for HIV counselling and testing	1867 (1596.08)	3474 (3549.17)	2670 (2851.38)
STI visits	Total annual visits for STI treatment	242 (599.59)	313(735.95)	277 (667.93)
HIV visits	Total annual visits for HIV treatment	2868 (7145.13)	4627 (12108.25)	6696 (10527.47)
Other visits	Total annual other MCH visits (ANC and CWC)	11808 (9886.75)	12600 (13095.74)	12204 (11535.94)
SRH visits	Total annual aggregated FP, PNC and Ca Cx visits	4196 (3593.02)	5363 (4635.37)	4779 (4162.38)
HCT/HIV visits	Total annual aggregated HCT, STI and HIV visits	4977 (7723.53)	8414 (12601)	6696 (10527.47)
QOC score	Composite index score for quality indicators	2.92 (1.71)	5.31(2.09)	4.14 (2.25)
<u>Contextual variables</u>				
HIV/STI FAC	HIV/STI services provided in the facility	6.5 (1.25)	6.7 (0.91)	6.64 (1.09)
HIV/STI MCH	HIV/STI services provided in the MCH unit	2.44 (1.18)	2.45 (1.10)	2.45 (1.14)
HIV/STI CS	HIV/STI service provided per clinical staff	1.86 (0.98)	1.76 (0.96)	1.81 (0.97)
HIV/STI R	HIV/STI services provided per room	1.37 (0.92)	1.35 (0.92)	1.36 (0.92)
FUINT	Functional integration score	1.24 (0.93)	1.29 (0.97)	1.27 (0.94)
CatchPop	Log of catchment population	135,674(283,592)	148,354(285,761)	142,014 (282,943)
PROPHIV	Proportion of HIV related visits	0.20(0.18)	0.29(0.19)	0.24(0.19)
PROPCLS	Proportion of clinical staff to other staff	0.49(0.15)	0.48(0.15)	0.48(0.15)
DUMMY PUBLIC	Government hospital	0.80(-)	0.80(-)	0.80(-)
DUMMY Other facility	Health centres, public health units and SRH clinics	0.54(-)	0.54(-)	0.54(-)
DUMMY RURAL	Rural facility	0.58(-)	0.58(-)	0.58(-)

ANC- Antenatal care; Ca Cx - Cervical cancer screening; CWC- child welfare clinic; FP – Family planning; PNC – Post natal care; HCT – HIV counselling and testing; STI – Treatment of sexually transmitted infections; MCH – Maternal and child health; SRH – Sexual and reproductive health

Estimation of technical efficiency

Technical efficiency of the health facilities incorporating quality measures is examined using an output oriented variable returns to scale DEA model. Output orientation is used based on the assumption that health facilities have more control over their outputs than their inputs. This is particularly relevant for public health facilities where resources are allocated centrally and therefore health facilities have no control over their inputs. In addition, it is expected that through integration, health providers will encourage the utilisation of HIV services hence increasing output. Variable returns to scale are assumed to allow for the accommodation of scale effects in the analysis to avoid the potential inefficiency that may arise if the facilities are forced to assume a non-optimal scale of production [36]. The Farrell output-oriented measure of technical efficiency is obtained as:

$$\begin{aligned} \text{Max } \theta_0 \quad & \text{Subject to:} \\ \sum_{j=1}^n X_{ij} \lambda_j & \leq X_{i0} \quad (i = 1 \dots m) \\ \sum_{j=1}^n Y_{rj} \lambda_j & \geq \theta Y_{r0} \quad (r = 1, \dots, s) \\ \sum_{j=1}^n \lambda_j & = 1 \quad \lambda_j \geq 0 \quad (j=1, \dots, n) \end{aligned} \quad (8.1)$$

Where: θ_0 is the maximum rate of proportional expansion in all outputs of DMU 0 given fixed levels of inputs or the DEA score; n is the number of DMUs; m is the number of inputs and s is the number of outputs; Y_{r0} is the amount of output r generated by unit 0 and X_{i0} is the amount of input i used by unit 0; λ_j is the set of

unique weights which DEA assigns to DMU_j to maximise its output-input ratio. The technical efficiency of DMU 0 is obtained by calculating $1/\theta$, and will be equal to 1 if the DMU is efficient and less than 1 if the DMU is inefficient when compared with the other DMUs. Technical efficiency estimates below 0.5 are considered low.

Three DEA variable returns to scale models were estimated using pooled data to estimate technical efficiency of each health facility under one best practice frontier. Data is pooled over time and each observation treated as an independent realization of the data generating process. Pooling of data increases the sample size and provides more confidence in the precision of DEA estimates from the first stage analysis. Table 8-2 provides a summary of the variables included in each model.

Table 8-2: Summary of variables used in DEA models

Variables	Model 1	Model 2	Model 3
Inputs			
Clinical staff FTE	X	X	X
Technical staff FTE	X	X	X
Floor space	X	X	X
Composite quality score	-	-	X
Outputs			
Cervical cancer visits	X	X	X
Family planning visits	X	X	X
Post natal care visits	X	X	X
STI treatment visits	X	X	X
HIV CT visits	X	X	X
HIV treatment visits	X	X	X
Other MCH visits	X	X	X
Composite quality score	-	X	-

Determinants of efficiency

In the second stage, DEA scores (θ) are regressed against a set of environmental variables (Table 8-1) to investigate how these variables (integration in particular) impact technical efficiency of health facilities. The truncated model is written as:

$$0 < \hat{\theta}_i = z_i \beta + \varepsilon_i \leq 1 \quad (8.2)$$

Where $\hat{\theta}_i = \theta_i - \text{bias}(\theta_i)$ is the bias corrected estimator of technical efficiency and $\text{bias}(\theta_i)$ is the bootstrap bias estimator of θ_i , z_i is a vector of environmental variables which are thought to have an impact on health facility efficiency, and β is the vector of parameters to be estimated.

Two methodological issues are addressed. First, as the efficiency scores produced by DEA are truncated (ranging from 0 to 1) and are serially correlated to one another, a bootstrap simulation on the DEA scores obtained from the first stage was performed using FEAR (Frontier Efficiency Analysis with R) version 2.0 package in R developed by Wilson [53]. The bootstrap introduced by Efron [54] is a resampling method for statistical inference and is commonly used to estimate confidence intervals and to estimate bias and variance of an estimator.

Bootstrapping is based on the idea of repeatedly simulating the data generating process through resampling, and applying the original estimator to each simulated sample so that resulting estimates mimic the sampling distribution of the original estimator [55]. Bootstrapping employs resampling with replacement (or Monte

Carlo resampling), to estimate the statistic's sampling distribution. If it can be determined, this empirical sampling distribution can be used to estimate the standard errors and confidence intervals for the DEA estimates.

The bootstrap procedure produces bias-corrected efficiency scores between, but excluding 0 and 1 and results in a lower number of facilities with high efficiency scores [56]. Second, since the regression residuals have a truncated distribution (because the DEA efficiency scores are bounded between 0 and 1); a truncated regression with a parametric bootstrap was performed. This produces robust regression coefficients and standard errors of the independent variables. The bias adjusted coefficients and the 95% bootstrap confidence interval are used to check the statistical significance of the estimated coefficients. The truncated regression model was performed in STATA version 12 and the steps of the double bootstrap procedure used follows Algorithm #2 of Simar and Wilson [20] as presented:

1. Using the original data, estimate the output oriented DEA technical θ_i s ($i = 1, \dots, n$)
2. Using maximum likelihood, obtain estimates β in the truncated regression of $0 < \theta_i = z_i \beta + \varepsilon_i \leq 1$ using $m < n$ observations, when $\theta_i > 1$
3. Loop over the next four steps (3.1-3.4) =100 times to obtain a set of bootstrap estimates $\beta = \{\theta_{ib}\}$ include
 - 3.1 For each $i = 1, \dots, n$, draw ε_i from the $N(0, \sigma^2)$ with left truncation at $(1 - z_i \beta)$
 - 3.2 Compute $\theta_i = z_i \beta + \varepsilon_i$. $i = 1, \dots, n$.
 - 3.3 Set x_i^* and $y_i^* = 1, \dots, n$.
 - 3.4 Using x_i^* and y_i^* to estimate θ_i ($i = 1, \dots, n$) using the DEA estimator
4. For each $i = 1, \dots, n$, compute the bias-corrected estimates $\hat{\theta}_i$ using the bootstrap estimates in β obtained in step 3.4 above and the original estimates θ_i

5. Estimate the truncated regression of $\hat{\theta}_i$ on z_i to obtain estimates $\hat{\beta}$ using maximum likelihood method.
6. Loop over the next three steps (6.1-6.3) $L2 = 2000$ times to obtain a set of bootstrap estimates $\gamma = \{\hat{\beta}^*\}$
 - 6.1 For each $i=1 \dots n$, draw ε_i from $N(0, \hat{\sigma}^2)$ with left truncation at $(1-z_i \hat{\beta})$.
 - 6.2 For each $i=1 \dots n$, compute $\theta_i^* = z_i \hat{\beta} + \varepsilon_i = 1 \dots n$.
 - 6.3 Estimate the truncated regression of θ_i^* on z_i yielding estimates of $\hat{\beta}^*$
7. Use the bootstrap values in γ and the original estimates $\hat{\beta}$ to construct confidence intervals for each element of β . The $(1-\alpha)$ confidence interval for β_j is constructed by finding values a_α, b_α such that
8. $\Pr[-b_{\alpha/2} \leq (\hat{\beta}^* - \hat{\beta}) \leq -a_{\alpha/2}] \approx 1 - \alpha$

Robustness check

Due to the non-parametric nature of DEA, it is not possible to test model specifications or goodness of fit as with parametric analysis. We assessed the robustness of the estimated results in two ways. First, by assessing the degree of correlation between the efficiency scores obtained from the three DEA models. Second, the second stage regressions are conducted using the efficiency estimates obtained from each of the three models.

8.2.4 Results

Technical efficiency

Table 8-3 presents the uncorrected and bias corrected mean technical efficiency scores obtained from the three DEA models. Overall, the DEA results indicate

considerable variation in efficiency scores between the different model specifications. Bias corrected mean efficiency scores range from 0.45 (standard DEA model), 0.65 (model with quality output) and 0.49 (model with quality input).

The correlation between the health facility specific efficiency scores obtained from the three DEA models are presented in Table 8-4. The correlation suggests that the results are sensitive to a degree to the model specification. Comparing models 1 and 2, we found that the mean bias corrected technical efficiency scores increases when quality is included in the DEA model as an output, rising from 0.45 to 0.65. Also comparing models 1 and 3, the mean bias corrected technical efficiency scores increase although marginally from 0.45 to 0.49 when quality is considered as an input.

Also notable is the difference between the uncorrected and bias corrected efficiency estimates. Table 8-6 and Table 8-7 in the Supplementary Appendix further present the mean uncorrected/ bias corrected efficiency scores for individual facilities and a summary of the scores by country, ownership, location and facility type across all three DEA models. Both tables indicate that the uncorrected efficiency estimates are upwardly biased illustrating the point that not correcting for bias, overestimates the efficiency scores of the health facilities.

Table 8-3: Uncorrected and bias corrected efficiency score results from the first stage DEA with bootstrap

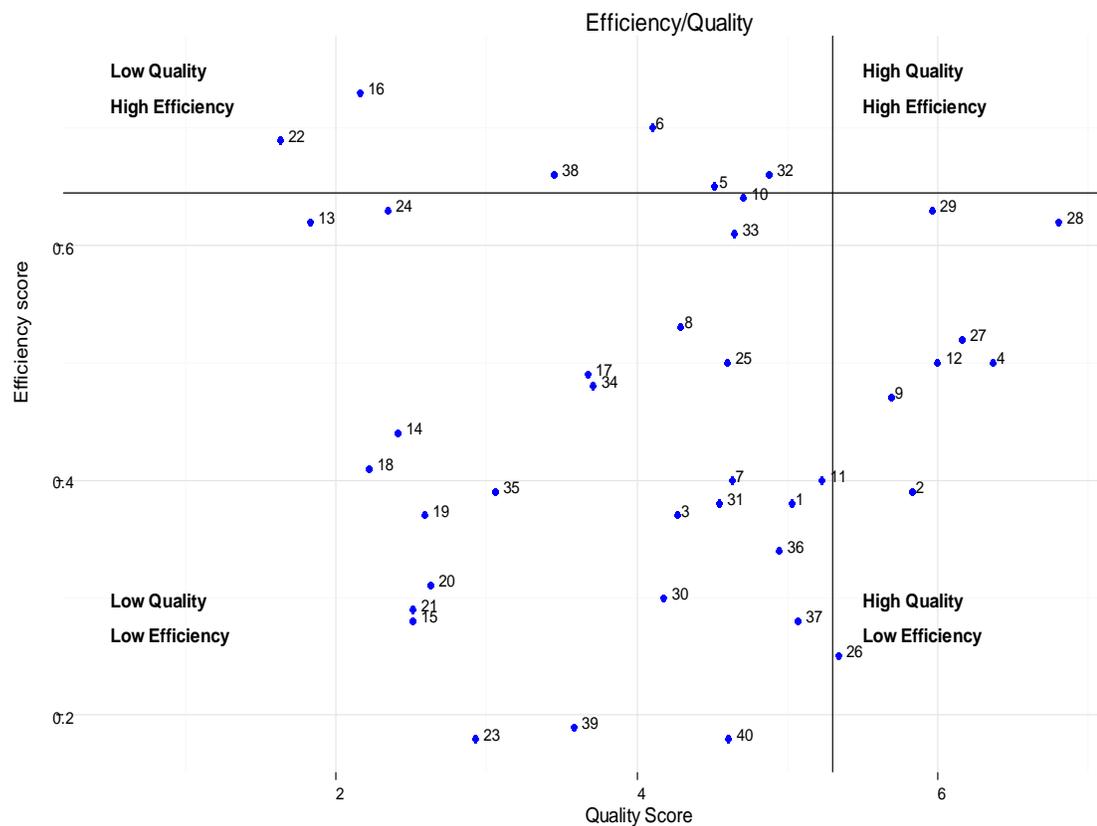
		Model 1: No quality			Model 2: Quality as an output variable			Model 3: Quality as an input variable		
		Uncorrected DEA scores	Bias corrected eff scores		Uncorrected DEA scores	Bias corrected eff scores		Uncorrected DEA scores	Bias corrected eff scores	
Year	N	Mean	Mean	SD	Mean	Mean	SD	Mean	Mean	SD
All	80	0.75	0.45	0.19	0.84	0.65	0.15	0.79	0.49	0.17
2009	40	0.68	0.42	0.19	0.79	0.62	0.16	0.74	0.46	0.19
2011	40	0.82	0.49	0.19	0.89	0.68	0.14	0.86	0.52	0.16

Table 8-4: Spearman's rank correlation test across all models

	Model 1	Model 2	Model 3
Model 1	1.0000		
Model 2	0.6597 (0.000)	1.0000	
Model 3	0.9282 (0.000)	0.5774 (0.000)	1.0000

Figure 8-1 considers quality and efficiency as separate performance dimensions and divides facilities into four different segments reflecting a definition of high quality and high efficiency. The 75th percentile quality score of 5.3 and efficiency score of 0.645 are chosen as acceptable benchmarks for quality and efficiency. Figure 8-1 shows that no facilities were identified as high quality/high efficiency (HQ/HE) facilities with quality scores above 5.3 and efficiency scores above 0.645. Although thirteen of the forty facilities were mapped in the low quality/high efficiency (LQ/HE) and high quality/low efficiency (HQ/LE) quadrants, the majority of the facilities were mapped as low quality/low efficiency. This suggests weak evidence of a trade-off between quality and efficiency among study facilities.

Figure 8-1: Efficiency and quality distribution of health facilities



Determinants of technical efficiency

The dependent variables in the second stage-truncated regressions are the bias corrected technical efficiency scores obtained using DEA models 1-3. A positive (negative) coefficient indicates a positive (negative) marginal effect on technical efficiency. Table 8-5 summarises the results of the bootstrapped truncated regressions and shows that the mean variance inflation factor is 2.81. This implies that the models do not suffer from multi-collinearity problems. Correlations between explanatory variables were also not statistically significant. Table 8-8, Table 8-9 and Table 8-10 in the Supplementary Appendix present the 95% percentile bootstrap confidence intervals of the truncated regression coefficients.

Model 1 was based on bias-corrected efficiency scores, estimated in the first stage DEA model with no quality measure considered. Models 2 and 3 are based on bias corrected efficiency scores obtained from the inclusion of quality as an output and input in the first stage DEA respectively. Overall, the results of Model 2 shows a slight improvement in the statistical significance of the estimated coefficients relative to mode 1 which does not include quality and model 3 which considers quality as an input.

Table 8-5: Results of the second stage truncated bootstrapped regressions and diagnostics

Variables	Model 1 β	Model 2 β	Model 3 β
HIVSTI FAC	-0.014	-0.008	-0.0214
HIVSTI MCH	0.083*	0.050*	0.085**
HIVSTICS	0.039	0.009	0.029
HIVSTIR	-0.096**	-0.085**	-0.078**
Functional index of integration	-0.004	0.007	0.004
Log catchment population	0.004	-0.009	0.006
Proportion of HIV services	-0.103	-0.145*	-0.119
Proportion of clinical staff	-0.413**	-0.058	-0.345**
Public	0.353**	0.161**	0.322***
Health centres and clinics	0.190**	0.124**	0.158**
Rural	-0.062	-0.164***	-0.045
Year2011	0.077*	0.069**	0.073**
Sigma	0.178***	0.135***	0.148***
Log-likelihood	25.57	46.42	35.88
Mean VIF	2.81		

Dependent variable: DEA bias-corrected efficiency scores from models 1-3.

HIVSTI FAC: Number of HIV/STI services provided in the facility; HIVSTI MCH: Number of HIV and STI services provided in the MCH; HIVSTICS: Number of HIV/STI services provided per clinical staff; HIVSTIR: Number of HIV/STI services provided per room.

***, **, * denote significance at 1%, 5% and 10% levels. Confidence intervals obtained from 1000 bootstrap interactions. Model 1 is based on DEA with no quality measures; Model 2 is based on DEA with quality as an output; and Model 3 is based on DEA with quality as an input.

When the structural aspects of integration were disaggregated, we found a positive significant coefficient for the number of additional HIV and STI services provided within the MCH and a negative significant coefficient for HIV services provided in the same room across all three models. However, no significant effect was found for the functional index of integration or the number of additional HIV/STI service within the facility and number of additional HIV services provided per clinical staff. Contrary to expectation, we found that public health facilities and health centres and clinics had significantly higher levels of technical efficiency compared to NGO facilities and hospitals. Surprisingly, we found a negative significant effect of the proportion of clinical staff on technical efficiency of health facilities.

8.2.5 Discussion

Integration of HIV and SRH services has been the source of significant policy interest over the last decade. While a number of reviews have postulated efficiency gains resulting from integration of HIV and SRH services [5, 57], little empirical evidence exists around this.

The results of the DEA indicate low estimates of technical efficiency across all model specifications suggesting a weak effect of integration on efficiency of HIV and SRH services. The mixed findings on the effects of the various measures of integration on technical efficiency also challenge the notion that integration of HIV and SRH services may substantially improve the technical efficiency of health facilities.

Although we found a positive significant effect of the number of HIV/STI services in the MCH unit on technical efficiency, no statistical significant effect was found for the functional integration measure. This result is puzzling at first glance, however a closer look reveals a complex relationship between availability of services and actual delivery of services. Recent findings by Mayhew et al [47] show that while health facilities may have the capacity to integrate services, this may not necessarily result in integrated delivery of services to clients. Indeed, it is possible that facilities may not be able to deliver integrated services due to other factors related more generally to the health system. This means that any efficiency gains to be derived from economies of scale and scope will be not be realised. Such

inhibiting factors identified across a wide range of settings may include poor facility management and supervision; staff shortages, high turnover, and inadequate staff training; inadequate infrastructure, equipment, and commodity supply; as well as client barriers to service utilization, including low literacy and acceptance of services [13].

The finding of a negative and significant effect of the number of HIV/STI services per clinical room suggests that integration of HIV/STI services in one room reduces the technical efficiency of service delivery. Although puzzling, observations at the health facilities support this finding, as where providers have multiple rooms available for service delivery, providers are better able to manage their client flow as they can provide multiple services simultaneously. For example, they can provide HIV counselling and testing in one room and then move on to another room to provide another service while the other client is waiting for their HIV results.

The significance of ownership and facility type across all models strengthens the evidence that there are certain unobserved characteristics of health facilities that impact the technical efficiency of HIV and SRH service delivery. The robustness of these findings can be attributed to their consistency across all three models. However, the interpretation that public health facilities and health centres/clinics operate at higher technical efficiency relative to their NGO and hospital counterparts should be made with caution. Both the NGO clinics and the large hospitals handle relatively more complicated cases thus providing more

sophisticated outputs (e.g. long term family planning methods, pap smears for cervical screening) an element which is not captured by the technical outputs and quality of health service measures. A recommendation to promote decentralisation of services to smaller health facilities based on technical efficiency results obtained without taking into account case mix would therefore be misleading.

The negative significant impact of the proportion of clinical staff on technical efficiency while surprising may be plausible because clinical staff are better trained and therefore spend more time with a client which lowers their technical efficiency. While this may be considered as a proxy for quality of care, it may also suggest lack of good management in allocating resources effectively across services. The negative and significant coefficient of the proportion of HIV services provided in the facility may be attributed to the fact that HIV services generally take longer to provide and are therefore associated with higher resource input lowering the technical efficiency of health facilities.

One of the main strengths of this study is that it incorporates quality measures into the analysis of technical efficiency. As stated earlier, few studies have considered quality issues when estimating efficiency, even though quality considerations are relevant to ensure that efficiency gains are not made at the expense of quality of health services. From the analysis of quality and efficiency as separate dimensions, we conclude that the empirical evidence is not sufficient to identify a clear trade-off between quality and efficiency. This implies that efficiency may well be achieved

without sacrificing quality. Nevertheless the results illustrate that analysing technical efficiency without considering quality will bias the results.

A number of limitations should be noted. First, the validity of these results may be challenged as the regression model does not account for endogeneity. Endogeneity is said to exist in an econometric model when an explanatory variable is correlated with the error term. This can arise as a result of several issues: measurement errors, omitted variables in the model specification or more commonly due to the presence of reverse causality between an independent and dependent variable. In this particular context, it is likely that there may be an issue of reverse causality between integration and efficiency and the direction of causality is not clear. In practice, it is possible that a higher degree of integration within a facility can improve efficiency but also that health facilities that are efficiently managed are better able to integrate services more readily. Endogeneity of regression predictors is a common problem in many areas of applied economics and not only specific to this analysis. One of the ways to address the issue of endogeneity in the econometric literature has been the use of instrumental variable approach. A limitation of this study is that the small panel dataset available could not provide for a valid instrument necessary to correct for the potential endogeneity of integration.

A second limitation of this study is associated with data limitations, which highlights the challenges of efficiency and quality measurement in LMIC settings. Given the lack of client classification systems according to the complexity of the HIV

and/or SRH service and resource consumption in both contexts, case mix effects were not considered in this analysis.

In relation to quality measurement, the study only considered structural, technical and interpersonal aspects of quality. Furthermore, this measure of quality did not adequately capture technology use. Future research on integrated HIV and SRH services would benefit from the incorporation of outcome measures that denote the effects of care on the health status of patients, which was difficult to obtain in this context.

8.2.6 Conclusion

This paper applied recent methodological advancements in health care efficiency analysis, and provided some important first insights not only into the technical efficiency of health facilities providing integrated HIV and SRH services but also into some of the determinants of technical efficiency. These findings highlight the fact that generally integration has not had a substantial effect on improving technical efficiency of health facilities and opportunities to improve technical efficiency still exist.

Methodologically, although this paper does not provide a definitive answer as to how quality should be incorporated into efficiency measurement studies it provides some insights into the issue. First, the results show that relying on efficiency measures without controlling for quality of care may provide the wrong results and should not be used to infer potential efficiency gains. Second, adjusting

for quality has an impact on the efficiency estimates and the magnitude depends on whether quality is considered an input or an output in the efficiency measurement model.

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References

1. Askew, I. and M. Berer, *The Contribution of Sexual and Reproductive Health Services to the Fight against HIV/AIDS: A Review*. Reproductive Health Matters, 2003. 11(22): p. 51-73.
2. Das, R., et al., *Strengthening Financial Sustainability through Integration of Voluntary Counseling and Testing Services with Other Reproductive Health Services*. 2007, Population Council: Washington DC.
3. Homan, R., et al., *Cost of introducing two different models of integrating VCT for HIV within family planning clinics in South Africa*, in *Linking Reproductive Health, Family Planning, and HIV/AIDS in Africa, 9 -10 October*. 2006: Addis Ababa.
4. Liambila, W., et al., *Feasibility, acceptability, effect and cost of integrating counseling and testing for HIV within family planning services in Kenya*. 2008, Population Council: Washington DC.
5. Church, K. and S. Mayhew, *Integration of STI and HIV prevention, care, and treatment into FP services: a review of literature*. Stud Fam Plann, 2009. 40(3): p. 171 - 186.
6. Murray, C.J.L., et al., *Development assistance for health: trends and prospects*. The Lancet, 2011. 378(9785): p. 8-10.
7. UNAIDS, *Global report: UNAIDS report on the global AIDS epidemic 2013*. 2013: Geneva: UNAIDS.
8. Lush, L., et al., *The role of MCH and family planning services in HIV/STD control: is integration the answer?* African Journal of Reproductive Health, 2001: p. 29-46.
9. Berer, M., *HIV/AIDS, sexual and reproductive health: intersections and implications for national programmes*. Health Policy and Planning, 2004. 19(suppl 1): p. i62-i70.
10. Dehne, K.L., R. Snow, and K.R. O Reilly, *Integration of prevention and care of sexually transmitted infections with family planning services: what is the evidence for public health benefits?* Bulletin of the World Health Organization, 2000. 78(5): p. 628-639.
11. Lush, L., *Service integration: an overview of policy development*. Issues in Perspective, 2002. 28(2): p. 71-76.
12. Church, K. and S.H. Mayhew, *Integration of STI and HIV Prevention, Care, and Treatment into Family Planning Services: A Review of the Literature*. Studies in Family Planning, 2009. 40(3): p. 171-186.
13. Kennedy, C.E., et al., *Linking sexual and reproductive health and HIV interventions: a systematic review*. Journal of the International AIDS Society, 2010. 13(1): p. 26.
14. Delvaux, T. and C. Nöstlinger, *Reproductive choice for women and men living with HIV: contraception, abortion and fertility*. Reproductive health matters, 2007. 15(29): p. 46-66.
15. Myer, L., K. Rebe, and C. Morroni, *Missed opportunities to address reproductive health care needs among HIV-infected women in antiretroviral therapy programmes*. Tropical Medicine & International Health, 2007. 12(12): p. 1484-1489.

16. Dudley, L. and P. Garner, *Strategies for integrating primary health services in low-and middle-income countries at the point of delivery*. Cochrane Database Systematic Reviews, 2011. 7.
17. Ickovics, J., "Bundling" HIV prevention: Integrating services to promote synergistic gain. Multiple Health Behavior Change (MHBC) Research, 2008. 46(3): p. 222-225.
18. Hollingsworth, B., *Efficiency measurement in health and healthcare / Bruce Hollingsworth and Stuart J. Peacock*. Routledge International studies in health economics, ed. S. Peacock. 2008, London: Routledge.
19. Arocena, P. and A. García-Prado, *Accounting for quality in the measurement of hospital performance: evidence from Costa Rica*. Health Economics, 2007. 16(7): p. 667-685.
20. Simar, L. and P.W. Wilson, *Estimation and inference in two-stage, semi-parametric models of production processes*. Journal of Econometrics, 2007. 136(1): p. 31-64.
21. Marschall, P. and S. Flessa, *Efficiency of primary care in rural Burkina Faso. A two-stage DEA analysis*. Health Economics Review, 2011. 1(1): p. 5.
22. Chaabouni, S. and C. Abednnadher, *Efficiency of public hospitals in Tunisia: a DEA with bootstrap application*. International Journal of Behavioural and Healthcare Research, 2012. 3(3/4): p. 198-211.
23. Sexton, T.R., R.H. Silkman, and A.J. Hogan, *Data envelopment analysis: Critique and extensions*. New Directions for Program Evaluation, 1986. 1986(32): p. 73-105.
24. Smith, P., *Model misspecification in data envelopment analysis*. Annals of Operations Research, 1997. 73: p. 233-252.
25. Sherman, H.D. and J. Zhu, *Benchmarking with quality-adjusted DEA (Q-DEA) to seek lower-cost high-quality service: Evidence from a U.S.bank application*. Annals of Operations Research, 2006. 145(1): p. 301-319.
26. Charnes, A., W.W. Cooper, and E. Rhodes, *Measuring the efficiency of decision making units*. European Journal of Operational Research, 1978. 2(6): p. 429-444.
27. Banker, R.D., A. Charnes, and W.W. Cooper, *Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis*. Management Science, 1984. 30(9): p. 1078-1092.
28. McFadden, D., *Cost, revenue and profit functions*, in *Production economics: A dual approach to theory and applications*, M. Fuss and D. McFadden, Editors. 1978, North-Holland Publishing Company Amsterdam.
29. Charnes, A., et al., *Data Envelopment Analysis: Theory*. 1994.
30. Nyman, J.A., D.L. Bricker, and D. Link, *Technical efficiency in nursing homes*. Medical care, 1990. 28(6): p. 541.
31. Salinas-Jiménez, J. and P. Smith, *Data envelopment analysis applied to quality in primary health care*. Annals of Operations Research, 1996. 67(1): p. 141-161.
32. García, F., et al., *Evaluation of Efficiency in Primary Health Care Centres: An Application of Data Envelopment Analysis*. Financial Accountability & Management, 1999. 15(1): p. 67-83.
33. Wagner, J.M., D.G. Shimshak, and M.A. Novak, *Advances in physician profiling: the use of DEA*. Socio-Economic Planning Sciences, 2003. 37(2): p. 141-163.

34. Rosenman, R. and D. Friesner, *Scope and scale inefficiencies in physician practices*. Health Economics, 2004. 13(11): p. 1091-1116.
35. Nedelea, I. and J. Fannin, *Technical efficiency of Critical Access Hospitals: an application of the two-stage approach with double bootstrap*. Health Care Management Science, 2013. 16(1): p. 27-36.
36. Cordero Ferrera, J., E. Cebada, and L. Murillo Zamorano, *The effect of quality and socio-demographic variables on efficiency measures in primary health care*. The European Journal of Health Economics, 2013: p. 1-14.
37. Charnes, A., W. Cooper, and E. Rhodes, *Measuring the efficiency of decision making units*. Eur J Oper Res, 1978. 2: p. 429 - 444.
38. Cooper, W., L. Seiford, and K. Tone, *Data Envelopment Analysis: A Comprehensive Text With Models, Applications, References and Dea-solver Software*. 2006: Springer-Verlag.
39. Jacobs, R., P.C. Smith, and A. Street, *Measuring Efficiency in Health Care: Analytic Techniques and Health Policy*. Cambridge and New York: Cambridge University Press. p xvii, 2006. 243.
40. Dyson, R.G., et al., *Pitfalls and protocols in DEA*. European Journal of Operational Research, 2001. 132(2): p. 245-259.
41. Allen, R., et al., *Weights restrictions and value judgements in data envelopment analysis: evolution, development and future directions*. Annals of Operations Research, 1997. 73: p. 13-34.
42. Warren, C., et al., *Study protocol for the Integra Initiative to assess the benefits and costs of integrating sexual and reproductive health and HIV services in Kenya and Swaziland*. BMC Public Health, 2012. 12(1): p. 973.
43. Jacobs, R., P.C. Smith, and A. Street, *Measuring Efficiency in Health Care: Analytic Techniques and Health Policy*. 2006: Cambridge University Press.
44. Donabedian, A., *The quality of care: How can it be assessed?* JAMA, 1988. 260(12): p. 1743-1748.
45. Jobson, J.D., *Principal Components, Factors and Correspondence Analysis*, in *Applied Multivariate Data Analysis*. 1992, Springer New York. p. 345-482.
46. Church, K., et al., *Integrating Sexual Health Services Into Primary Care: An Overview of Health Systems Issues and Challenges in Developing Countries*. International Journal of Sexual Health, 2010. 22(3): p. 131-143.
47. Mayhew, S., et al., *Innovation in the evaluation of service Integration: the Integra Indexes of HIV and Reproductive Health Integration*. Under review, 2014.
48. Tiemann, O., J. Schreyögg, and R. Busse, *Hospital ownership and efficiency: A review of studies with particular focus on Germany*. Health Policy, 2012. 104(2): p. 163-171.
49. Rosko, M.D., et al., *The effects of ownership, operating environment, and strategic choices on nursing efficiency*. Medical Care, 1995. 33(10): p. 1001-1021.
50. Rosko, M., *Impact of internal and external environmental pressures on hospital inefficiency*. Health Care Management Science, 1999. 2(2): p. 63-74.
51. Burgess, J.F., Jr. and P.W. Wilson, *Hospital Ownership and Technical Inefficiency*. Management Science, 1996. 42(1): p. 110-123.
52. Herr, A., *Cost and technical efficiency of German hospitals: does ownership matter?* Health Economics, 2008. 17(9): p. 1057-1071.
53. Wilson, P., *FEAR: Frontier Efficiency Analysis with R*. Vol. 1. 2006: R package version.

54. Efron, B., *Bootstrap methods: another look at the jackknife*. The annals of Statistics, 1979: p. 1-26.
55. Simar, L. and P.W. Wilson, *Sensitivity Analysis of Efficiency Scores: How to Bootstrap in Nonparametric Frontier Models*. Management Science, 1998. 44(1): p. 49-61.
56. Mukherjee, K., R. Santerre, and N.J. Zhang, *Explaining the efficiency of local health departments in the U.S.: an exploratory analysis*. Health Care Management Science, 2010. 13(4): p. 378-387.
57. Sweeney, S., et al., *Costs and efficiency of integrating HIV/AIDS services with other health services: a systematic review of evidence and experience*. Sexually Transmitted Infections, 2011.
58. Ferrier, G. and J. Trivitt, *Incorporating quality into the measurement of hospital efficiency: a double DEA approach*. Journal of Productivity Analysis, 2013. 40(3): p. 337-355.

Table 8-6: Mean efficiency score estimates

Facility ID	Model 1		Model 2		Model 3	
	Mean original score	Mean bias corrected score	Mean original score	Mean bias corrected score	Mean original score	Mean bias corrected score
HF1	0.78	0.38	0.78	0.56	0.81	0.42
HF2	0.79	0.38	0.84	0.61	0.80	0.45
HF3	1.00	0.37	1.00	0.66	1.00	0.47
HF4	0.60	0.49	0.77	0.69	0.66	0.49
HF5	1.00	0.64	1.00	0.73	1.00	0.67
HF6	0.84	0.70	0.85	0.74	0.88	0.72
HF7	0.52	0.40	0.61	0.48	0.91	0.50
HF8	0.97	0.52	0.98	0.73	0.97	0.59
HF9	0.58	0.47	0.74	0.66	0.65	0.53
HF10	0.92	0.64	0.92	0.73	0.93	0.63
HF11	1.00	0.40	1.00	0.65	1.00	0.47
HF12	1.00	0.50	1.00	0.69	1.00	0.55
HF13	1.00	0.62	1.00	0.74	1.00	0.63
HF14	0.82	0.43	0.82	0.62	1.00	0.45
HF15	0.71	0.28	0.71	0.47	0.81	0.42
HF16	0.88	0.73	0.91	0.80	0.91	0.76
HF17	0.60	0.48	0.75	0.66	0.67	0.55
HF18	0.94	0.41	0.94	0.69	1.00	0.55
HF19	0.67	0.37	0.81	0.60	0.67	0.40
HF20	0.76	0.30	0.81	0.56	0.76	0.39
HF21	0.38	0.29	0.84	0.75	0.38	0.31
HF22	0.96	0.69	0.96	0.78	1.00	0.60
HF23	0.22	0.18	0.37	0.32	0.60	0.24
HF24	1.00	0.63	1.00	0.75	1.00	0.59
HF25	0.62	0.50	0.81	0.71	0.81	0.42
HF26	0.58	0.25	0.69	0.49	0.59	0.28
HF27	0.67	0.52	0.75	0.66	0.70	0.48
HF28	0.90	0.62	0.99	0.79	0.90	0.64
HF29	1.00	0.63	1.00	0.76	1.00	0.66
HF30	0.67	0.30	0.91	0.69	0.67	0.32
HF31	0.47	0.38	0.51	0.45	0.48	0.38
HF32	0.82	0.66	0.99	0.84	0.82	0.67
HF33	0.96	0.60	1.00	0.77	0.96	0.65
HF34	0.57	0.48	0.66	0.60	0.58	0.48
HF35	0.49	0.39	0.97	0.82	0.49	0.40
HF36	0.63	0.34	0.70	0.51	0.66	0.38
HF37	1.00	0.28	1.00	0.61	1.00	0.39
HF38	0.80	0.66	0.88	0.78	0.90	0.67
HF39	0.24	0.19	0.38	0.34	0.38	0.30
HF40	0.62	0.18	0.96	0.71	0.62	0.26
Mean Eff	0.75	0.46	0.84	0.66	0.80	0.49

Table 8-7: Estimation results from the first stage DEA by facility characteristics

	N	Model 1			Model 2			Model 3		
		Original DEA scores Mean	Bias corrected efficiency scores Mean	SD	Original DEA scores Mean	Bias corrected efficiency scores Mean	SD	Original DEA scores Mean	Bias corrected efficiency scores Mean	SD
All	80	0.75	0.45	0.19	0.84	0.65	0.15	0.79	0.49	0.17
Country										
Kenya	60	0.78	0.47	0.19	0.85	0.66	0.14	0.84	0.50	0.18
Swaziland	20	0.66	0.41	0.19	0.81	0.64	0.18	0.69	0.46	0.17
Ownership										
NGO	16	0.66	0.40	0.20	0.81	0.64	0.19	0.71	0.42	0.18
Public	64	0.77	0.47	0.19	0.85	0.66	0.14	0.82	0.51	0.17
Location										
Urban	34	0.68	0.43	0.20	0.85	0.68	0.15	0.72	0.46	0.19
Rural	46	0.79	0.47	0.19	0.83	0.64	0.16	0.86	0.51	0.16
Facility type										
Hospital	26	0.69	0.41	0.19	0.79	0.62	0.15	0.77	0.46	0.18
Health centres	54	0.78	0.48	0.19	0.86	0.67	0.15	0.81	0.51	0.17

Table 8-8: Bootstrapped truncated regression: Model 1 (No quality measures)

Variables	Est. Coeff (Std error)	95% bootstrapped confidence intervals	
HIVSTIFAC	-0.013 (0.027)	-0.0141	0.0125
HIVSTIMCH	0.083* (0.040)	-0.0141	0.0284
HIVSTICS	0.0392(0.037)	-0.0169	0.0214
HIVSTIR	-0.095**(0.046)	-0.0272	-0.0161
Structural integration score	0.062(0.042)	-0.0166	0.0247
Function integration score	-0.004(0.024)	-0.0122	0.0128
Log catchment population	0.003(0.0216)	-0.0112	0.0109
Proportion of HIV services	-0.104(0.119)	-0.0674	0.0558
Proportion of clinical staff	-0.413**(0.171)	-0.1101	0.0577
Public	0.352**(0.111)	0.1340	0.5719
Health centres/clinics	0.190**(0.063)	0.0652	0.3152
Rural	-0.062(0.067)	-0.1943	0.0694
Year2011	0.077(0.042)	-0.0056	0.1606
Sigma	0.178***(0.016)	0.1478	0.2091

Table 8-9: Bootstrapped truncated regression: Model 2 (Quality as an output variable)

Variables	Est. Coeff (Std error)	95% bootstrapped confidence intervals	
HIVSTIFAC	-0.008 (0.020)	0.0131	0.0112
HIVSTIMCH	0.050* (0.029)	-0.0110	0.0280
HIVSTICS	0.00945(0.0275)	-0.0210	0.0156
HIVSTIR	-0.085**(0.0336)	-0.0251	0.0116
Structural integration score	0.009(0.309)	-0.0185	0.0156
Function integration score	0.007(0.0179)	-0.0097	0.0115
Log catchment population	-0.096**(0.016)	-0.0102	0.0081
Proportion of HIV services	-0.145*(0.087)	-0.0644	0.0416
Proportion of clinical staff	-0.058(0.1248)	-0.0691	0.0757
Public	0.161(0.0810)	-0.0019	0.3195
Health centres/clinics	0.123**(0.0460)	0.0337	0.2142
Rural	-0.164***(0.0494)	-0.2615	-0.0675
Year2011	-0.069**(0.0312)	0.0085	0.1308
Sigma	0.135***(0.0107)	0.1144	0.1564

Table 8-10: Bootstrapped truncated regression: Model 3 (Quality as an input variable)

Variables	Est. Coeff (Std error)	95% bootstrapped confidence intervals	
HIVSTIFAC	-0.0214(0.0236)	-0.0130	0.0103
HIVSTIMCH	0.085**(0.0343)	-0.009	0.0243
HIVSTICS	0.029(0.318)	-0.0151	0.0169
HIVSTIR	-0.078**(0.038)	-0.022	0.0126
Structural integration score	0.054(0.0360)	-0.0140	0.0208
Function integration score	0.004(0.0209)	-0.0099	0.0108
Log catchment population	-0.0055(0.0185)	-0.0093	0.0094
Proportion of HIV services	-0.119(0.1018)	-0.0588	0.0447
Proportion of clinical staff	-0.345**(0.1387)	-0.0906	0.0483
Public	0.322***(0.0947)	0.1368	0.5082
Health centres/clinics	0.158**(0.0537)	0.0529	0.2638
Rural	-0.045(0.0575)	-0.1583	0.6711
Year2011	0.073**(0.0362)	0.0021	0.1444
Sigma	0.156***(0.0128)	0.1310	0.1813

Chapter 9 Determinants of costs of integrated HIV and SRH services

9.1 Introduction

Chapter 8 presented the analysis of technical efficiency of integrated HIV and SRH services as a starting point to evaluating the potential efficiency gains from integrating HIV and SRH services. Building on this analysis, this chapter employs an econometric model of costs to provide a better understanding of the determinants of costs of integrated HIV and SRH services and evaluate the existence of economies of scale and scope hypothesized in chapters 6 and 7.

While chapter 8 considered the technical relationship between inputs and outputs, this chapter incorporates input prices to evaluate the ability of health facilities to produce maximum output at minimal cost.

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The candidate conceived the research question, developed the methodological framework and performed the analysis of primary cost data to examine the economies of scale and scope. The candidate prepared the manuscript and made subsequent revisions. Anna Vassall and Lorna Guinness assisted in the interpretation of the results and discussion of the findings.

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CANDIDATE'S SIGNATURE  **Date:** January 05, 2015

SUPERVISOR/SENIOR AUTHOR'S SIGNATURE (3 above) 

9.2 Research Paper 4

Economies of scale and scope: A cost function for integrated HIV and SRH services

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Abstract

Using panel data methodology this paper employs a multiproduct hospital cost function to estimate the economies of scale and scope in a sample of health facilities providing integrated HIV and SRH services in Kenya and Swaziland. We found negative significant impacts of the range of HIV and SRH services provided within the same room and provided by the same provider on the total costs of HIV and SRH services. Other significant determinants of costs were the number of client visits per clinical staff full time equivalent per day, facility type and location. We found evidence of output specific economies of scale for HIV counselling and testing and HIV treatment and care services and some evidence of economies of scope for some service combinations. However, we did not find evidence of ray economies of scale. We conclude that the integration of HIV and SRH services may achieve both economies of scope and scale; however the achievement of economies of scope depends on the service combinations.

9.2.1 Introduction

Since the global economic crisis, the ability of developed countries to meet their commitments to fund health programs in developing countries has been questioned. As such, increasing attention has been placed on identifying potential ways to improve efficiency of health care delivery in low and middle-income countries (Murray et al., 2011). In high HIV prevalence settings, emphasis has been placed on integration of HIV and sexual reproductive health (SRH) services as a means to achieve efficiency gains in health service provision. In this context, integration is defined as offering two or more HIV and SRH services at the same facility during the same visit.

The literature on the benefits of integrating HIV and SRH services has hypothesised potential efficiency gains through HIV/SRH integration (Askew and Berer, 2003, Das et al., 2007, Liambila et al., 2008, Homan et al., 2006, Church and Mayhew, 2009, Spaulding et al., 2009). Indeed, the notion that efficiencies may be gained through integration of health services has considerable intuitive appeal. One would expect that economies of scale may occur when there are large fixed costs associated with the delivery of a particular service. Economies of scale would therefore occur when unit costs of services decrease due to the increased utilisation of specialised labour and capital and spreading fixed costs over large volumes of output. HIV/SRH integration may create these economies of scale where the demand for HIV services increases, as a result of new SRH clients being offered HIV services.

Economies of scope on the other hand reflect cost savings from producing several outputs simultaneously rather than each separately. These savings can result from: i) reducing excess capacity by producing a broader output mix therefore lowering fixed costs and; ii) 'cost complementarity' across outputs, defined as the property of a cost function in which increasing one output reduces the marginal cost of all other outputs. Within the HIV/SRH context, HIV and SRH services often require the same type and level of inputs, particularly staff and equipment, when provided jointly as each would if provided separately. Excess staff and equipment capacity can be reduced as more services are provided, lowering the cost of each service compared to delivery of fewer output. Cost complementarities may arise where instead of taking patient details twice (once for family planning and then for HIV services), both can be condensed into one patient interview.

Despite the economic theory rationale for integration in this context, there is scarce evidence on how integration impacts provider costs when integration is carried out at scale (Sweeney et al., 2011). Evidence of economies of scope is especially central to the continuing debate over the possible advantages of integrating HIV and SRH services. Therefore, the direction of policy towards comprehensive service delivery and integration depends heavily on the nature and existence of scope economies in this context. If economies of scope actually exist in the provision of HIV and SRH services, then a valid policy argument can be made for integration in order to gain the benefits of these economies.

The purpose of this paper is to present evidence on scale and scope economies for the multi-output health facility in the context of HIV and SRH service

delivery. Using panel data methodology the paper employs a multiproduct hospital cost function to estimate the economies of scale and scope in a sample of 40 health facilities providing integrated HIV and SRH services in Kenya and Swaziland. Theoretically, a cost function describes the minimum cost of providing a given volume of output as a function of exogenous input prices (Carey et al., 2014). However, following recent developments in health economics literature (Grannemann et al., 1986, Vita, 1990, Vitaliano, 1987) that recognise that health facility production costs are influenced by numerous factors in addition to input prices and outputs, a hybrid cost function is used. The hybrid cost function introduced by Grannemann et al (Grannemann et al., 1986) combines input prices, output volumes and institutional variables to control for variation in cost due to factors such as facility ownership status, geographic location, and output mix. While hybrid functional forms have been used to evaluate the costs of delivering HIV services (Guinness et al., 2007, Gilman and Green, 2008), this study presents the first attempt to evaluate the determinants of the costs of integrated HIV and SRH services.

9.2.2 Methods

Cost function specification

Economists have largely used the multi-output cost function to analyse the behaviour of a firm. For empirical estimation of the cost function, an appropriate functional form must be chosen. An appropriate functional form representing a cost function must be non-negative, linearly homogenous, concave and non-decreasing in factor prices (Varian, 1984). The most

commonly used functional forms in the general empirical literature are the transcendental logarithm (translog) and quadratic functions. While the translog function introduced by Christensen et al (Christensen et al., 1973) has been applied widely, it has an important drawback in that the cost function is undefined for a zero output level making it unsuitable for measurement of economies of scope.

A number of solutions have been proposed to the problem of zero output values. These include estimating the costs with an arbitrarily small level of output e.g. 0.01 (Akridge and Hertel, 1986, Gilligan et al., 1984, Cowing and Holtmann, 1983) replacing the zero values with the minimum value of each output within the sample under consideration or with a value equal to ten per cent of output at the sample means (Kim, 1987) or using the Box-Cox transformation on output variables (Caves et al., 1980, Escarce and Pauly, 1998). However, both approaches introduce an unknown bias to the estimates (Triebes et al., 2012, Manning, 1998). To avoid these issues, the quadratic functional form, first proposed by Lau (Lau, 1974), which readily accommodates zero output and therefore better suited for measuring economies of scope is used in this paper.

Assuming that the health facilities cannot adjust capital stock over a short period of time in response to demand or changing input prices (Vita, 1990), a short run multiple output cost function with seven HIV and SRH outputs, measures of input prices and various measures of the characteristics of the health facility was estimated using the following functional form:

$$TC_{it} = \alpha_0 + \sum_{i=1}^m \alpha_1 y_{it} + \sum_{i=1}^n \beta_1 w_{it} + \frac{1}{2} \sum_i^m \sum_n^m \beta_2 y_{it}^m y_{it}^n + \mu_i + e_{it} \quad (9.1)$$

where the dependent variable TC_{it} is the total costs for HIV and SRH services in 2012 US dollars, $Y = (y_{it})$ is the output vector; and w_i is the factor price. The superscript m denotes the number of outputs (1,... n) and subscripts I and j denote the health facility and the year. The terms u_i and ε_{it} represent respectively the firm-specific individual effects and the random error term; α_0 is the constant and the α_i , β_1 and β_2 are the parameters to be estimated.

Estimation of cost function

The term ε_{it} is considered either a constant parameter using the fixed effects (FE) approach or independent and identically distributed (i.i.d) random component in random effects (RE) model. While both models have the advantage of allowing time variant inefficiency while controlling for firm level unobserved heterogeneity. However, a problem arises when the firm specific effects are correlated with the explanatory variables. In such a case, the RE estimators are affected by heterogeneity bias (Chamberlain, 1982) and the fixed effects model although consistent will overestimate efficiency variations. The GLS estimator, which provides an alternative specification to the RE is therefore estimated. Drawn from Mundlak's (Mundlak, 1978) formulation of a 'within' estimator in the random effects framework, when applied to the conventional random-effects model, the resulting GLS estimator is identical to the FE estimator (Farsi, 2009). The GLS estimator is therefore unbiased and allows for adjustment of estimates for correlation with exogenous variables.

Measurement of economies of scale and scope

Two distinct concepts of economies of scale arise in a multiproduct setting: product specific scale economies and ray (overall) economies of scale. Product specific economies of scale (EOS₁) in output Y₁ defined as declining average incremental costs, are given by:

$$EOS_1 = \frac{[C(Y_1, Y_2) - C(0, Y_2)]}{[Y_1 \left(\frac{\delta C}{\delta Y_1} \right)]} \quad (9.2)$$

Ray economies of scale (RES) or increasing returns to scale imply declining average costs for varying quantities of a set of multiple outputs combined in fixed proportions. Following Baumol, Panzar and Willig (Baumol et al., 1982), the degree of overall scale economies for the multi-product firm is obtained as the inverse of the sum of the cost elasticities of single products and is defined as:

$$RES = \frac{1 - \frac{\partial \ln C}{\partial \ln (k^*)}}{\sum_i^n \eta_i} \quad (9.3)$$

Where η_i is the cost elasticity of output i and is given by β_i which is the output parameter from the estimated cost function (Equation 1). Ray economies of scale are said to exist if $RES > 1$ and ray diseconomies of scale are said to exist if $RES < 1$. An increase of all outputs in an average health facility by 1% would increase costs by $1/RES\%$ (Gonçalves and Barros, 2011).

Economies of scope can be computed in a number of ways. A traditional measure of the degree of economies of scope is defined as the proportion of the cost of joint production that is saved by joint production. Therefore economies of scope are given by:

$$\text{SCOPE} = \frac{C(Y1,0) + C(0,Y2) - (Y1 - Y2)}{C(Y1,Y2)} \quad (9.4)$$

Vita (Vita, 1990) suggests another technique to measure economies of scope using weak cost complementarities (WCC) as a sufficient condition for economies of scope when there are zero values for some output types (Sinay and Campbell, 1995). In practice, the presence of WCC implies that the marginal cost of producing any one output decreases with increases in the quantities of all other outputs. This occurs if the expression

$$C_{ij} = \delta^2 C / \delta Y_i \delta Y_j \quad \text{is negative and } i \neq j \quad (9.5)$$

9.2.3 Data and variable description

This paper utilizes a balanced panel dataset of integrated HIV and SRH service delivery costs collected from 40 health facilities over a two year period as part of a large non-randomised trial (Integra Initiative - ClinicalTrials.gov identifier: NCT01694862) conducted in Kenya and Swaziland (Warren et al., 2012). The sample includes 30 health facilities in Kenya and 10 in Swaziland of which 80% are public health facilities; 43% are located in urban areas and 26% are classified as hospitals with inpatient facilities.

Data were collected for the entire facility in the health centres, public health units and SRH clinics; while in the hospitals, data were collected for the MCH-FP/HIV departments only. Costs were classified into two main categories: capital and recurrent costs. Capital costs included buildings, equipment and training costs. All capital costs were annualised and discounted at the standard rate of 3% (Drummond et al., 2005). Recurrent costs included staff salaries,

building maintenance (including utility expenses), drugs, medical and non-medical supplies, transport and diagnostics.

To obtain estimates of total economic costs of HIV/SRH services at each health facility, all costs of overhead/administrative and support departments (laboratory/ pharmacy) were allocated to the MCH/FP and HIV departments using the top down costing approach (Conteh and Walker, 2004).

Outputs were measured as number of visits for family planning (FP), post natal care (PNC), cervical cancer (Ca Cx) screening, counselling and testing for HIV (HCT), treatment of sexually transmitted infections (STI), HIV treatment and care and other maternal and child health (MCH) services. Data on the total number of visits were collected from registers and monthly reports.

Data on explanatory variables were either measured at each facility or obtained from secondary sources. These data allowed us to calculate the variables used in the cost function estimation. We included prices of labour inputs based on average wages for clinical and technical staff at each health facility. Information on staff wages were obtained from the Ministries of Health for the public health facilities and the NGO headquarters for the NGO facilities. Although wages for the public health facilities were set uniformly within each employee category, health facilities exhibited heterogeneous staff mixes and therefore average wages varied across facilities. Prices of capital stock and equipment were not included as these were valued using standard national agency prices and therefore did not vary across health facilities studied.

The total square footage available for HIV and SRH services was used as a proxy for the fixed level of capital in the short run cost formulation. We adjusted for quality of the labour input by incorporating a measure of the proportion of clinical staff to total staff. To control for service mix differences we incorporated a measure of the proportion of HIV services to total HIV/SRH services provided within the health facility. As a simple measure of economies of scale, we considered the number of visits per clinical staff in full time equivalents (FTEs) referred to as staff intensity.

The health facilities included in the study were characterised by different extents of HIV and SRH service integration. Therefore, to control for differences in extent of integration, a number of measures of the extent of integration were developed using data collected from three main sources: health facility registers, client flow analysis and health facility assessment. First, four individual measures of integration were used: range of HIV services provided within the facility; range of HIV services provided within the MCH unit; range of HIV services provided per clinical room and the range of HIV services provided per clinical staff.

Secondly, an index of functional integration describing service availability and utilisation patterns was also used. The functional integration index was developed using latent variable techniques with data obtained from the client flow analysis (Warren et al., 2012). The data focused on whether HIV treatment was being offered on site (or referred for); the range of services provided across days of the week; the range of services provided in a single consultation; and the range of services provided in single visits. Further details on the creation of the

functional index of integration are provided in Mayhew et al (Mayhew et al., 2014).

Finally, dummy variables were also included to control for unobserved health facility characteristics such as country, ownership (Public or NGO), location (rural or urban) and facility type (hospital or other). Table 9-1 presents the descriptive statistics for these variables.

Table 9-1: Descriptive statistics of variables used in the empirical study

Category	Variable	Variable Description	Obs	Mean	SD	(Min/Max)
Dependent variable	Total Cost (C _i)	Total annual HIV and SRH costs (US\$ 2011)	80	486,975.5	742,173.9	\$38,545.83 - \$4,777,045
Cost per visit US\$2011	FP	Unit cost per FP visit	80	\$7.86	5.44	\$1.54 - \$26.99
	PNC	Unit cost per PNC visit	63	\$8.02	8.51	\$0.19 - \$33.19
	Ca Cx	Unit cost per Ca Cx visit	49	\$9.86	10.63	\$1.08 - \$42.89
	HCT	Unit cost per HCT visit	80	\$9.13	8.17	\$0.05 - \$49.78
	STI	Unit cost per STI visit	54	\$17.40	\$22.44	\$0.76 - \$140.50
	HIV	Unit cost per HIV visit	54	\$45.35	63.46	\$0.02 - \$405.15
Outputs	FP	Total family planning visits	80	3,910	3628.60	471 - 22,194
	PNC	Total post natal care visits	63	692	873.51	4 - 3,331
	Ca Cx	Total cervical cancer screening visits	49	332	372.03	13 - 2,163
	HCT visits	Total HIV counselling & testing visits	67	2702	2922.69	18 - 15,878
	STI visits	Total STI treatment visits	54	434	797	3 - 3,712
	HIV visits	Total HIV treatment visits	54	5,551	11,679	46 - 71,615
	Other MCH	Total Other MCH visits	80	5274	5757	79 - 29,843
Input prices	CLNWAGES	Average annual wage of clinical staff	80	\$9,824.34	\$6,850.78	\$1,427 - \$37,552.96
	TECHWAGES	Average annual wage of tech & admin staff	80	\$3,473.73	\$2,696.36	\$228.44 - \$11,102.34
Integration measures	HIV/STIFAC	HIV/STI services provided in the facility	80	6.64	1.09	0 - 8
	HIV/STIMCH	HIV/STI services provided in the MCH unit	80	2.44	1.14	0 - 4
	HIV/STICS	HIV/STI service provided per clinical staff	80	1.81	0.97	0 - 4
	HIV/STIR	HIV/STI services provided per room	80	1.36	0.92	0 - 4
	FUINT	Functional integration index score	80	0.03	0.96	-1.26 - 3.59
Facility characteristics	FLSPACE	Total Sq. m available for HIV and SRH services	80	92.70	86.50	10.90-394.58
	Staffint	Total client visits per staff per day	80	14	10.85	2 - 57
	% Clinical	Proportion of clinical staff	80	0.48	0.15	0.17 - 0.94
Ownership	NGO	NGO affiliated SRH clinics	16	0.20	-	
	Public	Government health facilities	64	0.80	-	
Location	Urban	Urban facilities	34	0.43	-	
	Rural	Rural facilities	46	0.58	-	
Facility type	Hospital	Provincial, district and sub district hospitals	26	0.32	-	
	Other	Public health units and SRH clinics	54	0.68	-	

9.2.4 Results

4.1 Bivariate analysis

As a first step, we conducted bivariate subgroup comparisons to test for statistical differences in the mean cost per visit for each service type to identify possible predictors of costs. A number of facility level and environmental determinants of costs including facility ownership; facility type; geographic location and the extent of integration were examined in the analysis.

The results of the bivariate subgroup analysis are presented in Table 9-2. The results revealed significantly higher unit cost per visit in Swaziland compared to Kenya for FP ($P < 0.001$), PNC ($p < 0.001$), HCT ($p < 0.001$), STI treatment ($p < 0.05$) and HIV treatment ($p < 0.05$) services. As expected, we found that unit costs per visit for cervical cancer screening ($p < 0.05$), HCT ($P < 0.05$) and STI treatment ($p < 0.05$) are significantly lower in rural areas compared to urban areas.

Further, unit costs per visit for family planning, cervical cancer screening and postnatal care services were significantly higher in the NGO facilities compared to the public health facilities. We also found that the unit costs per visit for family planning services were significantly higher in other health facilities compared to the hospitals. However, we found no statistically significant association between the unit costs of all the other services and the facility type.

Table 9-2: Bivariate analysis of association between unit cost per visit (US\$ 2011) and health facility characteristics

Facility Characteristics	Unit cost per visit (US\$2011)					
	FP (Obs=80)	PNC (Obs=63)	Ca Cx (Obs = 49)	HCT (Obs=67)	STI (Obs=54)	HIV (Obs=54)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Country	***	***	NS	***	**	***
Kenya (N=60)	6.20(4.11)	33.93(4.97)	4.95(7.39)	5.92(4.72)	9.68(14.95)	18.90(9.37)
Swaziland (N=20)	11.69(6.84)	12.23(8.87)	8.48(13.66)	12.68(6.91)	16.10(29.71)	45.58(16.97)
Ownership	**	*	***	NS	NS	NS
Private (N=16)	11.36(6.89)	9.52(9.09)	14.15(12.67)	8.59(5.67)	16.83(9.77)	26.24(16.32)
Public (N=64)	6.99(4.69)	5.51(7.88)	4.02(7.51)	7.48(6.36)	10.24(21.92)	25.51(40.59)
Location	NS	NS	***	*	**	NS
Urban (N=34)	9.00(5.69)	7.74(9.03)	9.57(11.28)	9.23(6.53)	17.22(25.37)	26.05(28.11)
Rural (N=46)	7.03(5.17)	5.26(7.52)	3.43(7.20)	6.58(5.77)	7.37(14.23)	25.37(42.61)
Facility type	**	NS	NS	NS	NS	NS
Hospital (N=26)	5.90(3.09)	4.45(7.34)	4.37(7.05)	8.37(6.54)	12.58(19.30)	19.79(28.46)
Other (N=54)	8.80(6.08)	7.21(8.55)	6.85(10.57)	7.38(6.08)	11.06(20.78)	28.48(40.33)

NS - No significant differences between groups. Level of significance of difference between groups *** p<0.01, ** p<0.05, * p<0.10

Table 9-3 presents the results of the correlation analysis between the measures of integration and the unit cost per visit for each of the six services. We found a significant negative correlation between the range of services provided per clinical staff and the unit costs for PNC and HIV visits ($p < 0.05$). However, we found that the range of HIV and non-core SRH services available in the facility was significantly positively correlated with the unit costs for all services except HCT and HIV treatment. Statistically significant positive correlations were also found between the range of HIV services in the MCH unit and the unit costs for family planning, cervical cancer screening and STI treatment ($p < 0.05$). We also found statistically significant positive correlations between the functional integration index and the unit cost per visit for family planning services ($p < 0.05$) and HCT services ($p < 0.05$).

Table 9-3: Bivariate analysis of association between unit cost per visit (US\$ 2011) and measures of integration

Measures of integration	FP (Obs=80)	PNC (Obs=63)	Ca Cx (Obs = 49)	HCT (Obs=67)	STI (Obs=54)	HIV (Obs=54)
<i>HIV/STIFAC</i>	0.32*	0.24*	0.24*	0.19	0.22*	0.03
<i>HIV/STIMCH</i>	0.27*	0.13	0.43*	0.11	0.28*	-0.14
<i>HIV/STICS</i>	0.05	-0.19*	0.24*	0.02	0.05	-0.28*
<i>HIV/STIR</i>	0.29*	-0.07	0.41*	0.05	0.16	-0.13
<i>FUINT</i>	0.24*	0.09	0.08	0.22*	0.01	0.07

*Significant at 5% level.

Legend: HIV/STIFAC-Number of HIV /STI services in the facility; HIV/STICMCH-Number of HIV/STI services in the MCH unit; HIV/STICS – Number of HIV/STI services provided per clinical staff; and HIV/STIR- Number of HIV/STI services provided per room. FUINT – Functional integration score

Multivariate analysis

The empirical results of the two models of equation (1) estimated using the quadratic functional form are presented in Table 9-4. Model 1 controls for the extent of integration within the facility using four individual measures of

integration while model 2 controls for integration using the functional integration index.

Table 9-4: Short run cost function estimation results

<i>Dependent variable = (Total Cost)</i>	Model 1		Model 2	
	Coeff	SE	Coeff	SE
Ca Cx visits	-196.98	251.373	108.383	257.210
Ca Cx visits squared	0.166	0.112	0.067	0.115
FP visits	-46.97	35.92	-44.897	39.03
FP visits squared	0.0004	0.002	-0.0010	0.0019
PNC visits	-175.69	107.09	-117.438	117.27
PNC visits squared	0.021	0.0393	-0.0133	0.041
STI visits	-581.98***	158.266	-616.106***	172.347
STI visits squared	0.432***	0.0821	0.441	0.086
HCT visits	-77.325**	32.399	-106.678***	33.266
HCT visits squared	0.0012	0.0018	0.001	0.002
HIV visits	-21.98	14.308	-37.319**	14.523
HIV visits squared	0.004***	0.0006	0.004***	0.0006
Other visits	39.39**	18.398	62.677***	18.751
Other visits squared	-0.0012	0.0007	-0.0024**	0.0007
Ca Cx visits x HCT visits	-0.006	0.0229	-0.024	0.0249
FP visits x HCT visits	0.0089	0.006	0.0158**	0.007
PNC visits x HCT visits	0.023	0.015	0.021	0.0168
Ca Cx visits x STI visits	0.432**	0.206	0.257	0.223
PNC visits x STI visits	-0.067	0.047	0.0047	0.046
FP visits x STI visits	-0.062**	0.022	-0.070**	0.024
Ca Cx visits x HIV visits	-0.226***	0.032	-0.214***	0.034
PNC visits x HIV visits	-0.026**	0.008	-0.020**	0.008
FP visits x HIV visits	0.002	0.001	0.003	0.002
Clinical staff wages	-3.956	7.076	-11.895	7.345
Technical staff wages	-32.517**	12.318	-27.226**	12.509
HIV/STIFAC	93149.49	232371	-	-
HIV/STIMCH	996448.9***	274199	-	-
HIV/STICS	-144415**	47933.46	-	-
HIV/STIR	-25602.04**	46200	-	-
FUINT	-	-	34719.22	49302.64
FLSPACE	5.38 e-08**	2.93 e-08	5.91e-08	3.17e-08
Staff intensity	-33979.49*	18683.63	-67975.84***	16929.59
% Clinical Staff	104637.8	160262.3	87823.81	174125
Dummy COUNTRY - SWAZI ^a	537154.9***	134193.7	730414.7***	134373.7
Dummy OWN - PUBLIC ^b	247392.2	202967	-49146.32	190384.30
Dummy FACTYPE - OTHER ^c	-137455**	67113.4	-198356.4**	64364.6
Dummy LOC - RURAL ^d	-319677.1***	102899	-249776.7**	109188.10
Dummy 2010/2011 ^e	303417***	60170.84	371291.20***	55395
Intercept	424841.3	333121.5	905630.60***	297803.5

Note: CaCx: Cervical Cancer screening; FP: Family planning; PNC: Post natal care; STI: Treatment of sexually transmitted infections; HCT: HIV counselling and testing; HIV/STIFAC: Number of HIV/STI services in the facility; HIV/STIMCH: number of HIV/STI services in the MCH; HIV/STICS: number of HIV/STI per clinical staff; HIV/STIR: number of HIV/STI services provided per room. FUINT: functional integration score. a: reference category: Kenya; b: reference category: NGO; c: reference category hospitals; d: reference categories: Urban; e: reference category: Year 2008/09.

*** p<0.01, ** p<0.05, * p<0.10

Of particular interest were the parameter estimates of the measures of integration. We found a significantly positive effect of the range of HIV services provided within the MCH unit on total costs, indicating that health facilities providing a wider range of HIV services within the MCH unit had on average higher total HIV and SRH costs. Both measures of the range of HIV services provided within the same room in the MCH clinic and provided by one clinical staff were significantly negative, implying that health facilities with a higher number of HIV services provided in the same room with SRH services and by the same provider had lower total HIV and SRH costs. The coefficient for functional integration was positive but not significant.

Other significant determinants of costs were average technical wages, floor space available for HIV and SRH services, staff intensity measured as the number of client visits per clinical staff FTE per day, facility type and location which were all negative. As expected, the coefficient on the proportion of clinical staff within the health facility was positive for both models however this was not significant. The coefficient for facility ownership dummy was positive for model 1 and negative for model 2, and similarly not significant for either model.

Economies of scale and scope

Table 9-5 presents the results of the economies of scale and scope analysis. Following equation 3, economies of scale are measured by inverting the sum of the elasticities of output variables. We found evidence of economies of scale for

only HCT and other MCH services across both models estimated. However, estimates of RES for models 1 and 2 were both < 1 suggesting that ray economies of scale for all outputs do not exist.

Looking at two output combinations, we followed the method suggested by Vita (Vita, 1990) which indicate that weak cost complementarities i.e. $C_{ij} = \delta^2 C / \delta Y_i \delta Y_j < 0$ are a sufficient condition for economies of scope. The findings in Table 9-5 reveal some evidence of weak cost complementarities between Ca Cx screening and HIV care and treatment; PNC and HIV care and treatment; FP and STI services across both models estimated. However, we found a positive and significant coefficient on the scope effect for FP and HCT services for model 2.

Table 9-5: Economies of scale and scope

	Model 1	Model 2
Economies of scale		
Ray economies of scale	-0.001	-0.0013
Economies of scope		
Ca Cx x HCT	-0.006	-0.024
FP x HCT	0.0089	0.0158**
PNC x HCT	0.023	0.021
Ca Cx x STI	0.432**	0.257
PNC x STI	-0.067	0.0047
FP x STI	-0.062**	-0.070**
Ca Cx x HIV	-0.226***	-0.214***
PNC x HIV	-0.026**	-0.020**
FP x HIV	0.002	0.003

Note: CaCx: Cervical Cancer screening; FP: Family planning; PNC: Post natal care; STI: Treatment of sexually transmitted infections; HCT: HIV counselling and testing; ***, **, and * denote significance at the 1, 5 and 10% levels, respectively

9.2.5 Discussion

Although several studies have examined economies of scale within the HIV context in low and middle income settings (Kumaranayake and Watts, 2000,

Dandona et al., 2005a, Guinness et al., 2005, Guinness et al., 2007, Marseille et al., 2007, Lépine et al., 2013), no study identified has examined the economies of scope associated with joint production of HIV and other services or SRH services in particular. This study provides the first attempt to empirically examine the potential economies of scale and scope resulting from integration of HIV and SRH services.

Our findings indicate evidence of output specific economies of scale for STI and HCT services but no evidence of global economies of scale. These findings on economies of scale associated with HCT and STI services are consistent with findings from other studies (Dandona et al., 2005a, Dandona et al., 2005b, Marseille et al., 2007). Although we found economies of scale in the production of these two outputs, we also found that the hospitals and facilities in urban areas were not necessarily more efficient at providing these two services compared to the smaller health facilities. The findings that large hospitals have higher unit costs for these services may suggest diseconomies of scale, but may also be attributed to differences in clinical practices particularly for STI and cervical cancer screening services. Larger hospitals with laboratory facilities may require laboratory diagnosis for STI treatment or provide pap smears for cervical cancer screening. Similarly, different staff members may provide HCT services, with counselling provided by a clinical staff and testing provided by a technical staff in the laboratory.

The gains in efficiency observed, as output increases are a result of not only positive scale effects but also cost complementary effects. The higher unit costs

and total costs in hospitals and urban facilities with a wider scope of services provided therefore suggest diseconomies of scope. However, this may also be indicative of the complexity of cases being managed in urban and larger hospitals. In deed both urban facilities and larger hospitals provide more complex services, which are both staff and equipment intensive. An example of this is the provision of more complex services for cervical cancer screening, long term family planning methods, STI services and even HIV care and treatment.

The positive significant coefficients on the scope effect for FP and HCT services may be attributed to limited scale effects realised from integrating these services. Although FP has provided an entry point for HIV services, it appears that integrating HCT with FP services alone has not been able to achieve sufficient demand to achieve scale effects. Given that HCT services are provided once in three months to existing FP clients, integrating HCT services into FP it may be beneficial to integrate HCT services with other MCH services beyond FP services where there is more possibility of capturing new clients.

Our results indicate that the simplest measures of scope, range of services provided within the same room and by the same provider, are significant determinants of the costs of HIV and SRH services. This finding is consistent with economic theory, which suggests that the intensity of use of fixed resources may increase cost efficiency. The negative significant impact of the average technical wages on costs can be explained by the wide variation in technical wages across facilities as supported by the descriptive data. The

classification of technical staff ranged from laboratory technicians to HIV counsellors with a wide variation in wages.

Some limitations of this study should be noted. First, although this is one of the largest studies to date on the impacts of integrating HIV and SRH services in a low and middle income setting, the results obtained from this study lack the statistical power of larger panel datasets. This limits the strength of the conclusions that can be drawn. Also, although the study captures the heterogeneity in health facilities in terms of HIV and SRH services provided, no case mix variables are included to control for complexity of services provided because of unavailability of such data in study setting.

Nevertheless, the findings reported have implications on the organisation of HIV and SRH services at the facility level. The significance of the range of services provided within one room suggests that even though the capital costs associated with provision of HIV and SRH services are low in general, the provision of more than one service within a room is as beneficial in achieving cost efficiency as the provision of services by the same service provider. Therefore facilities seeking to reduce excess capacity may consider integrating HIV and SRH services that require the same type and level of inputs.

9.2.6 Conclusion

The existence of economies of scale and scope associated with integration of HIV and SRH services have been hypothesized however this has not been supported in the literature. The results in this paper are consistent with the

hypothesis that (i) output specific economies of scale and scope economies for some service combinations exist and, ii) integration of HIV with SRH services at the room and provider level have a negative impact on the costs of HIV and SRH services. In addition, we found that unobserved health facility characteristics such as facility type and location of facility have an impact on the costs of HIV and SRH services. Further work with longer and larger panels is required to address the econometric issue of the causal relationship between integration and the costs of HIV and SRH services.

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Ethical approval

Approval for the study was obtained from the Ethical Committee at LSHTM (approval no. 5436), from the Population Council Review Board (protocol nos. 443 and 444), from the Kenya Medical Research Institute (approval no. KEMRI/RES/7/3/1, protocol no's SCC/113 and SCC/114) and the Swaziland Scientific and Ethics Committee (approval nos. MH/599B and MH/599C).

References

- AKRIDGE, J. T. & HERTEL, T. W. 1986. Multiproduct cost relationships for retail fertilizer plants. *American journal of agricultural economics*, 68, 928-938.
- ASKEW, I. & BERER, M. 2003. The Contribution of Sexual and Reproductive Health Services to the Fight against HIV/AIDS: A Review. *Reproductive Health Matters*, 11, 51-73.
- BAUMOL, W. J., PANZAR, J. C. & WILLIG, R. D. 1982. *Contestable Markets and the Theory of Industry and Structure*, New York, Harcourt, Brace and Jovanovich.
- CAREY, K., BURGESS, J. F. & YOUNG, G. J. 2014. Economies of scale and scope: The case of specialty hospitals. *Contemporary Economic Policy*.
- CAVES, D. W., CHRISTENSEN, L. R. & TRETHERWAY, M. W. 1980. Flexible Cost Functions for Multiproduct Firms. *The Review of Economics and Statistics*, 62, 477-481.
- CHAMBERLAIN, G. 1982. Multivariate regression models for panel data. *Journal of Econometrics*, 18, 5-46.
- CHRISTENSEN, L. R., JORGENSON, D. W. & LAU, L. J. 1973. Transcendental Logarithmic Production Frontiers. *The Review of Economics and Statistics*, 55, 28-45.
- CHURCH, K. & MAYHEW, S. 2009. Integration of STI and HIV prevention, care, and treatment into FP services: a review of literature. *Stud Fam Plann*, 40, 171 - 186.
- CONTEH, L. & WALKER, D. 2004. Cost and unit cost calculations using step-down accounting. *Health Policy and Planning*, 19, 127-135.
- COWING, T. G. & HOLTMANN, A. G. 1983. Multiproduct short-run hospital cost functions: empirical evidence and policy implications from cross-section data. *Southern Economic Journal*, 637-653.
- DANDONA, L., SISODIA, P., PRASAD, T., MARSEILLE, E., CHALAPATHI RAO, M., KUMAR, A., KUMAR, S., RAMESH, Y., OVER, M., SOMESHWAR, M. & KAHN, J. 2005a. Cost and efficiency of public sector sexually transmitted infection clinics in Andhra Pradesh, India. *BMC Health services research*, 5, 69.
- DANDONA, L., SISODIA, P., RAMESH, Y., KUMAR, S., KUMAR, A., RAO, M., SOMESHWAR, M., HANSL, B., MARSHALL, N., MARSEILLE, E. & KAHN, J. 2005b. Cost and efficiency of HIV voluntary counselling and testing centres in Andhra Pradesh, India. *Natl Med J India*, 18, 26 - 31.
- DAS, R., BISWAS, K., PANDA, P., KHAN, M. E. & HOMAN, R. 2007. Strengthening Financial Sustainability through Integration of Voluntary Counseling and Testing Services with Other Reproductive Health Services. Washington DC: Population Council.

- DRUMMOND, M., SCULPHER, M., TORRANCEGE, G., O'BRIEN, B., STODDART & GREG, L. 2005. *Methods for the economic evaluation of healthcare programmes*, Oxford, Oxford University Press.
- ESCARCE, J. J. & PAULY, M. V. 1998. Physician opportunity costs in physician practice cost functions. *Journal of health economics*, 17, 129-151.
- FARSI, M., AND FILIPPINI, M. 2009. An analysis of cost efficiency in Swiss multi-utilities. *Energy Economics*, 31, 306-315.
- GILLIGAN, T., SMIRLOCK, M. & MARSHALL, W. 1984. Scale and scope economies in the multi-product banking firm. *Journal of Monetary Economics*, 13, 393-405.
- GILMAN, B. H. & GREEN, J. C. 2008. Understanding the variation in costs among HIV primary care providers. *AIDS Care*, 20, 1050-1056.
- GONÇALVES, R. & BARROS, P. P. 2011. Economies of scale and scope in the provision of diagnostic techniques and therapeutic services in Portuguese hospitals. *Applied Economics*, 45, 415-433.
- GRANNEMANN, T. W., BROWN, R. S. & PAULY, M. V. 1986. Estimating hospital costs: A multiple-output analysis. *Journal of Health Economics*, 5, 107-127.
- GUINNESS, L., KUMARANAYAKE, L. & HANSON, K. 2007. A cost function for HIV prevention services: is there a 'u' - shape? *Cost Effectiveness and Resource Allocation*, 5, 13.
- GUINNESS, L., KUMARANAYAKE, L., RAJARAMAN, B., SANKARANARAYANAN, G., VANNELA, G., RAGHUPATHI, P. & GEORGE, A. 2005. Does scale matter? The costs of HIV-prevention interventions for commercial sex workers in India. *Bull World Health Organ*, 83, 747 - 755.
- HOMAN, R., MULLICK, S., NDUNA, M. & KHOZA, D. 2006. Cost of introducing two different models of integrating VCT for HIV within family planning clinics in South Africa. *Linking Reproductive Health, Family Planning, and HIV/AIDS in Africa, 9 -10 October*. Addis Ababa.
- KIM, H. Y. 1987. Economies of Scale in Multi-Product Firms: An Empirical Analysis. *Economica*, 54, 185-206.
- KUMARANAYAKE, L. & WATTS, C. 2000. HIV/AIDS Prevention and Care Interventions in Sub-Saharan Africa: An Econometric Analysis of the Costs of Scaling-Up. *South African Journal of Economics*, 68, 455-467.
- LAU, L. J. 1974. *Applications of Duality Theory: Comments*, Amsterdam North Holland.
- LÉPINE, A., VASSALL, A., CHANDRASHEKAR, S., LE NESTOUR, A. & BLANC, E. 2013. Effect of Scaling-Up HIV Prevention Services on Cost: Evidence from the Avahan Initiative in India. *Available at SSRN 2286916*.
- LIAMBILA, W., ASKEW, I., AYISI, R., GATHITU, M., MWANGI, J., HOMAN, R. & AL, E. 2008. Feasibility, acceptability, effect and cost of integrating counseling and testing for HIV within family planning services in Kenya. Washington DC: Population Council.
- MANNING, W. G. 1998. The logged dependent variable, heteroscedasticity, and the retransformation problem. *Journal of Health Economics*, 17, 283-295.

- MARSEILLE, E., DANDONA, L., MARSHALL, N., GAIST, P., BAUTISTA-ARREDONDO, S., ROLLINS, B., BERTOZZI, S., COOVADIA, J., SABA, J., LIOZNOV, D., DU PLESSIS, J.-A., KRUPITSKY, E., STANLEY, N., OVER, M., PERYSHKINA, A., KUMAR, S. P., MUYINGO, S., PITTER, C., LUNDBERG, M. & KAHN, J. 2007. HIV prevention costs and program scale: data from the PANCEA project in five low and middle-income countries. *BMC Health services research*, 7, 108.
- MAYHEW, S., PLOUBIDIS, G. B., CHURCH, K., OBURE, C. D., BIRDTHISTLE, I., SWEENEY, S., ZHOU, W., WARREN, C., INITIATIVE, I., WATTS, C. & VASSALL, A. 2014. Innovation in the evaluation of service Integration: the Integra Indexes of HIV and Reproductive Health Integration. *Under review*.
- MUNDLAK, Y. 1978. On the pooling of time series and cross section data. *Econometrica*, 64 (1): 69-85., 64, 69-85.
- MURRAY, C. J. L., ANDERSON, B., BURSTEIN, R., LEACH-KEMON, K., SCHNEIDER, M., TARDIF, A. & ZHANG, R. 2011. Development assistance for health: trends and prospects. *The Lancet*, 378, 8-10.
- SINAY, U. & CAMPBELL, C. 1995. Scope and scale economies in merging hospitals prior to merger. *Journal of Economics and Finance*, 19, 107-123.
- SPAULDING, A., BRICKLEY, D. & KENNEDY, C. 2009. Linking family planning with HIV/AIDS interventions: a systematic review of evidence. *AIDS*, 23, S79 - S88.
- SWEENEY, S., OBURE, C. D., MAIER, C. B., GREENER, R., DEHNE, K. & VASSALL, A. 2011. Costs and efficiency of integrating HIV/AIDS services with other health services: a systematic review of evidence and experience. *Sexually Transmitted Infections*.
- TRIEBS, T., SAAL, D. S., AROCENA, P. & KUMBHAKAR, S. C. 2012. Estimating economies of scale and scope with flexible technology. Ifo Working Paper.
- VARIAN, H. R. 1984. *Microeconomic Analysis*, New York, w.W. Norton.
- VITA, M. G. 1990. Exploring hospital production relationships with flexible functional forms. *Journal of Health Economics*, 9, 1-21.
- VITALIANO, D. F. 1987. On the estimation of hospital cost functions. *Journal of Health Economics*, 6, 305-318.
- WARREN, C., MAYHEW, S., VASSALL, A., KIMANI, J. K., CHURCH, K., OBURE, C. D., DU-PREEZ, N. F., ABUYA, T., MUTEMWA, R., COLOMBINI, M., BIRDTHISTLE, I., ASKEW, I. & WATTS, C. 2012. Study protocol for the Integra Initiative to assess the benefits and costs of integrating sexual and reproductive health and HIV services in Kenya and Swaziland. *BMC Public Health*, 12, 973.
- WORLD BANK. *PPP conversion factor, GDP (LCU per international \$)* [Online]. Available: <http://data.worldbank.org/indicator/PA.NUS.PPP>.

Chapter 10 Discussion & Conclusion

10.1 Introduction

The search for potential efficiency improvements of health care delivery continues to be of interest both from a policy and practice point of view in many contexts. As HIV prevention and treatment programs in sub-Saharan Africa continue to scale up and uncertainty remains around funding, efficiency maximisation within this particular context becomes more crucial. Although there is a growing body of evidence on the benefits of integrating HIV/STI services and SRH services, reviews have consistently demonstrated research gaps on the efficiency gains associated with such integration [8, 12, 18-21]. The few studies [22-24] identified suggesting that integration of HIV and SRH services yielded cost savings were conducted at a relatively small scale and only focused on the integration of HIV CT into one component of SRH services, usually family planning services or integrating family planning into HIV care and treatment services [25].

The overall aim of this PhD study was therefore to contribute to the understanding of the optimal organisation of HIV and SRH service delivery to achieve efficiency gains. To achieve this aim, standard economic techniques were used to assess both cost and technical efficiency of integrating HIV and SRH services in two resource constrained settings. In so doing, this study makes several empirical and methodological contributions to the field of efficiency measurement in health in general and HIV and SRH in particular.

Chapters 6 – 9 have included discussions of the specific chapter findings and limitations. The subsequent sections of this chapter will therefore provide an overview of the contributions of the thesis to the literature, the limitations of the thesis, the implications of the research findings on practice and policy and recommendations for future research, and concluding comments.

10.2 Contribution of thesis

Chapter 4 contributed to the literature by highlighting the considerable content and methodological gaps in efficiency measurement particularly for lower levels of primary care in LMIC settings. In particular, the review drew attention to the paucity of studies investigating both technical and cost efficiency gains associated with integrating HIV and SRH services at the health facility level despite the widespread adoption of integration policies within high HIV prevalence Sub-Saharan African countries.

Moreover, the chapter showed that much of the existing literature on efficiency in the general health care context has concentrated only on economies of scale with less effort made in estimating economies of scope. Second, it identified a significant gap in the incorporation of quality measures within the efficiency measurement literature in low and middle-income settings. Few attempts have been made at incorporating quality measures in these settings [159, 160]. The existing literature was shown to assume that output quality did not vary across facilities studies.

10.2.1 Costs of integrated HIV and SRH services

Chapter 6 contributed to building the evidence filling in the literature on the costs of integrated HIV and SRH services by providing the first descriptive analysis of the costs of integrated HIV and SRH services in two HIV contexts. A comprehensive costing exercise requiring extensive effort was conducted in 40 health facilities over a period of two years to determine the costs of service delivery. This constitutes the largest study of its kind to determine the costs of services. These data may be used for budgeting and planning purposes and for exploring the cost-effectiveness of SRH/HIV services. The examination of costs and costs structure is the preliminary step in the more detailed analysis of cost and technical efficiency.

The descriptive analysis of costs of providing six integrated HIV and SRH services in chapter 6 revealed that HCT and HIV treatment costs are increasingly accounting for a significant proportion of total facility costs. This is particularly important given the policy context in both Kenya and Swaziland where HIV prevention and treatment as prevention strategies are being scaled up [50, 56].

Second, considerable variation in the unit costs, levels of fixed costs and patterns of resource use exist in the provision of integrated HIV and SRH services between facilities. This wide variation suggests considerable room to improve efficiency at both the facility and service level. Third, unit costs of HIV and SRH visits were largely driven by fixed costs including capital, staff and

while variability in visit costs across facilities was explained mainly by technology used and service maturity.

An important finding from this analysis was the high proportion of fixed costs across all service types. Fixed costs remain the same regardless of the number of units produced and fixed costs per unit decreases as the number of unit increases. This finding highlights the potential for improving health facility efficiency through integrating HIV and SRH services. HIV and SRH services often require the same type and level of fixed inputs (staff, space and equipment) and therefore providing more services thereby reducing excess capacity can result in lowering the cost of each service.

Chapter 7 presented a comparison of the unit costs of integrated HIV counselling and testing referred to as PITC and stand-alone VCT services. The results revealed lower unit costs for PITC in all facilities in Kenya and some facilities in Swaziland demonstrating the potential for substantial gains in efficiency in the provision of integrated HCT services within MCH departments.

The results showed that not all VCTs had higher costs compared to PITC services provided in the same facility, suggesting that there is nothing inherent in the VCT model that makes it less efficient than the PITC. Therefore, although PITC services compared favourably to VCT services in terms of cost efficiency, considerations of how to deliver services efficiently are context specific and need to be informed by local contextual factors such as HIV prevalence, service demand and the availability of human resources.

The results also highlighted differences in staff workloads as the main driver of personnel costs. Such differences in staff workload could be explained partly by differences in service delivery models and in part by the organisation of service delivery where staff provided multiple services. These findings are particularly critical as PITC is rolled out in many settings with generalised epidemics with the aim of increasing HIV testing rates and subsequently increasing access to HIV prevention, treatment and care.

10.2.2 Impact of integration on technical and cost efficiency

Chapter 8 demonstrated the utility of DEA in providing insight into the level of technical efficiency among health facilities providing integrated HIV and SRH services and contributing to understanding why some health facilities perform better than others. The chapter exploited recent methodological advancements in statistical inference applied to non-parametric DEA. Specifically, a two-stage semi-parametric technique was used to estimate the technical efficiency of health facilities and make inferences about the impact of a number of exogenous factors on technical efficiency of health facilities.

The literature on the determinants of efficiency has highlighted one major problem with DEA models estimating and explaining efficiency scores: the assumption that exogenous non-discretionary inputs are uncorrelated with efficiency. In fact, Simar and Wilson [115] have shown that DEA efficiency estimates are serially correlated and therefore standard inference approaches used in the conventional two stage DEA are statistically invalid. The innovative

double bootstrap procedure, arguably the most notable methodological advancement in non-parametric efficiency measurement literature, was therefore employed to correct for bias and improve the statistical efficiency of estimates while simultaneously producing standard errors and confidence intervals for the efficiency scores.

The low estimates of technical efficiency suggest that integration has not had a major influence in improving the technical efficiency of health facilities. Furthermore, the mixed findings of the effects of the different measures of integration on efficiency indicate that a complex relationship exists between integration and efficiency. While a positive and significant effect is found for the range of HIV/STI services within the MCH, no significant effect is found for the measure of functional integration on technical efficiency. These findings support findings by Mayhew et al [171], who show that while health facilities may have the capacity to integrate services, this may not necessarily result in integrated delivery of services to clients. This may be as a result of a number of factors related to the health systems in general such as staff shortages, high staff turnover and inadequate staff training; inadequate equipment, and commodity supply; and poor management capacity [12]. In addition, where resources are not managed effectively, increased staff workloads from integrated service delivery may result in burnout and low morale, thus discouraging the provision of integrated services.

The negative significant effect of range of HIV/STI services provided within the same room on the technical efficiency suggests that where more than one room

is available for service delivery, providers are better able to manage their patient flow hence improve technical efficiency by providing multiple services simultaneously. An example of this is where a health provider provides HCT in one room and moves to the next room to provide other services to other clients as the first client awaits their test results.

In Chapter 9, the econometric model of costs was used to provide a better understanding of the drivers of costs and evaluate the existence of economies of scale and scope associated with integrated HIV and SRH services hypothesized in chapters 6 and 7.

The findings from this chapter showed that integration impacts services differently. More importantly, the findings also established that the hypothesized negative relationship between the extent of integration and HIV and SRH service costs was statistically significant for two simple measures of integration: range of HIV/STI services provided within the same consultation room and range of HIV/STI services provided by the same SRH provider. These findings support the argument that integration may improve the efficiency of resource utilisation.

As would be expected, the number of HIV/STI services provided in the MCH unit had a positive significant effect on costs of HIV and SRH services. However, the coefficient for extent of functional integration while positive was not statistically significant. These results are not surprising as it is logical that an increase in the number of services provided within the MCH room and actually

delivered within one consultation would increase the total cost of HIV and SRH services, as more staff time and supplies are now required to provide services.

The coefficient for staff intensity, a measure of staff workload, was negative and statistically significant suggesting that high staff workloads resulted in lower total costs for HIV and SRH services. This result highlights the potential for improving cost efficiency through resource allocation practices that take into account demand for services within a health facility to ensure that existing staff capacity is fully utilized.

The analysis of cost efficiency also provided new indicative evidence on the existence of economies of scale for HCT, STI treatment and HIV treatment and care services. It also provided evidence of weak cost complementarities suggesting economies of scope associated with the provision of cervical cancer screening and HIV care and treatment; PNC and HIV care and treatment; FP and STI service combinations. The source of scope economies in this case is largely indivisible shared assets (both human and physical). Clinically, cervical cancer screening and treatment strategies that use visual inspection with acetic acid (VIA, may be performed by the same clinical staff during consultations for HIV treatment without additional fixed input requirements. Similarly, PNC consultations may easily include HIV care and treatment and provision of long term family planning methods particularly IUCDs may also allow for syndromic management of STIs without additional fixed inputs. Generally, cost complementarities arise in the provision of these service combinations, when the infrastructure developed to conduct the clinical processes for Ca Cx screening,

PNC, FP can be used to provide STI and HIV care and treatment at the same time during the same consultation.

Evidence of diseconomies of scope were however found for FP and HCT service combination supporting the notion that in principle savings could be realised from shared processes but in practice the delivery requirements of both services may not always be operationally compatible [174]. It would thus seem that any reduction in inputs resulting from integration of HCT into family planning services was overcompensated by larger requirements for labour time input.

It is important to highlight that the finding of diseconomies of scope for FP and HCT service combination does not contradict the findings of chapter 7 that demonstrated efficiency gains from integrating HCT services. Rather, this finding suggests that the efficiency gains from integrated HCT were largely as a result of scale effects and not scope. Furthermore, these results suggest that integrating HIV services into family planning alone may not be sufficient to generate the demand for services required to achieve economies of scale.

10.2.3 Quality of care

Chapter 8 also extended the literature on efficiency measurement in LMIC settings by developing and incorporating quality measures within the efficiency measurement framework. Only two studies to date, have incorporated some element of quality into the efficiency measurement framework in a LMIC setting [159, 160], and none in the context of HIV/SRH integration.

An index of structure and process quality measures was developed for the health facilities using principal components analysis and technical efficiency estimated while controlling for quality of care. Three DEA models were compared to determine how the treatment of quality influences findings regarding technical efficiency. First, the chapter found that adjusting for quality clearly changes the efficiency scores as incorporating a measure of quality into the efficiency model reduces the variation in the efficiency scores. Second, the magnitude of the change depends on whether quality is incorporated as an input or an output variable. However, it was not obvious from the analysis, the “optimal” way to incorporate quality into efficiency measurement studies. Nevertheless, these results illustrate that analysing technical efficiency without considering quality of care will bias results.

Finally, when quality and efficiency were examined as separate dimensions of performance, only a small number of facilities exhibited high efficiency and low quality with the majority of the study facilities exhibiting both low efficiency and low quality of care. While the empirical evidence does not provide sufficient evidence to conclude that a trade-off between quality and efficiency exists among the sample facilities, it draws attention to the low quality results.

10.2.4 Environmental determinants of technical and cost efficiency

The results from chapter 8 revealed a number of significant environmental determinants of technical efficiency. These included ownership, health facility

type, proportion of clinical staff and proportion of HIV services provided in the health facility.

Public health facilities and smaller health facilities (health centers, public health units and SRH clinics) were found to have significantly higher levels of technical efficiency compared to the NGO facilities and hospitals respectively. At least two explanations can be given for this finding. First, this can be explained by lower staffs levels in public and smaller health facilities compared to the NGO facilities and hospitals that may encourage a higher staff workload. This explanation is supported by descriptive data from the health facilities. A second explanation is related to case mix effects. The NGO facilities and hospitals provide more complex services such as long-term FP methods; pap smears for cervical cancer screening and HIV treatment and care, which are labor intensive and therefore associated with higher resource requirement.

The coefficients for the proportion of clinical staff and proportion of HIV services delivered were both negative and significant. This suggests that technical efficiency of health facilities decreases with the increase in proportion of clinical staff and HIV services. This is may be explained by the fact that clinical staff are better trained and therefore spend more time with a client which lowers their technical efficiency, or again that these facilities receive more complex cases. In the same vein, HIV services are more resource intensive compared to SRH services and therefore an increase in these services results in a lower output/input ratio.

Chapter 9 also showed that unobserved health facility characteristics such as facility type and location of facility have a significant impact on costs of HIV and SRH services. Specifically, the dummy variables comparing the cost efficiency of other facility types (health centers, public health units and SRH clinics) to that of hospitals and rural to urban facilities were negative and significant. These results suggest that other health facilities and rural facilities had lower costs compared to hospitals and urban facilities. Given that nationally input prices did not vary, one logical explanation for this is that hospitals provided more complex services that required more qualified clinical staff (hence more expensive), more equipment and higher staff time input which would result in higher service delivery costs.

10.3 Interpretation of technical and cost efficiency findings

The findings from the analysis of technical and cost efficiency (chapter 8 and 9) indicate that analysing both technical and cost efficiency is important as results may depend on the efficiency analysed. As illustrated by the findings in this study, health facility characteristics that have a positive impact on technical efficiency may have a negative impact on cost efficiency. For example, an increase in the number of HIV/STI services provided within the same room decreases technical efficiency, but increases the cost efficiency of integrated HIV and SRH services. Similarly, the number of services provided within the MCH unit improves the technical efficiency of health facilities but increases the costs of HIV and SRH services.

The only consistent finding between the analysis of cost and technical efficiency was the impact of facility type. Smaller health facilities had higher technical efficiency and lower costs compared to hospitals. However as previously stated, these results can be explained by higher staff densities (fewer staff relative to output), lower output levels, and less complex services (case mix) provided within the smaller facilities compared to the hospitals.

Three different explanations can be given for the observed differences between the results of the analysis of cost and technical efficiency. Apart from the fact that technical efficiency has been analysed in this thesis using non-parametric techniques while cost efficiency using parametric techniques, conceptually, differences exist between the concepts of technical efficiency and cost efficiency.

First, technical efficiency is strictly concerned with the relationship between outputs and inputs while cost efficiency focuses on the relationship between outputs and costs. Additionally, while technical efficiency is a requirement for cost efficiency, cost efficiency subsumes technical efficiency and allocative efficiency (optimal allocation of resources). It is therefore plausible that facilities can be technically efficient but not cost efficient in the sense that it is not using the least expensive combination of inputs for its given services. Within this context, it is possible that two facilities producing the same level of output hence same level of technical efficiency have different costs resulting from different input mixes to produce the same level of output. Different input combinations may include differences in staff types and levels delivering the

same services as well as different equipment and supplies available for service provision.

Secondly, the difference in the results of technical and cost efficiency analyses could be explained by the fact that not all costs that are part of the cost function can be related to specific technical inputs. While the production function only includes staff and capital as the technical inputs, the cost function also included other non-technical inputs such as drugs and diagnostics, defined as variable costs, which influence cost efficiency but are not directly related to technical efficiency. In deed the descriptive analysis presented in chapter 6 confirms that variable costs account for up to 84% of total unit costs across the different services. While interesting, it is unexpected that these variable costs lead to different conclusions about integration.

Third, the differences in the results of the technical efficiency and cost efficiency models are associated with the different model specifications commonly used for both analyses. Technical efficiency focuses solely on the relationship between inputs and outputs while the analysis of cost efficiency also includes factor input prices. In this particular study although standard price list were used for all inputs across all study sites, there were differences in relative mix of inputs (staff, equipment and supplies) across study sites. While this will not affect the technical efficiency results it certainly affects the results of the cost efficiency analysis.

10.4 Differences between countries

The results of both technical and cost efficiency differed for Kenya and Swaziland. The average technical efficiency scores for Swaziland were lower than those estimated for Kenya across all three DEA models. Similarly, the bivariate analysis of costs of the differences services revealed significantly higher unit costs for family planning, HIV counselling and testing, STI treatment and HIV treatment in Swaziland compared to Kenya. Considerable variation was also found in the mean unit cost per visit across service types in both countries. In Kenya, the lowest absolute differences in cost was found for family planning services, while in Swaziland, STI services had the least variation in absolute terms. Total costs of integrated HIV and SRH services were also significantly higher in Swaziland than in Kenya.

Given the small sample sizes, it was difficult to make any strong conclusions about the differences in technical and cost efficiency across countries. However, these results lead to the conclusion that country specific factors are important determinants in explaining differences in technical and cost efficiency of HIV and SRH service delivery. Apart from demand factors particularly the HIV prevalence; these differences may be attributed to variations in input mix used for service delivery, technology used for the different services and differences in input prices across countries. More specifically, the public health facilities in Swaziland had larger staff and capital complements than the health facilities in Kenya, as may be typical in a higher income country. Input mixes also varied between countries with clinical staff providing services such as HIV counseling

and testing services in Swaziland while non-clinical (lower salaried) staff provided similar services in Kenya. The technology used for some services such as cervical cancer screening also varied. In Swaziland, some health facilities had a dedicated staff providing cervical cancer screening services using visual inspection with acetic acid (VIA) and treatment with cryotherapy. In addition, input price differentials also existed between the two countries with Swaziland exhibiting higher unit costs for all the inputs compared to Kenya particularly for labor, which accounted for a significant proportion of costs of HIV and SRH services.

There were also differences in relation to the quality of health services between the two countries as measured by the structural and process indicators of quality. The health facilities in Swaziland scored higher on availability of infrastructure and equipment; management aspects including training of staff, availability of information, communication and education (IEC) materials and guidelines and standards when compared to the Kenyan facilities. However, the facilities in Swaziland performed poorly on the availability of commodities and the technical competence of providers in providing family planning services and HIV/STI risk assessment relative to the Kenyan facilities.

10.5 Limitations of the thesis

Despite its contribution to knowledge, this thesis has a number of limitations.

The analysis of costs of integrated HIV and SRH services in chapter 6 was limited by the retrospective nature of the study. The retrospective data

collection and reliance on routine monitoring systems that are not specifically designed for cost analyses means that the output data is subject to errors. In addition, financial data was used as a proxy for economic costs in some instances due to lack of records at the facility level.

The analysis of technical and cost efficiency in chapters 8 and 9 were limited by the sample size. Although this is one of the largest studies to date on the impacts of integrating HIV and SRH services in a LMIC setting, the dataset is still small, limiting the strength of the conclusions. Generally, the use of flexible cost functions is computationally expensive imposing great demands on the data because of the large number of explanatory variables required for the analysis. This poses significant challenges in LMIC's where data are scarce and health information systems are not designed to collect information on resource use and other variables required to undertake such analysis.

Third, the exploration of the determinants of cost and technical efficiency was limited by lack of variables to capture the case mix differences across facilities. While the study captures the heterogeneity in health facilities in terms of HIV and SRH services provided, no case mix data was available to control for the complexity of services provided. It can be argued that since the variation of resource use across clients accessing outpatient HIV and SRH services is significantly smaller, the lack of an appropriate case mix measure for HIV and SRH services is less problematic. However, differences in family planning and cervical cancer screening methods exhibit variations in resource use among health facilities. Similarly, resource use for HIV treatment varies widely

between people starting treatment and those that are in pre ART or stable on treatment. Indeed a previous study on the determinants of costs of HIV treatment costs showed that newly initiated ART patients required substantially more resources than established ART patients, and pre-ART patients substantially less [175]. Therefore, ideally a case mix adjusted measure should be used to control for the nature of this variation.

Finally, the issue of endogeneity in chapters 8 and 9 warrants some concern. As mentioned in chapter 8, it is likely that there is an issue of reverse causality between integration and efficiency. However, the direction of causality is not clear. In practice, it is possible that a higher degree of integration within a facility can improve efficiency but also that health facilities that are efficiently managed are better able to integrate services more readily. Endogeneity of regression predictors is a common problem in many areas of applied economics and not only specific to this analysis. One of the ways to address the issue of endogeneity in the econometric literature has been the use of instrumental variable approach. A limitation of this study is that the small panel dataset available could not provide for valid instruments necessary to correct for the potential endogeneity of integration.

10.6 Implications for policy and practice

The limited evidence on the efficiency of integrated HIV and SRH services has meant that discussions on the desirability of integrating various components of HIV and SRH services have been based largely on the patient perspective and

therefore ensuring continuity and quality of care for the patients. However, while integration may have positive impacts on patients' access to care, the mixed effects of integration on technical and cost efficiency at the service delivery level reported in this study suggest an apparent tension between efficiency and clinical issues as the driver behind integration of services within this context. The findings from this study therefore have some interesting policy and practice implications for how to organise HIV and SRH services to improve the efficiency of delivering these services.

The large variation in unit costs of service delivery across services in different settings suggests that decisions on which components of service delivery can be integrated need to be informed by local contextual factors including HIV prevalence, service demand as well as physical and human resource capacity.

The comparison of integrated HCT and standalone VCT services demonstrated that different service delivery models of HIV counselling and testing may be appropriate for different client groups in different settings. The lower unit costs for VCT visits in some facilities in Swaziland show that stand alone VCT sites play an important role in high HIV prevalence settings such as Swaziland. This may therefore be the most efficient way to scale up HIV counselling and testing services where demand for these services is high.

Moreover, PITC and VCT services are not perfect substitutes for one another in all settings. While integrated HCT within maternal and child health units are largely accessed by women, VCT services are more able to meet the needs of

other segments of the population including adult men and youth. In addition, other people may also prefer VCT services because they provide specialised HIV services thereby ensuring privacy of clients. Therefore a recommendation would be that where stand-alone organisational structure exists, a way to improve efficiency would be through the addition of extra services to VCT sites such as family planning services and sharing staff with other services to ensure that excess staff capacity is utilised maximum.

The issue of scale within this context has often been related to discussion of staff requirements and workload but rarely discussed explicitly in terms of cost implications. Overall, the findings on technical and cost efficiency from this study suggest that within this context, efficiency gains are largely associated with indivisibility of physical and human resources. Therefore efficiency gains can be achieved largely through economies of scale. In particular, the existence of diseconomies of scope for FP and HCT services highlight the fact that scale is an important factor in achieving desired efficiency gains. While FP services form a natural entry point for HIV services, it appears that integrating HCT and HIV treatment and care with only FP services is not enough to generate the demand required to achieve economies of scale. Therefore, from a policy perspective, integration of HIV services within the wider MCH services may be more beneficial in achieving substantial economies of scale and scope.

From a practice perspective, the findings from this study suggest that to achieve technical efficiency, health facilities should increase the range of HIV/STI services provided within the MCH unit and increase the range of services

provided per clinical staff and within the same room to achieve cost efficiency. Additionally, the high unit costs resulting largely from high fixed costs associated with HIV and SRH services and the low technical efficiency levels of health facilities suggests that there is room for improving efficiency of HIV and SRH service delivery through increased scale of services. However, it is important for health facilities to be able to make decisions on the best way to allocate its resources to ensure that efficiency gains are achieved given its human and physical resource capacity.

The findings of low quality and high technical inefficiency in the majority of the study facilities warrant some concerns. Variations in quality and efficiency may arise from differences in quantity and quality of management effort supplied to the facility. Therefore it may well be that differences in efficiency observed are more about management capacity as often ineffective management will contribute to inadequate organization of work and ineffective use of the existing resources which in turn affects the quality of services and efficiency of health facilities. In particular, lack of management capacity to properly allocate resources across services may result in overworked staff with low morale and may compromise the quality of services provided. A recommendation would therefore be to improve supervisory and training frameworks at health facilities to ensure that local facility managers are equipped to support effective use of resources at the service delivery level.

In relation to integration, existing literature on integration of HIV and SRH services has shown that some of the factors that may promote or inhibit

integration of services include inadequate staff training, infrastructure and equipment, poor management and supervision and inconsistent commodity supplies [12, 176]. Although integration is part of the policy agenda in many settings in sub-Saharan Africa, there is often a lack of capacity within health systems to provide necessary support to local managers to facilitate integration. The measures of quality used in this study, which attribute low scores to health facilities on the structural, and process indicators of quality support this. Therefore, critical factors that enable integration at the facility level such as adequate staffing, infrastructure, equipment, and ensuring security of commodities for both HIV and SRH services need to be addressed.

10.7 Implications for future research

This section proposes future research issues that stems from this thesis. The findings of this thesis have some implications for future research on the efficiency gains associated with integrated HIV and SRH services. Further work on cost and technical efficiency should address a number of issues. Of particular importance is the issue of endogeneity of integration. Future research on the impacts of integration on efficiency could benefit from larger longitudinal datasets, which may be able to provide valid instruments to correct for potential endogeneity. Scope exists to develop a panel data set of integrated HIV and SRH services as more countries adopt integration policies as data could be collected from routine monitoring data systems. This would not only enable an extension of the analysis provided in this thesis but would also improve the knowledge on different impacts of integration across different settings.

In addition, while endogeneity and the resultant distortions on the estimation of economic models are frequently discussed in econometrics literatures, its effects on non-parametric methods have received little attention to date. Therefore, future research on integration employing non-parametric data envelopment analysis should aim to specifically account for potential endogeneity.

This study is the first within the HIV/SRH context to consider quality measures, incorporating structural and process attributes of quality within the technical efficiency measurement framework. Although this provides a basis for measuring quality of integrated HIV and SRH services, future research would benefit from the inclusion of outcome measures that denote the effects of care on the health status of patients. Furthermore, in relation to the methods of incorporating the quality measures into the efficiency measurement framework, the findings of this analysis did not provide a definitive way of incorporating quality, nor did it conclusively prove that either method is inappropriate. However, it highlights the need for further study in this area.

In relation to cost efficiency, it is likely that consideration of the broader health systems costs may have a larger impact on the efficiency gains resulting from integration. To aid policymakers in their efforts to improve the efficiency of HIV and SRH programs, future research may wish to take into account costs beyond the service delivery point that are not considered in this thesis. In addition, taking a broader perspective and incorporating an analysis of patient level and societal costs would inform on the true gains in allocative efficiency which are

likely to be important as patients make fewer visits to health facilities for care and possibly spend less time at the facilities.

Finally, efficiency measurement exercises in LMIC contexts in general have been hindered by lack of accurate and reliable data. Data scarcity remains a major issue, as data required for such analysis is not consistently collected as part of the routine health management information systems. Where some data is available, it is fragmented and the quality of the data is questionable as health providers find it difficult to maintain vertical data collection. This makes data collection for the purposes of efficiency analysis in these settings not only difficult but an expensive venture. For example, a minimum of two weeks per health facility was required to obtain the data to conduct the analysis in this thesis. This involved travel to the facility and district headquarters to collect data that was not available at the health facility level.

Therefore there is a critical need to develop simple integrated data reporting systems that can provide accurate information on input, activities and costs across all service/disease settings within facilities. Improving routine data collection at the service delivery level by integrating health management information tools would not only make it less complex for health providers but would also contribute to better efficiency estimates. Further, as management appears to be a critical factor in determining the efficiency of health facilities, developing and incorporating a measure of management capacity, as a determinant of efficiency should also be added to a future research agenda in this area.

10.8 Concluding remarks

The literature on the benefits of integrating HIV and SRH services has long hypothesized efficiency gains from integrating these complementary services. In addition, economic theory supports such integration as a means to achieve efficiency gains through economies of scale and scope. However this conventional wisdom has remained unsupported by empirical data.

The overarching aim of this thesis was to contribute to understanding the efficiency gains associated with integration of these services. Using non-parametric and parametric techniques to evaluate technical and cost efficiency, the findings of this study highlight the importance of analysing both technical and cost efficiency as results may depend on the type of efficiency analysed. Specifically, the findings from the analysis of technical and cost efficiency of integrated HIV and SRH services indicate that organisational characteristics that may have a positive impact on technical efficiency have negative impact on cost efficiency.

The findings of this thesis also show that inefficiencies exist in the provision of integrated HIV and SRH services. Nevertheless, the analysis of cost efficiency clearly indicates that efficiency gains from integration largely arise from increased scale of HIV services and confirm the presence of cost complementarities associated with some service combinations. However, future work is needed to account for potential endogeneity of integration.

Bibliography

1. UNAIDS, *Global report: UNAIDS report on the global AIDS epidemic 2012*. 2012, UNAIDS.
2. Lusti-Narasimhan, M., L. Say, and M.T. Mbizvo, *Linking HIV and sexual and reproductive health services to enhance program outcomes*. International Journal of Gynecology & Obstetrics, 2010. **110**: p. S7-S9.
3. Nougua, A. and A. Ayalew, *Integration of family planning into HIV counselling and testing, prevention of mother to child transmission and antiretroviral therapy services*. 2010, Pathfinder International: Watertown, MA.
4. Berer, M., *HIV/AIDS, sexual and reproductive health: intersections and implications for national programmes*. Health Policy and Planning, 2004. **19**(suppl 1): p. i62-i70.
5. UNAIDS, *Sexual and reproductive health services with HIV interventions in practice: Background Paper*, in *26th Meeting of the UNAIDS Programme Coordinating Board*. 2010: Geneva.
6. Lush, L., et al., *The role of MCH and family planning services in HIV/STD control: is integration the answer?* African Journal of Reproductive Health, 2001: p. 29-46.
7. Delvaux, T. and C. Nöstlinger, *Reproductive choice for women and men living with HIV: contraception, abortion and fertility*. Reproductive health matters, 2007. **15**(29): p. 46-66.
8. Dudley, L. and P. Garner, *Strategies for integrating primary health services in low-and middle-income countries at the point of delivery*. Cochrane Database Systematic Reviews, 2011. **7**.
9. Ickovics, J., *"Bundling" HIV prevention: Integrating services to promote synergistic gain*. Multiple Health Behavior Change (MHBC) Research, 2008. **46**(3): p. 222-225.
10. Baumol, W.J., John C. Panzar., and R.D. Willig, *Contestable Markets and the Theory of Industry and Structure*. 1982, New York: Harcourt, Brace and Jovanovich.
11. Hanefeld, D.J. and D.N. Palmer. *Using a qualitative health policy analysis framework to better understand integration of HIV services with health systems*. in *Global Health Systems Symposium*. 2010. Montreux.
12. Kennedy, C.E., et al., *Linking sexual and reproductive health and HIV interventions: a systematic review*. Journal of the International AIDS Society, 2010. **13**(1): p. 26.
13. Dehne, K.L., R. Snow, and K.R. O Reilly, *Integration of prevention and care of sexually transmitted infections with family planning services: what is the evidence for public health benefits?* Bulletin of the World Health Organization, 2000. **78**(5): p. 628-639.
14. Lush, L., *Service integration: an overview of policy development*. Issues in Perspective, 2002. **28**(2): p. 71-76.
15. Askew, I. and M. Berer, *The Contribution of Sexual and Reproductive Health Services to the Fight against HIV/AIDS: A Review*. Reproductive Health Matters, 2003. **11**(22): p. 51-73.

16. Church, K. and S.H. Mayhew, *Integration of STI and HIV Prevention, Care, and Treatment into Family Planning Services: A Review of the Literature*. *Studies in Family Planning*, 2009. **40**(3): p. 171-186.
17. WHO, et al., *Sexual and reproductive health and HIV/AIDS: a framework for priority linkages 2005*. 2005.
18. Church, K. and S. Mayhew, *Integration of STI and HIV prevention, care, and treatment into FP services: a review of literature*. *Stud Fam Plann*, 2009. **40**(3): p. 171 - 186.
19. Spaulding, A., D. Brickley, and C. Kennedy, *Linking family planning with HIV/AIDS interventions: a systematic review of evidence*. *AIDS*, 2009. **23**(suppl. 1): p. S79 - S88.
20. Sweeney, S., et al., *Costs and efficiency of integrating HIV/AIDS services with other health services: a systematic review of evidence and experience*. *Sexually Transmitted Infections*, 2011.
21. Siapka, M., et al., *Is there scope for cost savings and efficiency gains in HIV services? A systematic review of the evidence from low and middle income countries*. *Bulletin of the World Health Organization*, 2014. **ISSN 0042-9686 (In Press)**.
22. Homan, R., et al., *Cost of introducing two different models of integrating VCT for HIV within family planning clinics in South Africa*, in *Linking Reproductive Health, Family Planning, and HIV/AIDS in Africa*, 9 -10 October. 2006: Addis Ababa.
23. Das, R., et al., *Strengthening Financial Sustainability through Integration of Voluntary Counseling and Testing Services with Other Reproductive Health Services*. 2007, Population Council: Washington DC.
24. Liambila, W., et al., *Feasibility, acceptability, effect and cost of integrating counseling and testing for HIV within family planning services in Kenya*. 2008, Population Council: Washington DC.
25. Shade, S.B.a., et al., *Cost, cost-efficiency and cost-effectiveness of integrated family planning and HIV services*. *AIDS*, 2013. **27 Supplement**(1): p. S87-S92.
26. Conteh, L. and D. Walker, *Cost and unit cost calculations using step-down accounting*. *Health Policy and Planning*, 2004. **19**(2): p. 127-135.
27. Barnum, H. and J. Kutzin, *Public hospitals in developing countries: resource use, cost, financing*. 1993.
28. UNFPA and IPPF, *Integrating HIV voluntary counseling and testing services into reproductive health settings: 2004. Stepwise guidelines for programme planners, managers and service providers*. 2004: London.
29. UNGASS, *Declaration of commitment on HIV/AIDS*. 2001, UNITED NATIONS GENERAL ASSEMBLY SPECIAL SESSION ON HIV/AIDS 25-27 JUNE 2001: New York.
30. UNFPA, *The Glion Call to Action on Family Planning and HIV/AIDS in Women and Children*, 3- 5 May 2004. 2004, United Nations Population Fund: New York, NY.
31. UNFPA, *The New York Call to Commitment: Linking HIV/AIDS and Sexual Reproductive Health*. 2004.
32. Gleneagles, G., *The Gleneagles Communique on Africa*. 2005.

33. UNGASS, *Resolution 60/262. Political Declaration on HIV/AIDS 2006*: New York, NY.
34. UNGASS, *Resolution 65/277. Political Declaration on HIV and AIDS: Intensifying Our Efforts to Eliminate HIV and AIDS*. 2011.
35. World Health Organization Secretariat. *Draft WHO HIV strategy 2011–2015 in SIXTY-FOURTH WORLD HEALTH ASSEMBLY*. 2011.
36. Best, K., *Cambodia: clients find everything they need in one place*. Network. Family Health International, 2004. **23**(17).
37. Family Health International, *Family planning and HIV service integration*. Network, 2004 **23**(2).
38. Family Health International, *Integrating family planning into VCT services*. Network, 2004. **23**(3).
39. Duerr, A., et al., *Integrating family planning and prevention of mother-to-child HIV transmission in resource-limited settings*. *The Lancet*. **366**(9481): p. 261-263.
40. Grossman, D.a.b., et al., *Integration of family planning services into HIV care and treatment in Kenya: a cluster-randomized trial*. *AIDS*, 2013. **27 Supplement**(1): p. S77-S85.
41. Schneider, H., H. Hlophe, and D. van Rensburg, *Community health workers and the response to HIV/AIDS in South Africa: tensions and prospects*. *Health Policy and Planning*, 2008. **23**(3): p. 179-187.
42. World Bank, *World Development Indicators*. 2013.
43. United Nations Development Programme, *Human Development Report 2013. The Rise of the South: Human Progress in a Diverse World*. 2013, United Nations Development Programme: New York, NY.
44. Kenya National Bureau of Statistics, *Kenya 2009 Population & Housing Census Highlights*. 2010.
45. Kenya National Bureau of Statistics (KNBS) and I. Macro, *Kenya Demographic and Health Survey 2008-09*. 2010, KNBS and ICF Macro.: Calverton, Maryland.
46. National AIDS and STI Control Programme, M.o.H., Kenya, *Kenya AIDS Indicator Survey 2012: Preliminary Report*. Nairobi, Kenya. 2013.
47. NASCOP, *2007 Kenya AIDS Indicator Survey: Final Report*. 2009, NASCOP: Nairobi, Kenya.
48. National AIDS Control Council, *Kenya National HIV/AIDS Strategic Plan (KNASP) 2005/06-2009/10*. 2005: Nairobi.
49. USAID, *Kenya Adopts First National Reproductive Health Policy*. 2007.
50. Ministry of Public Health and Sanitation and the Ministry of Medical Services, *National Reproductive Health and HIV and AIDS Integration Strategy*. 2009.
51. United Nations, *2013 World Statistics Pocketbook Country Profile: Swaziland*. 2013.
52. World Bank. *How we Classify Countries*. 2013; Available from: <http://data.worldbank.org/about/country-classifications>.
53. CSO, *Swaziland Demographic and Health Survey 2006-07*, C.S. Office, Editor. 2007, Central Statistical Office Mbabane, Swaziland.

54. Ministry of Health. *Swaziland HIV Incidence Measurement Survey (SHIMS): First Findings Report*. 2012; Available from: http://www.k4health.org/sites/default/files/SHIMS_Report.pdf.
55. Government of Swaziland, *The National Multi-sectoral Strategic Framework For HIV and AIDS 2009 – 2014* 2009.
56. Ministry of Health, *National policy on sexual and reproductive health*. 2013, Government of Swaziland.
57. Hollingsworth, B., *Efficiency measurement in health and healthcare / Bruce Hollingsworth and Stuart J. Peacock*. Routledge International studies in health economics, ed. S. Peacock. 2008, London: Routledge.
58. Jacobs, R., P.C. Smith, and A. Street, *Measuring Efficiency in Health Care: Analytic Techniques and Health Policy*. 2006: Cambridge University Press.
59. Panzar, J.C. and R.D. Willig, *Economies of scope*. The American Economic Review, 1981. **71**(2): p. 268-272.
60. Bell, C.R., *Economies of, versus returns to, scale: A clarification*. Journal of Economic Education, 1988: p. 331-335.
61. Hollingsworth, B. and A. Street, *The market for efficiency analysis of health care organisations*. Health Economics, 2006. **15**(10): p. 1055-1059.
62. McGuire, A. and R. Westoby, *A production function analysis of acute hospitals*. 1983, University of Aberdeen, Aberdeen, UK. .
63. Akridge, J.T., *Measuring productive efficiency in multiple product agribusiness firms: A dual approach*. American Journal of Agricultural Economics, 1989. **71**(1): p. 116-125.
64. Debreu, G., *The coefficient of resource utilization*. Econometrica: Journal of the Econometric Society, 1951: p. 273-292.
65. Farrell, M.J., *The Measurement of Productive Efficiency*. Journal of the Royal Statistical Society. Series A (General), 1957. **120**(3): p. 253-290.
66. Farrell, M., *The measurement of productive efficiency*. J R Stat Soc, 1957. **120**(3): p. 253 - 258.
67. Aigner, D., C.A.L. Lovell, and P. Schmidt, *Formulation and estimation of stochastic frontier production function models*. Journal of econometrics, 1977. **6**(1): p. 21-37.
68. Meeusen, W. and J. Van den Broeck, *Efficiency estimation from Cobb-Douglas production functions with composed error*. International economic review, 1977. **18**(2): p. 435-444.
69. Battese, G.E. and G.S. Corra, *Estimation of a production frontier model: with application to the pastoral zone of Eastern Australia*. Australian Journal of Agricultural and Resource Economics, 1977. **21**(3): p. 169-179.
70. Aigner, D.J. and S.F. Chu, *On estimating the industry production function*. The American Economic Review, 1968. **58**(4): p. 826-839.
71. Charnes, A., W. Cooper, and E. Rhodes, *Measuring the efficiency of decision making units*. Eur J Oper Res, 1978. **2**: p. 429 - 444.
72. Deprins, D., L. Simar, and H. Tulkens, *Measuring labor-efficiency in post offices, in Public goods, environmental externalities and fiscal competition*. 2006, Springer. p. 285-309.

73. Coelli, T. and S. Perelman, *Efficiency measurement, multiple-output technologie and distance functions: With application to European Railways*. 1996.
74. Butler, J.R., *Hospital cost analysis*. Vol. 3. 1995: Springer.
75. Greene, W.H., *The econometric approach to efficiency analysis*. The measurement of productive efficiency and productivity growth, 2008: p. 92-250.
76. Vitaliano, D.F. and M. Toren, *Cost and efficiency in nursing homes: a stochastic frontier approach*. Journal of Health Economics, 1994. **13**(3): p. 281-300.
77. Akridge, J.T. and T.W. Hertel, *Multiproduct cost relationships for retail fertilizer plants*. American journal of agricultural economics, 1986. **68**(4): p. 928-938.
78. Gilligan, T., M. Smirlock, and W. Marshall, *Scale and scope economies in the multi-product banking firm*. Journal of Monetary Economics, 1984. **13**(3): p. 393-405.
79. Cowing, T.G. and A.G. Holtmann, *Multiproduct short-run hospital cost functions: empirical evidence and policy implications from cross-section data*. Southern Economic Journal, 1983: p. 637-653.
80. Kim, H.Y., *Economies of Scale in Multi-Product Firms: An Empirical Analysis*. Economica, 1987. **54**(214): p. 185-206.
81. Caves, D.W., L.R. Christensen, and M.W. Tretheway, *Flexible Cost Functions for Multiproduct Firms*. The Review of Economics and Statistics, 1980. **62**(3): p. 477-481.
82. Escarce, J.J. and M.V. Pauly, *Physician opportunity costs in physician practice cost functions*. Journal of health economics, 1998. **17**(2): p. 129-151.
83. Triebs, T., et al., *Estimating economies of scale and scope with flexible technology*. 2012, Ifo Working Paper.
84. Manning, W.G., *The logged dependent variable, heteroscedasticity, and the retransformation problem*. Journal of Health Economics, 1998. **17**(3): p. 283-295.
85. Siciliani, L., *Estimating Technical Efficiency in the Hospital Sector with Panel Data: A Comparison of Parametric and Non-Parametric Techniques*. Applied Health Economics and Health Policy, 2006. **5**(2): p. 99-116.
86. Banker, R.D., A. Charnes, and W.W. Cooper, *Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis*. Management Science, 1984. **30**(9): p. 1078-1092.
87. Forbes, M., et al., *Measuring the technical efficiency of public and private hospitals in Australia*, in Presented at the Australian Conference of Economists. 2010: Sydney.
88. Banker, R.D., R.F. Conrad, and R.P. Stráuss, *A Comparative Application of Data Envelopment Analysis and Translog Methods: An Illustrative Study of Hospital Production*. Management Science, 1986. **32**(1): p. 30-44.
89. Kooreman, P., *Data envelopment analysis and parametric frontier estimation: complementary tools*. Journal of Health Economics, 1994. **13**(3): p. 345-346.

90. Lopez-Valcarcel, G. and P.B. Perez, *Changes in the efficiency of Spanish public hospitals after the introduction of program-contracts*. *Investigaciones Economicas*, 1996. **20**(3): p. 377-402.
91. Linna, M. and U. Häkkinen, *A Comparative Application of Econometric Frontier and Dea Methods for Assessing Cost Efficiency of Finnish Hospitals*, in *Health, the Medical Profession, and Regulation*, P. Zweifel, Editor. 1998, Springer US. p. 169-187.
92. Jacobs, R., *Alternative methods to examine hospital efficiency: data Envelopment analysis and stochastic frontier analysis*. *Health Care Management Science*, 2001. **4**: p. 103 - 115.
93. Valdmanis, V., L. Kumanarayake, and J. Lertiendumrong, *Capacity in Thai Public Hospitals and the Production of Care for Poor and Nonpoor Patients*. *Health Services Research*, 2004. **39**(6p2): p. 2117-2134.
94. Osei, D., et al., *Technical efficiency of public district hospitals and health centres in Ghana: a pilot study*. *Cost Effectiveness and Resource Allocation*, 2005. **3**: p. 9.
95. Huang, Y.-G. and C.P. McLaughlin, *Relative efficiency in rural primary health care: an application of data envelopment analysis*. *Health Services Research*, 1989. **24**(2): p. 143.
96. Tortosa-Ausina, E., et al., *Sensitivity analysis of efficiency and Malmquist productivity indices: An application to Spanish savings banks*. *European Journal of Operational Research*, 2008. **184**(3): p. 1062-1084.
97. Efron, B., *Bootstrap methods: another look at the jackknife*. *The annals of Statistics*, 1979: p. 1-26.
98. Street, A. and U. Häkkinen, *Health system productivity and efficiency*, in *Performance measurement for health system improvement: experiences, challenges and prospects*, P.C. Smith, et al., Editors. 2009, Cambridge University Press. p. 222-248.
99. Jenkins, L. and M. Anderson, *A multivariate statistical approach to reducing the number of variables in data envelopment analysis*. *European Journal of Operational Research*, 2003. **147**(1): p. 51-61.
100. Wagner, J.M. and D.G. Shimshak, *Stepwise selection of variables in data envelopment analysis: Procedures and managerial perspectives*. *European Journal of Operational Research*, 2007. **180**(1): p. 57-67.
101. Friedman, L. and Z. Sinuany-Stern, *Scaling units via the canonical correlation analysis in the DEA context*. *European Journal of Operational Research*, 1997. **100**(3): p. 629-637.
102. Cooper, W., L. Seiford, and K. Tone, *Data Envelopment Analysis: A Comprehensive Text With Models, Applications, References and Dea-solver Software*. 2006: Springer-Verlag.
103. Nunamaker, T.R., *Using data envelopment analysis to measure the efficiency of non-profit organizations: A critical evaluation*. *Managerial and Decision Economics*, 1985. **6**(1): p. 50-58.
104. Adler, N. and E. Yazhemy, *Improving discrimination in data envelopment analysis: PCA-DEA or variable reduction*. *European Journal of Operational Research*, 2010. **202**(1): p. 273-284.
105. Dyson, R.G., et al., *Pitfalls and protocols in DEA*. *European Journal of Operational Research*, 2001. **132**(2): p. 245-259.

106. Golany, B. and Y. Roll, *An application procedure for DEA*. Omega, 1989. **17**(3): p. 237-250.
107. Vladmanis, V., *Sensitivity analysis for DEA models: an empirical example using public vs NFP hospitals*. Journal of Public Economics, 1992. **48**: p. 185-205.
108. Ozcan, Y.A. and R.D. Luke, *A national study of the efficiency of hospitals in urban markets*. Health Services Research, 1993. **27**(6): p. 719-739.
109. Rosko, M.D., et al., *The effects of ownership, operating environment, and strategic choices on nursing efficiency*. Medical Care, 1995. **33**(10): p. 1001-1021.
110. Asbu, E., D. McIntyre, and T. Addison, *Hospital efficiency and productivity in three provinces of South Africa*. South African Journal of Economics, 2001. **69**(2): p. 336 - 358.
111. Kirigia, J. and E. Asbu, *Technical and scale efficiency of public community hospitals in Eritrea: an exploratory study*. Health Economics Review, 2013. **3**(1): p. 6.
112. Charnes, A., W.W. Cooper, and E. Rhodes, *Measuring the efficiency of decision making units*. European Journal of Operational Research, 1978. **2**(6): p. 429-444.
113. de Borger, B., K. Kerstens, and M. Staat, *Transit costs and cost efficiency: Bootstrapping non-parametric frontiers*. Research in Transportation Economics, 2008. **23**(1): p. 53-64.
114. Hoff, A., *Second stage DEA: Comparison of approaches for modelling the DEA score*. European Journal of Operational Research, 2007. **181**(1): p. 425-435.
115. Simar, L. and P.W. Wilson, *Estimation and inference in two-stage, semiparametric models of production processes*. J Econ, 2007. **136**(1): p. 31-64.
116. Simar, L. and P.W. Wilson, *Estimation and inference in two-stage, semi-parametric models of production processes*. Journal of Econometrics, 2007. **136**(1): p. 31-64.
117. Salinas-Jiménez, J. and P. Smith, *Data envelopment analysis applied to quality in primary health care*. Annals of Operations Research, 1996. **67**(1): p. 141-161.
118. García, F., et al., *Evaluation of Efficiency in Primary Health Care Centres: An Application of Data Envelopment Analysis*. Financial Accountability & Management, 1999. **15**(1): p. 67-83.
119. Giuffrida, A. and H. Gravelle, *Measuring performance in primary care: econometric analysis and DEA*. Applied Economics, 2001. **33**: p. 163 - 175.
120. Wagner, J.M., D.G. Shimshak, and M.A. Novak, *Advances in physician profiling: the use of DEA*. Socio-Economic Planning Sciences, 2003. **37**(2): p. 141-163.
121. Amado, C.A.d.E.F. and S.P.d. Santos, *Challenges for performance assessment and improvement in primary health care: The case of the Portuguese health centres*. Health policy (Amsterdam, Netherlands), 2009. **91**(1): p. 43-56.

122. Cordero Ferrera, J., E. Cebada, and L. Murillo Zamorano, *The effect of quality and socio-demographic variables on efficiency measures in primary health care*. The European Journal of Health Economics, 2013: p. 1-14.
123. Boller, C., et al., *Quality and comparison of antenatal care in public and private providers in the United Republic of Tanzania*. Bulletin of the World Health Organization, 2003. **81**(2): p. 116-122.
124. Donabedian, A., *The quality of care: How can it be assessed?* JAMA, 1988. **260**(12): p. 1743-1748.
125. Gilson, L., H. Kitange, and T. Teuscher, *Assessment of process quality in Tanzanian primary care*. Health Policy, 1993. **26**(2): p. 119-139.
126. Rosenman, R. and D. Friesner, *Scope and scale inefficiencies in physician practices*. Health Economics, 2004. **13**(11): p. 1091-1116.
127. Nedelea, I. and J. Fannin, *Technical efficiency of Critical Access Hospitals: an application of the two-stage approach with double bootstrap*. Health Care Management Science, 2013. **16**(1): p. 27-36.
128. Allen, R., et al., *Weights restrictions and value judgements in Data Envelopment Analysis: Evolution, development and future directions*. Annals of Operations Research, 1997. **73**(0): p. 13-34.
129. Shimshak, D.G., M.L. Lenard, and R.K. Klimberg, *Incorporating quality into data envelopment analysis of nursing home performance: A case study*. Omega, 2009. **37**(3): p. 672-685.
130. Sherman, H.D. and J. Zhu, *Benchmarking with quality-adjusted DEA (Q-DEA) to seek lower-cost high-quality service: Evidence from a U.S.bank application*. Annals of Operations Research, 2006. **145**(1): p. 301-319.
131. Zervopoulos, P. and T. Palaskas, *Applying quality-driven, efficiency-adjusted DEA (QE-DEA) in the pursuit of high-efficiency-high-quality service units: an input-oriented approach*. IMA Journal of Management Mathematics, 2011. **22**(4): p. 401-417.
132. Ferrier, G. and V. Valdmanis, *Rural hospital performance and its correlates*. Journal of Productivity Analysis, 1996. **7**(1): p. 63-80.
133. Lovell, C.A.K., *Production Frontiers and Productive Efficiency*, in *The Measurement of Productive Efficiency*, L.C. Fried HO, Schmidt SS, Editor. 1993, Oxford University Press: New York.
134. Weaver, M. and A. Deolalikar, *Economies of scale and scope in Vietnamese hospitals*. Social Science & Medicine, 2004. **59**(1): p. 199-208.
135. Marseille, E., et al., *Assessing the Efficiency of HIV Prevention around the World: Methods of the PANCEA Project*. Health Serv Res, 2004. **39**(6 Pt 2): p. 1993 - 2012.
136. Grosskopf, S. and V. Valdmanis, *Measuring hospital performance: A non-parametric approach*. Journal of Health Economics, 1987. **6**(2): p. 89-107.
137. Jat, T.R. and M.S. Sebastian, *Technical efficiency of public district hospitals in Madhya Pradesh, India: a data envelopment analysis*. Global Health Action, 2013. **6**(21742).
138. Akazili, J., et al., *Using data envelopment analysis to measure the extent of technical efficiency of public health centres in Ghana*. BMC International Health and Human Rights, 2008. **8**: p. 11.

139. Chang, H., *Determinants of hospital efficiency: the case of central government- owned hospitals in Taiwan*. Omega International Journal of Management Science, 1998. **26**(2): p. 307 - 317.
140. Ichoku, H., et al., *Evaluating the technical efficiency of hospitals in South Eastern Nigeria*. European Journal of Business and Management, 2011. **3**(2): p. 24 - 37.
141. Kirigia, J., A. Emrouznejad, and L. Sambo, *Measurement of technical efficiency of public hospitals in Kenya: using data envelopment analysis*. Journal of Medical Systems, 2002. **26**(1): p. 39 - 45.
142. Kirigia, J., et al., *Using Data Envelopment Analysis to measure the technical efficiency of public health centres in Kenya*. Journal of Medical Systems, 2004. **28**(2): p. 155 - 166.
143. Kirigia, J., E. Lambo, and L. Sambo, *Are public hospitals in Kwazulu-Natal Province of South Africa technically efficient*. African Journal of Health Sciences, 2000. **7**(3-4): p. 25 - 32.
144. Kirigia, J., et al., *Technical efficiency of zone hospitals in Benin*. The African Health Monitor, 2010. **12**: p. 30 - 39.
145. Kirigia, J., et al., *Technical efficiency of primary health units in Kailahun and Kenema districts of Sierra Leone*. International Archives of Medicine, 2011. **4**: p. 15.
146. Masiye, F., et al., *Efficient Management of Health Centres Human Resources in Zambia*. J Med Syst, 2006. **30**: p. 473 - 481.
147. Renner, A. and J. Kirigia, *Technical efficiency of health centers in Sierra Leone*. African Health Economics Monitor, 2005. **6**(number 1).
148. Tlotlego, N., et al., *Assessment of productivity of hospitals in Botswana: a DEA application*. International Archives of Medicine, 2010. **3**: p. 27.
149. Kirigia, J., et al., *A performance assessment method for hospitals: the case of Municipal Hospitals in Angola*. Journal of Medical System, 2008. **32**(6): p. 509 - 519.
150. Marschall, P. and S. Flessa, *Efficiency of primary care in rural Burkina Faso. A two-stage DEA analysis*. Health Economics Review, 2011. **1**(1): p. 5.
151. Sebastian, M. and H. Lemma, *Efficiency of the health extension programme in Tigray, Ethiopia: a data envelopment analysis*. BMC International Health and Human Rights, 2010. **10**(1): p. 16.
152. Shahhoseini, R., et al., *Efficiency measurement in developing countries: application of data envelopment analysis for Iranian hospitals*. Health Services Management Research, 2011. **24**(2): p. 75-80.
153. Zere, E., *Hospital Efficiency in Sub-Saharan Africa. Evidence from South Africa*. 2000.
154. Zere, E., et al., *Technical efficiency of district hospitals: Evidence from Namibia using data envelopment analysis*. Cost Effectiveness and Resource Allocation, 2006. **4**: p. 5.
155. Ramanathan, T.V., K.S. Chandra, and W.M. Thupeng, *A comparison of the technical efficiencies of health districts and hospitals in Botswana*. Development Southern Africa, 2003. **20**(2): p. 307-320.

156. Yawe, B., *Hospital Performance Evaluation in Uganda: A Super-Efficiency Data Envelope Analysis Model*. Zambia Social Science Journal, 2010. **1**(1): p. 6.
157. Ismail, M.A., *Technical Efficiency of Sudan's Health Institutions: A State-level Analysis*. Population, 2010. **70**: p. 19922.
158. Al-Shammari, M., *A multi-criteria data envelopment analysis model for measuring the productive efficiency of hospitals*. International Journal of Operations & Production Management, 1999. **19**(9): p. 879-891.
159. Blaakman, A.P., A.S. Salehi, and R. Boitard, *A cost and technical efficiency analysis of two alternative models for implementing the basic package of health services in Afghanistan*. Glob Public Health, 2013.
160. Hu, H.-H., Q. Qi, and C.-H. Yang, *Analysis of hospital technical efficiency in China: Effect of health insurance reform*. China Economic Review, 2012. **23**(4): p. 865-877.
161. Chaabouni, S. and C. Abednnadher, *Efficiency of public hospitals in Tunisia: a DEA with bootstrap application*. International Journal of Behavioural and Healthcare Research, 2012. **3**(3/4): p. 198-211.
162. Kirigia, J.M. and E.Z. Asbu, *Technical and scale efficiency of public community hospitals in Eritrea: an exploratory study*. Health Econ Rev, 2013. **3**(1): p. 6.
163. Osei, D., et al., *Technical efficiency of public district hospitals and health centres in Ghana: a pilot study*. Cost Effectiveness and Resource Allocation, 2005. **3**: p. 9.
164. Zere, E., D. McIntyre, and T. Addison, *Technical Efficiency and Productivity of Public Sector Hospitals in Three South African Provinces*. South African Journal of Economics, 2001. **69**(2): p. 336-58.
165. Akazili, J., et al., *What are the technical and allocative efficiencies of public health centres in Ghana?* Ghana medical journal, 2008. **42**(4): p. 149.
166. Harper, J., K. Hauck, and A. Street, *Analysis of Costs and Efficiency in General Surgery Specialties in the United Kingdom*. HEPAC: Health Economics in Prevention and Care, 2001. **2**(4): p. 150-57.
167. Zeng, W., et al., *How much can we gain from improved efficiency? An examination of performance of national HIV/AIDS programs and its determinants in low- and middle-income countries*. BMC Health Services Research, 2012. **12**(1): p. 74.
168. Warren, C., et al., *Study protocol for the Integra Initiative to assess the benefits and costs of integrating sexual and reproductive health and HIV services in Kenya and Swaziland*. BMC Public Health, 2012. **12**(1): p. 973.
169. Liambila, W.N., et al., *Feasibility, acceptability, effect and cost of integrating counseling and testing for HIV within family planning services in Kenya*. 2008: Population Council, FRONTIERS in Reproductive Health.
170. Kumaranayake, L., et al., *Costing guidelines for HIV prevention strategies*. Birth, 2000. **27**(3): p. 189-190.
171. Mayhew, S., et al., *Innovation in the evaluation of service Integration: the Integra Indexes of HIV and Reproductive Health Integration*. Under review, 2014.
172. Jackson, J.E., *A user's guide to principal components*. Vol. 587. 2005: John Wiley & Sons.

173. Jobson, J.D., *Principal Components, Factors and Correspondence Analysis*, in *Applied Multivariate Data Analysis*. 1992, Springer New York. p. 345-482.
174. Foreit, K., K. Hardee, and K. Agarwal, *When does it make sense to consider integrating STI and HIV services with family planning services?* Int Fam Plann Serv, 2002. **28**(2): p. 105 - 107.
175. Menzies, N.A., A.A. Berruti, and J.M. Blandford, *The Determinants of HIV Treatment Costs in Resource Limited Settings*. PLoS ONE, 2012. **7**(11): p. e48726.
176. Dickinson, C., K. Attawell, and N. Druce, *Progress on scaling up integrated services for sexual and reproductive health and HIV*. Bulletin of the World Health Organization, 2009. **87**: p. 846-851.

Appendix 1: Summary of health facilities

Country	Facility Name	Facility type	Ownership	Location	No of Clinical Staff
Swaziland	Raleigh Fitkin Memorial (RFM)	Provincial	Public/Mission Hospital	Urban	218
	King Sobhuza Memorial (KSII)	Public health unit	Public - Clinic	Urban	12
	Mankayane	Hospital	Public-Hospital	Rural	73
	Mbabane	Public health unit	Public PHU	Urban	18
	Dvokolwako	Health Centre	Public - HC	Rural	30
	Nhlangano	Health Centre	Public – HC	Rural	45
	Matsanjeni	Health Centre	Public – HC	Rural	24
	Sithobela	Health Centre	Public – HC	Rural	23
	FLAS Manzini	SRH Clinic	NGO SRH Clinic	Urban	6
	FLAS Mbabane	SRH Clinic	NGO SRH Clinic	Urban	3

Country	Facility Name	Facility type	Ownership	Location	No of Clinical Staff
Kenya	Nyeri	Provincial	Public	Peri-Urban	297
	Muranga	District	Public	Peri-Urban	86
	Nyahururu	District	Public	Peri-Urban	210
	Thika	District	Public	Peri-Urban	288
	Ruiru	SDH	Public	Rural	15
	Kirwara	SDH	Public	Rural	14
	Engineer	SDH	Public	Rural	12
	Warazo	Health Centre	Public	Rural	6
	Ngorano	Health Centre	Public	Rural	4
	Kigumo	Health Centre	Public	Rural	9
	Kangari	Health Centre	Public	Rural	3
	Njabini	Health Centre	Public	Rural	14
	Makueni	District	Public	Peri-Urban	147
	Nunguni	SDH	Public	Rural	6
	Kathonzweni	Health Centre	Public	Rural	5
	Mavindini	Health Centre	Public	Rural	4
	Kilala	Health Centre	Public	Rural	3
	Kyambekye	Health Centre	Public	Rural	3
	Kitui	District	Public	Peri-Urban	174
	Mutito	SDH	Public	Rural	4
	Kauwi	SDH	Public	Rural	6
	Yatta	Health Centre	Public	Rural	4
	Miambane	Health Centre	Public	Rural	4
	Mbitini	Health Centre	Public	Rural	3
	Nairobi West	SRH Clinic	NGO	Urban	15
	Nakuru	SRH Clinic	NGO	Urban	4
	Eldoret	SRH Clinic	NGO	Urban	12
	Kisumu	SRH Clinic	NGO	Urban	5
	Meru	SRH Clinic	NGO	Urban	3
	IFHOK Thika	SRH Clinic	NGO	Urban	2

Appendix 2: Periodic Activity Review Tool



Economic Analysis of Integrated SRH and HIV Services in Kenya and Swaziland

Periodic Activity Review of Facilities providing Integrated SRH & HIV Services

Topic Guide for Information Collection

London School of Hygiene and Tropical Medicine

100. Facility Name:

101. Contact Person:

102. Date of Activity Review:

Introduction

This periodic activity review is intended to document the nature, range and method of delivery of sexual reproductive health and HIV services in each project facility. Specifically, we would like to understand how service integration is working in this facility. The periodic activity review has the following objectives:

1. To understand the organization and size of the facility.
2. To review activities and services currently being delivered in each facility.
 - To understand the evolution of services i.e. was a service previously provided? How long has the service been delivered for?
 - To identify new services or activities planned and the likely timeframe.
 - To understand what other facilities/services patients are referred to?
3. To understand how integration of services provided in this facility works.
4. To understand the patient flow, by illustrating what happens when a patient comes into a clinic.
5. To understand the nature of existing monitoring.
 - What indicators are collected and how are they collected? E.g. For age, are the actual ages noted down or is a patient labelled as either youth or adult?
 - What information is actually entered and who enters the information? Is it the patient or the service providers? What is collected in paper or electronic form?
6. To identify providers of substitute services if any in the community.
7. To feed into the development of a costing protocol.

This instrument is designed for members of the economics team to collect information through interviews with key staff and observation of activities in each project facility.

Organization of the Topic Guide

Section 1: Interviews with the receptionist and observation focusing on facility description, services offered and patient/client flows.

Section 2: Interviews with the clinic manager focusing on the process of integration of services.

Section 3: Interviews with other health service providers in the facility e.g. nurses, VCT counsellors focusing on service integration from their point of view and client/patient flow.

Section 4: Management and Supervision costs.

**Topic Guide for Periodic Activity Review
Section 1: Interview with Facility in-charge**

1a. Facility Description							
Location/District							
Type of facility							
No of outpatient visits per year							
No of clinical staff							
No of technical staff							
No of admin/management staff							
Total Sq. meters of facility							
1b. Facility/Individual Clinic Operating Hours							
	Mon	Tue	Wed	Thru	Fri	Sat	Sun
MCH/PHU							
VCT							
STI							
CCC/ART							
TB							

**Topic Guide for Periodic Activity Review
Section 1: Interview with Facility in-charge**

1c. Facility size (number of rooms and size available for each service). A separate sheet is included to draw a map of the rooms in the MCH/PHU/STI/TB/ART Clinics and VCT Centres.							
1. FP				8. Pharmacy			
2. PITC				6. Laboratory			
3. STI Management				7. Administration			
4. PNC				8. Cleaning and Laundry			
5. Ca Cervix Screening				11. Maintenance			
6. VCT				12. Other MCH/PHU			
7. TB				13. Other			
1d. What are the types of staff currently working in the clinics? Include entire hospital where known.							
	Hospital	MCH	VCT		Hospital	MCH	VCT
Medical Officers (MO)				Public Health Techs			
Clinical Officers (CO)				VCT/PITC Counsellors			
Registered Nurses (RN)				Admin/Senior Mgmt.			
Enrolled Nurses (EN)				Data Clerks			
Laboratory Techs				Casual Staff			
Pharmaceutical Techs				Other			
1e. How many staff does each clinic have?							
	MCH/FP	STI Clinic	VCT	TB Clinic	ART Clinic	Other	
Clinical staff							
Technical staff							
Admin staff							
Volunteers							

**Topic Guide for Periodic Activity Review
Section 1: Interview with Facility in-charge**

Notes:

Topic Guide for Periodic Activity Review
Section 1: Interviews with the Facility in-charge

1f. Map of the Facilities – This is a sketch of the physical layout of the facility

Topic Guide for Periodic Activity Review
Section 1: Interviews with the Facility in-charge

SERVICES OFFERED

1g. Overall Description of SRH And HIV Related Services Offered in the MCH and VCT Centre					
Does your facility offer the following integrated sexual and reproductive health products and services? For services offered, please also indicate what type of staff provides the service (i.e. doctor, nurse, lab tech).					
	MCH	VCT	ART/ CCC	Staff providing service	If not provided in MCH or VCT where are clients referred? Notes.
Contraceptive pills					
IUCD					
Injectables					
Implants					
Vasectomy and BTL					
Male and female condoms					
Emergency contraceptive					
Antenatal care					
Postnatal care					
Child welfare clinic					
Pap smear (Via Villi)					
Post abortal care (MVA)					
Maternity/Gynea services					
Male circumcision					
Management of infertility					
General SRH counselling					

**Topic Guide for Periodic Activity Review
Section 1: Interviews with the Facility in-charge**

PITC					
VCT					
PMTCT					
STI management					
Anti-retroviral treatment					
CD4 Count					
Youth friendly services					
Curative services					
Laboratory					
Pharmacy					
1h. Are there any other services or activities other than those indicated above, offered in the facility? Please list and include date service began.					
Service			Start date		Staff type involved in service provision
1i. Service provision hours. Are all the services listed in 1g and 1h provided daily? If not, when are they provided?					
Notes					

Topic Guide for Periodic Activity Review
Section 2: Interviews with MCH/PHU Clinic Staff

2a. Brief description of how the facility is organized or draw organogram. If available get a copy of an organization chart if any. Include a personal introduction of interviewee.

Discussion points:

- 1. *Personal introduction of interviewees - how long he/she has worked in the clinic***
- 2. *Organization of the clinic.***
- 3. *Type of clinic (mobile/static clinics)***
- 4. *Range of services provided in the clinic***
- 5. *Target population.***
- 6. *Relationship with other clinics around***

Topic Guide for Periodic Activity Review
Section 2: Interviews with MCH/PHU Clinic Staff

INTEGRATION OF SERVICES

2b. When did service integration in this facility begin?	Last Year			
	2 Years ago			
	3 Years ago			
	More than 3 Years ago			
2c. How was service integration initiated?				
2d. Was there any training on service integration provided to staff?	Yes		No	

Topic Guide for Periodic Activity Review
Section 2: Interviews with MCH/PHU Clinic Staff

If Yes, provide a summary of the training provided and names/titles of the clinic staff who attended, duration of training and who provided training.

Notes:

2e. Describe nature of any interventions aimed at strengthening/enabling integration of services. E.g. Apart from staff training were any other opportunities to strengthen integration provided? Such as equipment and supply purchases.

Notes:

Topic Guide for Periodic Activity Review
Section 2: Interviews with MCH/PHU Clinic Staff

2f. Please describe a typical client visit in the Clinic. I.e. Who does the client see upon arrival at the clinic and then what happens.

2g. Pictoral Flow of Clients

Based on the map of the clinic, show the different sequential locations that the patient visits.

Topic Guide for Periodic Activity Review
Section 2: Interviews with MCH/PHU Clinic Staff

2h. How does integration of services work? Focus on integration of CT/STI/ART into FP and PNC			
<i>Describe the type of integration currently in the facility. I.e. is it structural or functional. Structural integration is defined as provision of different services by different people under the same roof while functional integration is defined as provision of different services by the same person in the same room/facility.</i>			
2i. Has provision of any of the integrated services provided in the clinic been disrupted?	Yes		No
If yes, which service and why?			
Service	Inconsistent Supplies / Stock Outs	Other or Description/Explanation	

Topic Guide for Periodic Activity Review
Section 2: Interviews with MCH/PHU Clinic Staff

2j. Are there any new services/activities (both SRH and non-SRH) that are yet to be implemented? If yes, please provide details including the likely timeframe.		
Service	Expected implementation date. Are they included in the annual plan?	
2k. Substitute Services - Who else provides similar types of products and services within the community?		
Service	Service Provider	Location
2l. Why do clients return to this clinic/hospital despite the presence of other substitute service providers?		

Topic Guide for Periodic Activity Review
Section 2: Interviews with MCH/PHU Clinic Staff

2m. Are there any fees charged for services provided in the clinic? If fees are charged, how are fees for services determined? Also list any other financing schemes in the facility such as Safe motherhood vouchers etc.

Topic Guide for Periodic Activity Review
Section 3: Interviews with VCT/TB/ART Staff

3a. Brief description of how the clinic/centre is organized or draw organogram. If available get a copy of an organization chart if any. Include a personal introduction of interviewee.

Discussion points:

- 1. Personal introduction of interviewee.-how long he/she has worked in the clinic**
- 2. Organization of the unit**
- 3. Services offered in the unit/clinic**

3b. Client Flow

Description of a typical client visit from the service providers point of view

3c. A pictorial representation of patient flow

3a. Brief description of how the clinic/centre is organized or draw organogram. If available get a copy of an organization chart if any. Include a personal introduction of interviewee.

Discussion points:

- 1. Personal introduction of interviewee.-how long he/she has worked in the clinic**
- 2. Organization of the unit**
- 3. Services offered in the clinic/unit**

Topic Guide for Periodic Activity Review
Section 3: Interviews with VCT/TB/ART Staff

3b. Client Flow

Description of a typical client visit from the Service Providers Point of View

3c. A pictorial representation of patient flow

Topic Guide for Periodic Activity Review
 Section 4: Facility Records review

Service	Indicators	Where are these indicators reported?	How long have indicators been collected for (indicate start year):
STI treatment			
Cervical cancer screening			
HCT			
HIV treatment and care (ART)			

Appendix 3: Integration Index

Innovation in the evaluation of service integration: the Integra Indexes of HIV and reproductive health integration

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Abstract (Word count: 179)

Objectives: To develop an 'Integration Index' measuring the degree and type of integration between HIV and reproductive health (RH) services within primary and secondary health facilities in Kenya and Swaziland, under the Integra Initiative.

Methods We used latent variable measurement models, suitable for the nature of the data and derived latent dimensions of integration. All models were estimated with the Mplus 6.12 software. Data were drawn from client flow (N=XXX) and economic costing tools implemented between 2009-2011 in 40 clinics in Kenya and Swaziland.

Results: The modelling produced two clear and uncorrelated dimensions of integration at facility level leading to the development of two sub-indices: a Structural Integration Index (integrated physical and human resource infrastructure) and a Functional Integration Index (integrated delivery of services to clients).

Conclusions: The Indices are an important methodological contribution for evaluating complex interventions. The findings highlight the importance of multi-dimensional assessments of integration, since structural integration is not sufficient to achieve the integrated delivery of care to clients – i.e. “functional integration”.

Trial registration: NCT01694862 (ClinicalTrials.gov)

What this paper adds

Section 1: What is already known on this subject?

- Multiple studies and reviews published between 1990 and 2013 have highlighted a dearth of convincing evidence on the impact of integrating reproductive health and HIV services on costs or health-related outcomes.
- This lack of robust evidence stems in part from inadequacies in the measurement of integrated care, which traditionally relies on data inputs collected among providers and managers, rather than observations in clinics or assessment of integrated services received by the client.

Section 2: What this study adds

- Our study has developed a two dimensional measure of integration using multiple data sources, which demonstrate that the delivery of integrated health care to clients is not necessarily correlated with the provision of structural inputs in clinics.
- The study confirms the need to broaden traditional evaluations of integrated care through the incorporation of service-delivery data, to avoid misleading conclusions on its 'impact' on health outcomes.

Introduction

The integration of health services has been something of a holy grail for its proponents who commonly point to the potential for cost savings as well as improving the relevance of services to patients and ultimately improving health outcomes. The debate on the relative merits of 'integrated' versus 'vertical' health service delivery has been on-going since the Alma Ata declaration on primary health care in 1978. Since the mid-1990s there has been an expectation, in developing countries, that integration of HIV-related services (such as HIV testing, condom provision, and HIV treatment for HIV infected women) with family planning, antenatal and post-natal care services, would streamline service delivery. In practice, countries take a myriad of different approaches to the organisation of care, and 'integrated' services at the primary care level remain poorly defined. [1-3] There are many ways to describe, measure and interpret integration. In lower- and middle-income (LMIC) contexts it usually implies the amalgamation of previously separate components of care, or the addition of a new intervention into an existing service (e.g. adding HIV testing to family planning services).[4] In industrialised country settings, it is often interpreted as a mechanism to improve the coordination of care between different organisations and professional bodies at different levels of the health system.[5] Similarly, there is no standard definition of the different dimensions of integration, which have been variously categorised by different authors and studies.[4, 6, 7]

This complexity poses a considerable challenge to researchers and policy makers. The multi-dimensional nature of integration raises the fundamental question of how 'integration' or improvements in the levels of integration should actually be measured. This is an important challenge, as without clarity on this, it is extremely difficult to assess the degree to which services are integrated, or whether the delivery of integrated services leads to cost savings, greater client satisfaction, or improved patient outcomes. To date, only a few studies have attempted to measure, rank or assess the causal impact of integrated care.[8] One study in the US attempted to rank clinics by their degree

of integration of HIV with primary care services, determined by interviews with facility managers, then applied this to HIV client visit data to give an 'index of integrated care utilisation'. [9] Another in South Africa attempted to quantify different levels of integration, again based on questionnaires with staff. [10] A third, sought to describe the relationship between integration and 'teen-friendly' service outcomes, and measured integration through both staff and client interviews. [11] More broadly, evaluations on integrated health care packages, such as the Integrated Management of Childhood Illness (IMCI) have focused on the measurement of inputs to assess intervention implementation adequacy, rather than receipt of additional or integrated services by clients. [12]

The Integra Initiative is the largest complex evaluation of its kind seeking to determine the impact of service integration on service and health outcomes in Kenya and Swaziland. Integra's focus is the integration of HIV/sexually transmitted infection (STI) services (including HIV/STI counselling, testing and treatment) and reproductive health (RH) services (including family planning, antenatal and post-natal care), for which multiple benefits have been claimed yet the evidence is at best inconsistent. [13, 14] Integra uses mixed methods to analyse the claimed causal pathway between integration and its theorised outcomes, which include costs, quality of care, service utilisation, stigma and sexual and reproductive behaviours. Integra is embedded research, working in public sector and NGO facilities in Kenya and Swaziland. The initial study design was to conduct a pre/post service intervention study with pair-matched intervention (integrated) and comparison (non-integrated) sites. However, because we had no control over clinic organisation, staff turnover, or external influences like funding and training programmes, it became apparent that it would not be possible to ensure that comparison sites did not receive support to provide integrated services from other donors, or ensure that trained staff in the intervention facilities actually remained in intervention facilities for the duration of the study. Indeed, especially as HIV-RH integration was national policy in both Kenya and Swaziland, a range of externally supported integration activities were implemented in the study clinics. It quickly became clear that any longitudinal analysis would be confounded by the varying levels of

integration already existing in both intervention and comparison sites. It was this that prompted the concept of an index of integration, for the initial purpose of defining a starting point on a spectrum of integration for each study clinic. This later developed into a tool for measuring progress. Our situation is not unique: when evaluating complex health interventions within 'real world' settings, designs that capture the process and extent of implementation are becoming increasingly necessary, particularly where organisational change is involved, and where RCT designs may simply not be feasible.[15-17] This paper thus aims to contribute to the field of complex intervention evaluation, as well as the broader policy debate on integration, by describing the development of a tool to measure the degree of HIV-RH integration achieved in the health facilities studied: the Integra Index.

Methods

The Integra Initiative

The Integra Initiative is a non-randomised, pre/post intervention trial using household and facility-based data. It aims to evaluate the impact of different models of delivering integrated HIV and reproductive health (RH) services in Kenya and Swaziland on a range of health and service outcomes (ClinicalTrials.gov registration number NCT01694862).[18] Research was conducted in both high- and moderate-HIV prevalence settings (Swaziland, 10 clinics; and Kenya, 30 clinics). An intervention was developed in collaboration with the national Ministries of Health to support service integration in study clinics (see Warren et al. for details [18]). Study facilities (n=40) included both primary care clinics (dispensaries, health centres, public health units) (n=30) and secondary outpatient clinics (at district or provincial hospitals) (n=10). 32 clinics were primarily managed by the public sector, and 8 were run by NGOs.

Measurement & ranking of integrated care: the Integra Index

The Integra Index was developed to measure the level of integration at baseline and follow-up in the 40 study facilities. The construction of the Index involved four steps, detailed below.

1) Identification of integration attributes and indicators

We reviewed the key aspects of integration identified in the literature [4-7, 19-24], and assessed what was feasible to measure using the study data. The multi-disciplinary research team (including evaluation researchers, epidemiologists, health systems researchers, economists and statisticians) identified eight 'attributes' that reflect four important dimensions of integration: physical (what rooms/buildings different services are delivered in); temporal (on what days/times); provider (by whom); and functional (defined as "actual services received by client") (Table 1). Given the study's focus, the indicators focused on the provision/receipt of any RH service (family planning (FP), antenatal care, post-natal care) AND any HIV/STI service (HIV counselling and testing, HIV anti-retroviral therapy (ART) treatment, CD4 count services, STI treatment, cervical cancer screening).

Table 1 about here

2) Use of clinic data to generate attribute scores

We drew on two Integra datasets to capture the eight selected attributes, with data from each collected from the 40 clinics at baseline (2008-9) and endline (2011-12): (i) an economics dataset (that included service statistics) and (ii) a client flow dataset.

The economics dataset was derived from costing and periodic activity review tools, completed by researchers in collaboration with facility managers and staff. The tools collected data on expenditures, facility characteristics, staffing and services. They included data from facility registers on services provided, as well as observations of services offered and resource use. The latter involved researchers observing staff members and facility practice over a one-week

period. In addition, interviews were conducted with facility staff, including completion of timesheets, to better understand how both physical infrastructure and human resources were used to provide services. The economics dataset was used to confirm the range of services available in the relevant department and facility, to estimate the average number of different RH-HIV services provided in each consultation room per day, and measure the range of services provided per staff member, and as such, provides information on the physical and human resource infrastructure that is in place and being used (structural integration).

The client flow dataset was derived from a five-day assessment of service utilisation patterns in each study clinic. A client flow form was used to record all services received by/referred to for each client in every consultation over one day's visit. Forms were completed by each provider seen. In Swaziland, 4202 clients were tracked at baseline, and 5040 at endline; in Kenya, 4775 clients were tracked at baseline, and 5829 at endline. The dataset was used to measure whether HIV treatment was being offered on site (or referred off-site); the range of services provided across days of the week; the range of services provided in single consultations; and the range provided in single visits. In this way, this data provides information on each clinic's ability to deliver integrated services to clients (functional integration).

From these data sources, tables containing eight data points (for each attribute in Table 1) for each study clinic were constructed (Supplementary Table 1).

3) Expert validation of attributes and clinic rankings

We sought the views of 22 service providers, managers and researchers from Kenya and Swaziland on the selected integration attributes in order to (1) validate the (pre-chosen) attributes upon which the model was built; and (2) weigh the relative importance of attributes, allowing sensitivity within the model to different attributes of care. Participants were purposively sampled:

those with knowledge of the country contexts, services being investigated and a range of the study clinics.

First, all participants were asked to rank the eight attributes in order of their importance to defining integrated care, using a modified Delphi technique involving ranking, discussion and re-ranking to reach consensus.[25, 26]

Secondly, participants were asked to rank the 40 study clinics by their perceived degree of integration. This provided a crude check against the clinic ranking produced by the model.

4) Generating composite scores and weights

A latent variable modeling approach was used to develop a model that combines information from the eight attributes of integration listed in Table 1.

“Integration” is accepted as a complex phenomenon embracing multiple concepts and definitions. Integration is thus viewed as a metric whose true values cannot be directly observed [27] and the assumption is that our attributes are manifestations of this latent construct of integration.

Latent variable models allow the combination of information from the different attributes without making any assumptions about their measurement unit and also allow the empirical assessment of the reliability and validity of these. We modeled the relationship between the observed attributes of integration and the latent integration construct using a Bayesian estimation framework, suitable for the small sample of 40 clinics.

Technical details of the procedure are given in Appendix 1.

The procedure is a sophisticated development of confirmatory factor analysis and as such allows the construction of differing dimensions of integration, if the data supports them, to best describe the overall concept of “integration”.

The latent integration model is influenced by all attributes; the relative contribution of each is expressed by the factor loading scores of each attribute. An examination of these scores may suggest that more than one factor is at work and that these should be separated so as to better understand the underlying constructs of “integration”.

In our case the data suggested that two factors are at work and these can be seen in Tables 2 and 3 and are described in the results section. This two-factor model had an improved fit to the data and also made good intuitive sense.

Results

Attributes associated with integration

Table 2 shows the standardised factor loadings for the data-only and combined data/expert-rankings at baseline and endline derived from a unidimensional latent variable model, where a single latent dimension of integration accounts for all variation in the observed attributes. These loadings describe the relative weight or association between the attribute and the latent summary of “integration”. A factor loading of 0.7 is very satisfactory and above 0.4 acceptable.[29] Three attributes had scores above 0.7 in the data-only baseline model: range of services ‘accessed daily’, services accessed in ‘single consultation’, and services accessed in a ‘facility visit’ were the most strongly associated with integration in the model (i.e. had the strongest positive loadings with latent integration). These loadings remained high using the endline 2012 data.

Table 2 about here

As Table 2 shows, expert opinion and actual data were not consistent on the relative importance of attributes of integration, with the experts ranking attributes to do with physical and human-resource integration as more important for integration than the service-delivery attributes, although it

should be noted that the front-line service providers in the expert group did rank the service-delivery attributes higher.

Table 2 also demonstrates clear differences between client flow-derived and economics-derived attributes, with two latent dimensions of integration emerging. The four client flow-derived attributes, measuring “*functional integration*”, are strongly associated with integration (as defined by the composite Index model), while the attributes from activity and register tools measuring “*structural integration*” behave very differently, and are collectively the least associated with integration.

The behaviour of the attributes representing two different data sources indicates that structural integration and the ability to deliver integrated services are not correlated. In other words, structural integration does not necessarily result in integrated delivery of services to the client. While one might expect structural integration characteristics to be correlated with (or at least be a pre-requisite for) integrated service delivery, in fact the findings suggest that an inverse relationship may exist. This is not necessarily counter-intuitive, as it is plausible that some sites, particularly smaller ones, may have high levels of structural integration, but in practice may not be able to deliver integrated services because of competing time and logistic constraints. We ran further tests to assess whether the results were driven by facility size (not shown): there were no significant differences although confidence intervals were too wide to interpret.

As a result of the differences in the loadings of the attributes from the client flow and economic attributes of integration in the composite Index model, we estimated a two-factor model where the index was separated to create two sub-indices. Table 3 shows the very strong data-driven loadings of the attributes on each latent factor implying that these most likely reflect valid variance and no systematic error due to different data collection techniques. As in the composite model, all items in the sub-Indices model functioned equivalently with respect to facility size. In the composite index model, experts seem to rank structural

integration attributes more highly than functional integration attributes; the actual data suggests that the structural and the functional attributes constitute two distinct and uncorrelated (orthogonal) dimensions of integration. Thus we retained two distinct factors: a Structural Integration Index and a Functional Integration Index.

Clinic rankings

Based on the two indices model, a score was assigned to each clinic and a relative ranking of study clinics at a particular point in time was derived that allowed us to track change over time. Figure 1 shows the change in clinic scores from baseline to endline for each of the two Indexes. There is clear heterogeneity across the 40 study facilities, confirming the importance of a measure of integration that is independent of a study 'intervention' for the analysis of causal impact. There were some differences between the scores for the two Indexes. The Functional Integration Index shows greater heterogeneity at both time-points and average change over time was negative (-0.05), as higher-ranking clinics lost ground over time, although some lower ranking ones gained considerably. By contrast, there was a positive average change in the Structural index (0.06) despite a high degree of heterogeneity. There was no clear pattern in changes in index scores in each clinic: 12 had positive changes over time in each; 10 had negative changes in each; 11 had a decrease in functional score, but increase in structural; and 7 had a structural increase but functional decrease. No doubt there is a degree of regression to the mean in the service delivery results but there is also a suggestion of useful improvements in functional integration to be gained from initially low scoring facilities. However, this deserves further validation and investigation.

Discussion

This paper addresses a major deficiency in the literature on measurement of integrated care and seeks to develop a tool that can be used to assess the degree of service integration. The analysis uses multiple data from a moderate

number of clinics, in combination with sophisticated statistical modelling, to develop a measure of service integration. This is an important advance on previous research: many previous reports simply categorize clinics as integrated or not depending on whether they received an intervention (or as self-reported by staff), but do not assess the extent of integration as a multi-dimensional continuum. Furthermore, studies rarely evaluate whether the facility actually achieved integrated *care* (i.e. multiple services received by a client from one provider or in one visit). [3, 13, 14]

Two findings from our study are of particular importance. First, the two uncorrelated factors that emerged from our analysis strongly suggest that simply putting infrastructure and multi-tasking staff in place (“structural integration”) are not sufficient to achieve integrated service *receipt* by the client (“functional integration”). This may be due to barriers like vertical reporting/recording systems, time constraints and staff motivation. The emergence of two distinct dimensions illustrates the difference between the structural integration of a facility, offering *potential* for integrated delivery, and integrated services *actually received* by the client. This distinction suggests that measures of physical integration and staff multi-tasking should not be used *on their own* to measure integration or relate integration to outcomes as this may result in a misinterpretation of results. Yet many studies do equate structural integration with integrated delivery of care.

Second, the ranking of the clinics underlines the high degree of heterogeneity across clinics in both countries, illustrating that integration is highly complex and is implemented and achieved differently in every clinic. This highlights and reinforces the value of using an ‘independent’ measure able to adequately measure and account for the impact of integration beyond the study intervention alone – this is critical if a *causal* relationship between integration and impact is to be established.

A number of important limitations need to be taken into account when reflecting on our findings. Economics data based on observation, self-reporting

and routine service records is susceptible to a number of biases, including provider-reporting bias. However, the methods followed allowed for some triangulation between different data sources for the indicators used. Client flow data, collected over one week, may not be representative of monthly/annual client flow (e.g. staff on training that week, national holidays, seasonal use etc.). Coordinating the same five days across facilities was logistically challenging and not always achieved. Nevertheless, clinic register data could not be used as an alternative since registers could not record how many different services each client received in a visit.

Despite these limitations, the Structural and Functional Integration Indexes have useful future applications. First, they can assess how clinics are changing over time relative to other clinics in terms of service integration – useful for policy or programme decision-makers interested in knowing how clinics are progressing. Second, they help identify what attributes are most closely associated with integration in different contexts – important for policy makers and funders who wish to know where to channel resources. Further analysis of the individual attributes is on-going to determine a) whether a sequencing of inputs can be identified (e.g. do you need physical and human resource integration in place before you get availability of services within an MCH unit and what enables this to lead to delivery of integrated care); b) if a minimum effective score can be determined (i.e. is there a minimum score above which there are clear service-use, health or cost benefits). Third, the Indices can enable the attribution of a particular health or service outcome to service integration, something greatly lacking in the literature. [3] For example, within the Integra Initiative we are using the Indexes to assess a dose-response relationship between women’s cumulative exposure to integrated services and study outcomes, including unintended pregnancy, HIV-risk behaviour and costs.

The Indexes as a tool are, in principle, replicable by researchers in other settings and for other service-integration packages – but as stated above may not be easy to construct from routine service data. More work needs to be done to see whether some of the research based evidence (observations, client flow

data) – could be replaced by more routine methods, or a smaller number of indicators, while still providing an accurate assessment of integration. This would enable it to be used by programme and policy decision-makers to monitor programme achievements on integration in both high- and low-income settings.

To conclude, the Integra Indexes are data driven and strongly suggest that “integration” exists in two forms that are distinct, but easily confused. Functional integration is linked to actual receipt of multiple services at one time and place and is unrelated to structural integration where different services are “available”, but not necessarily provided in a convenient form. As such the indexes are a major methodological contribution to enabling the attribution of particular health/service outcomes to integration – an achievement that has proven elusive to date. Our findings have important implications for research on integrated services since they underline the importance of 1) having an ‘independent’ measure to adequately measure and account for the impact of integration beyond a study intervention alone and so establish a *causal* relationship between integration and impact; 2) the importance of assessing both structural integration (physical and human resources) and delivery of integrated services to a client in order to determine the ‘achievement’ of integrated services.

Footnotes

Ethical approval

Approval for the study was obtained from the Ethical Committee at LSHTM (approval no. 5436), from the Population Council Review Board (protocol nos. 443 and 444), from the Kenya Medical Research Institute (approval no. KEMRI/RES/7/3/1, protocol no’s SCC/113 and SCC/114) and the Swaziland Scientific and Ethics Committee (approval nos. MH/599B and MH/599C).

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Transparency

The lead author (SM) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned and registered have been explained.

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Data sharing

No additional data available until 2015; available thereafter from the corresponding author at: Susannah.mayhew@lshtm.ac.uk

Competing interests

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any

commercial organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Contributions

SM and AV designed the study, they are guarantors. SM initially drafted and then finalised the manuscript. GP conducted the statistical analysis. KC, IB and AV provided significant inputs into the manuscript. KC and CO prepared and analysed the data. CO and SS led collection of the costing data. SM, KC, CO, IB, SS, CEW, CW and AV contributed to the conceptualisation of the index, selection of the indicators, and interpretation of the results. AV and SM designed the participant validation exercise.

Other members of the Integra Initiative research team who contributed to the design of the study: Timothy Abuya, Ian Askew, Manuela Colombini, Natalie Friend du-Preez, Joshua Kikuvi, James Kimani, Jackline Kivunaga, Joelle Mak, Christine Michaels-Igbokwe, Richard Mutemwa, Charity Ndwiga, Andy Sloggett and Weiwei Zhou. We would also like to thank: the fieldwork teams; the research participants who gave their time to be interviewed; the managers of the clinics who facilitated data collection; and the Ministries of Health in Kenya and Swaziland who supported the research and are key partners in the Integra Initiative. Finally, we would like to thank other colleagues who advised on aspects of research design and/or analysis, including John Cleland and Ian Askew.

Table 1: Index dimensions, attributes (indicators) and data source

Dimension	Attribute and indicator description	Data source
Physical Integration	Service availability at MCH/FP* Unit: % of HIV and other non-core services [1-5 below†] available in the MCH/FP unit at each facility.	Periodic Activity Review
	Service availability in facility: % of core [6-8 below†] and non-core services available anywhere in the facility	Periodic Activity Review
	Range services per room: % non-core services that are provided in each MCH/FP consultation room	Costing study (registers)
	HIV treatment location and referral‡: location of ART and functionality of referral system to ART for SRH clients	Client Flow tool
Temporal integration	Range of services accessed daily: % days in the week on which any core services AND any non-core services are accessed	Client Flow tool
Provider Integration	Human Resources: % non-core services that are provided per MCH/FP clinical staff member in a day	Costing Study (registers)
Functional Integration	Range of services provided in one consultation: % clients who receive any core services AND any non-core services in one of their provider contacts	Client flow tool
	Range of services provided in one visit to facility: % who receive any core services AND any non-core services during their visit to the facility (one day)	Client flow tool

*Maternal and child health/family planning unit

† Range of services assessed: **Non-core services are** 1) Antiretroviral therapy (ART); 2) Cervical cancer screening; 3) CD4 count services; 4) HIV/AIDS testing services; 5) STI treatment. **Core services are** 6) Family Planning; 7) Post-natal care; 8) Antenatal care

‡ We recognised that the appropriateness of including this indicator is dependent on the need for ART in the catchment population; we took into account the fact that smaller clinics do not provide ART on site by using a graded scoring system incorporating referrals, as follows. HIV treatment score: 0=Received no ART ("HIV care") and not referred for ART; 1=Referred for ART but not received during that visit; 2=Received ART during visit, either as 1 service only, or as additional service but with a different provider; 3=Received ART in addition to an SRH service (FP/ANC/PNC/STI) with the same provider.

Table 2: Standardised factor loading scores for attributes of data and expert driven models, at baseline and endline

	Data driven model		Combined data/expert opinion model	
	2009	2012	2009	2012
Integration attributes				
<i>Indicators of integrated service delivery (from client-flow data)</i>				
HIV treatment location	0.501	0.684	-0.267	-0.217
Range of services accessed daily	0.786	0.918	0.206	0.503
Range of services per consultation	0.983	0.988	-0.002	-0.001
Range of services per visit	0.982	0.993	-0.021	-0.020
<i>Indicators of structural integration (from activity reviews & register data)</i>				
Service availability in MCH/FP unit	-0.092	-0.106	0.936	0.913
Service availability at facility	-0.185	-0.068	0.582	0.738
Range of services per provider	-0.006	-0.049	0.807	0.605
Range of services per room	-0.151	0.126	0.711	0.517

Table 3: Standardised factor loading scores for the two Factors at baseline and endline

Integration attributes	Factor 1		Factor 2	
	Integrated service delivery		Structural integration	
	2009	2012	2009	2012
<i>Indicators of integrated service delivery (from client-flow data)</i>				
HIV treatment location	0.489	0.672		
Range of services accessed daily	0.774	0.910		
Range of services per consultation	0.979	0.986		
Range of services per visit	0.984	0.993		
<i>Indicators of structural integration (from activity reviews & register data)</i>				
Service availability in MCH/FP unit			0.952	0.884
Service availability at facility			0.617	0.642
Range of services per provider			0.836	0.748
Range of services per room			0.795	0.736

Supplementary Data Table 1

An Example of Data Records for Health Facilities							
Facility Type and ID	Service availability in MCH/FP unit	Range of services accessed daily	Human resources: staff integration	Physical resources: room integration	Range of services provided in 1 consultation	Range of services provided in 1 visit	ART integration and referral
FP 1	60%	100%	39%	7%	20.4%	20.4%	4%
FP2	40%	100%	57%	19%	4.0%	6.4%	2%
FP3	40%	100%	52%	33%	10.0%	10.0%	4%
FP4	60%	100%	47%	16%	1.7%	1.9%	22%
FP5	60%	100%	56%	22%	5.5%	5.9%	1%
FP6	40%	80%	31%	22%	0.0%	1.2%	28%
FP7	60%	100%	41%	16%	15.1%	15.6%	1%

Appendix 1

Composite integration scores for each clinic were generated from the eight individual attributes using a latent variable measurement model suitable for the nature of these data, to derive a latent dimension of integration – in other words to determine a model-based description of “integration”.

Latent variable models allow the combination of information from different attributes of integration without making any assumptions about their measurement unit and also allow the empirical assessment of the reliability and validity of these. We modeled the relationship between observed attributes of integration and latent integration using appropriate link functions (probit) for the binary and ordinal nature of the indicators [27]. In this framework, the ordering of the clinics on the integration latent variable is influenced by all attributes; the relative contribution of each is expressed by the loading of each attribute to the latent summary of integration.

Given the small sample of 40 clinics, the Bayesian estimation framework was used. The Bayesian framework offers an attractive alternative to maximum likelihood estimation, which may produce biased estimates in small-sample studies because of its reliance on large sample (asymptotic) theory. The Bayesian framework also allows for analysis of parameter estimates that do not have a normal distribution. We employed “non informative priors”, for the data-only analyses, and “informative priors”, where information derived from expert opinion on integration indicators was used along with the actual data. The mean and standard deviation of the experts’ standardised responses were used to create a normally distributed prior distribution for the parameters (factor loadings) that link each indicator on the latent integration dimension.

All models were estimated using the Markov Chain Monte Carlo algorithm (two chains, 50,000 Bayes iterations) based on the Gibbs sampler, firstly on baseline data (2009) for each indicator. Model convergence was assessed with the Proportional Scale Reduction (PSR) criterion (values close to 1 indicate model convergence). All models were estimated in Mplus 6. [28] Finally, we re-

estimated the model with endline data (2012) to describe whether associated attributes had changed and whether clinic rankings had changed over time.

Based on the findings from the Composite Index Model (see Table 2), we estimated a two dimensional model where the index was separated to create two sub-indices. This two-factor model had a much improved fit to the data and was retained.

References

1. Atun, R., et al., *A systematic review of the evidence on integration of targeted health interventions into health systems*. Health Policy Plan, 2010. **25**(1): p. 1-14.
2. Atun, R., et al., *Integration of targeted health interventions into health systems: a conceptual framework for analysis*. Health Policy Plan, 2010. **25**(2): p. 104-11.
3. Dudley, L. and P. Garner, *Strategies for integrating primary health services in low- and middle-income countries at the point of delivery*. Cochrane Database Syst Rev, 2011. **7**.
4. Ekman, B., I. Pathmanathan, and J. Liljestrand, *Integrating health interventions for women, newborn babies, and children: a framework for action*. Lancet, 2008. **372**(9642): p. 990-1000.
5. Curry, N. and C. Ham, *Clinical and service integration: the route to improved outcomes*. 2010, The King's Fund: London.
6. Fleischman Foreit, K.G., K. Hardee, and K. Agarwal, *When does it make sense to consider integrating STI and HIV services with family planning services?* International Family Planning Perspectives, 2002. **28**(2).
7. Askew, I., *Achieving synergies in prevention through linking sexual and reproductive health and HIV services*, in *International Conference on Actions to Strengthen Linkages between Sexual and Reproductive Health and HIV/AIDS*. 2007: Mumbai, India.
8. Sweeney, S., et al., *Costs and efficiency of integrating HIV/AIDS services with other health services: a systematic review of evidence and experience*. Sex Transm Infect, 2012. **88**(2): p. 85-99.
9. Hoang, T., et al., *The impact of integrated HIV care on patient health outcomes*. Med Care, 2009. **47**(5): p. 560-7.
10. Uebel, K.E., et al., *Integrating HIV care into primary care services: quantifying progress of an intervention in South Africa*. PLoS One, 2013. **8**(1): p. e54266.
11. Brindis, C.D., et al., *Service integration and teen friendliness in practice: a program assessment of sexual and reproductive health services for adolescents*. J Adolesc Health, 2005. **37**(2): p. 155-62.
12. Bryce, J., et al., *The multi-country evaluation of the integrated management of childhood illness strategy: lessons for the evaluation of public health interventions*. Am J Public Health, 2004. **94**(3): p. 406-15.
13. Kennedy, C.E., et al., *Linking sexual and reproductive health and HIV interventions: a systematic review*. J Int AIDS Soc, 2010. **13**: p. 26.
14. Church, K. and S.H. Mayhew, *Integration of STI and HIV prevention, care, and treatment into family planning services: a review of the literature*. Studies in Family Planning, 2009. **40**(3): p. 171-186.
15. Victora, C.G., J.P. Habicht, and J. Bryce, *Evidence-based public health: moving beyond randomized trials*. Am J Public Health, 2004. **94**(3): p. 400-5.
16. Habicht, J.P., C.G. Victora, and J.P. Vaughan, *Evaluation designs for adequacy, plausibility and probability of public health programme performance and impact*. Int J Epidemiol, 1999. **28**(1): p. 10-8.

17. Cousens, S., et al., *Alternatives to randomisation in the evaluation of public-health interventions: statistical analysis and causal inference.* J Epidemiol Community Health, 2011. **65**(7): p. 576-81.
18. Warren, C.E., et al., *Study protocol for the Integra Initiative to assess the benefits and costs of integrating sexual and reproductive health and HIV services in Kenya and Swaziland.* BMC Public Health, 2012. **12**: p. 973.
19. WHO, et al., *Sexual and reproductive health & HIV/AIDS: a framework for priority linkages.* 2005, World Health Organization: Geneva.
20. Bradley, H., et al., *HIV and family planning service integration and voluntary HIV counselling and testing client composition in Ethiopia.* AIDS Care, 2008. **20**(1): p. 61-71.
21. Criel, B., V. De Brouwere, and S. Dugas, *Integration of vertical programmes in multi-function health services,* in *Studies in Health Services Organisation and Policy.* 1997, ITG Press: Antwerp.
22. Mitchell, M., S.H. Mayhew, and I. Haivas, *Integration revisited. Background paper to the report "Public choices, private decisions: sexual and reproductive health and the Millennium Development Goals".* 2004, United Nations Millennium Project.
23. Maharaj, P. and J. Cleland, *Integration of sexual and reproductive health services in KwaZulu-Natal, South Africa.* Health Policy Plan, 2005. **20**(5): p. 310-8.
24. Zwarenstein, M., et al., *Outreach education for integration of HIV/AIDS care, antiretroviral treatment, and tuberculosis care in primary care clinics in South Africa: PALSA PLUS pragmatic cluster randomised trial.* BMJ, 2011. **342**: p. d2022.
25. Hasson, F., S. Keeney, and H. McKenna, *Research guidelines for the Delphi survey technique.* J Adv Nurs, 2000. **32**(4): p. 1008-15.
26. Okoli, C. and S.D. Pawlowski, *The Delphi method as a research tool: an example, design considerations and applications.* Information & Management, 2004. **42**(1): p. 15-29.
27. Rabe-Hesketh, S. and A. Skrondal, *Classical latent variable models for medical research.* Statistical Methods in Medical Research, 2008. **17**(1): p. 5-32.
28. Muthen, L.K. and B.O. Muthen, *Mplus User's Guide. Sixth Edition,* ed. M. Muthen. 1998-2010, Los Angeles, CA.
29. Gorsuch, R.L., *Factor Analysis. 2nd ed.* . 1983, Hillsdale, N.J.: Lawrence Erlbaum.

Appendix 4: Client Flow Tool

CLIENT FLOW ASSESSMENT FORM

Client No:

Facility name: _____ Entry unit: MCH PHU

Other: _____

Date today: -- Sex of client: Male Female DOB: --
Age:

Client type: Adult (alone) Adult with child (age of child in months _____)

Client's residence [KENYA]: District: _____ Division: _____

Location: _____

Client Reporting Time at Triage: :

Client's Call for Consultation with 1st Provider: : (Record time in 24 hr clock)

Instructions to client: Please take this form to each nurse, doctor or other counsellor that you see during your visit at this clinic today. Please hand the form back in to one of the interviewers before you leave.

Instructions to the provider: Please complete a new row for each client you see. Fill in the time that the client arrives, and the time the client leaves. In the first column, tick for each of the services that you provide to the client. If you refer the client somewhere else, tick the appropriate box (es) in the second column, and indicate if it was an internal or external referral (or both). If you do not refer the client on, leave question 2 blank.

NOTE: In the boxes beside each service, please insert numbers 1, 2, 3,...etc., depending on the main service which the client has come for. The main service should always be number 1.

1st Provider seen: Consultation start time: :: Consultation end time: ::

1. What is client seen for? (tick all that apply)

Ante-natal care Pap smear

Child immunization Pharmacy (drugs)

Child welfare PMTCT

Counselling (general) PNC for baby

Family planning (exam)

counselling PNC for mother

Family planning (exam)

provision STI counselling

Gynaecologist STI treatment

HIV care (pre ART or TB care/treatment

ART) X-ray

HIV counselling Other

HIV testing (blood test)

Laboratory test

2. What is client referred for? (tick all that apply)

Ante-natal care Pap smear

Child immunization Pharmacy (drugs)

Child welfare PMTCT

Counselling (general) PNC for baby

Family planning (exam)

counselling PNC for mother

Family planning (exam)

provision STI counselling

Gynaecologist STI treatment

HIV care (pre ART or TB care/treatment

ART) X-ray

HIV counselling Other

HIV testing (blood
test)

Laboratory test

Is this/are these: Internal referral(s) External referral(s)

If external, where?

2 nd Provider seen: <input type="checkbox"/> <input type="checkbox"/>	Consultation start time: <input type="checkbox"/> <input type="checkbox"/> : <input type="checkbox"/> <input type="checkbox"/>	Consultation end time: <input type="checkbox"/> <input type="checkbox"/> :
<p>1. What is client seen for? (tick all that apply)</p> <p><input type="checkbox"/> Ante-natal care <input type="checkbox"/> Pap smear</p> <p><input type="checkbox"/> Child immunization <input type="checkbox"/> Pharmacy (drugs)</p> <p><input type="checkbox"/> Child welfare <input type="checkbox"/> PMTCT</p> <p><input type="checkbox"/> Counselling (general) <input type="checkbox"/> PNC for baby</p> <p><input type="checkbox"/> Family planning counselling (exam) <input type="checkbox"/> PNC for mother</p> <p><input type="checkbox"/> Family planning provision (exam) <input type="checkbox"/> STI counselling</p> <p><input type="checkbox"/> Gynaecologist <input type="checkbox"/> STI treatment</p> <p><input type="checkbox"/> HIV care (pre ART or ART) <input type="checkbox"/> TB care/treatment</p> <p><input type="checkbox"/> HIV counselling <input type="checkbox"/> X-ray</p> <p><input type="checkbox"/> HIV testing (blood test)</p> <p><input type="checkbox"/> Laboratory test</p>	<p>2. What is client referred for? (tick all that apply)</p> <p><input type="checkbox"/> Ante-natal care <input type="checkbox"/> Pap smear</p> <p><input type="checkbox"/> Child immunization <input type="checkbox"/> Pharmacy (drugs)</p> <p><input type="checkbox"/> Child welfare <input type="checkbox"/> PMTCT</p> <p><input type="checkbox"/> Counselling (general) <input type="checkbox"/> PNC for baby</p> <p><input type="checkbox"/> Family planning counselling (exam) <input type="checkbox"/> PNC for mother</p> <p><input type="checkbox"/> Family planning provision (exam) <input type="checkbox"/> STI counselling</p> <p><input type="checkbox"/> Gynaecologist <input type="checkbox"/> STI treatment</p> <p><input type="checkbox"/> HIV care (pre ART or ART) <input type="checkbox"/> TB care/treatment</p> <p><input type="checkbox"/> HIV counselling <input type="checkbox"/> X-ray</p> <p><input type="checkbox"/> HIV testing (blood test)</p> <p><input type="checkbox"/> Laboratory test</p> <p>Is this/are these: <input type="checkbox"/> Internal referral(s) <input type="checkbox"/> External referral(s)</p> <p>If external, where?</p> <p>_____</p>	

3rd Provider seen: Consultation start time: :
 Consultation end time: :

1. What is client seen for? (tick all that apply)

Ante-natal care Pap smear

Child immunization Pharmacy (drugs)

Child welfare PMTCT

Counselling (general) PNC for baby

Family planning (exam)

counselling PNC for mother

Family planning (exam)

provision STI counselling

Gynaecologist STI treatment

HIV care (pre ART or TB care/treatment

ART) X-ray

HIV counselling Other

HIV testing (blood test)

Laboratory test

2. What is client referred for? (tick all that apply)

Ante-natal care Pap smear

Child immunization Pharmacy (drugs)

Child welfare PMTCT

Counselling (general) PNC for baby

Family planning (exam)

counselling PNC for mother

Family planning (exam)

provision STI counselling

Gynaecologist STI treatment

HIV care (pre ART or TB care/treatment

ART) X-ray

HIV counselling Other

HIV testing (blood
test)

Laboratory test

Is this/are these: Internal referral(s) External referral(s)

If external, where?

4 th Provider seen: <input type="checkbox"/> <input type="checkbox"/>	Consultation start time: <input type="checkbox"/> <input type="checkbox"/> : <input type="checkbox"/> <input type="checkbox"/>	Consultation end time: <input type="checkbox"/> <input type="checkbox"/> :				
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px; vertical-align: top;"> <p>1. What is client seen for? (tick all that apply)</p> <p><input type="checkbox"/> Ante-natal care <input type="checkbox"/> Pap smear</p> <p><input type="checkbox"/> Child immunization <input type="checkbox"/> Pharmacy (drugs)</p> <p><input type="checkbox"/> Child welfare <input type="checkbox"/> PMTCT</p> <p><input type="checkbox"/> Counselling (general) <input type="checkbox"/> PNC for baby</p> <p><input type="checkbox"/> Family planning counselling (exam) <input type="checkbox"/> PNC for mother</p> <p><input type="checkbox"/> Family planning provision (exam) <input type="checkbox"/> STI counselling</p> <p><input type="checkbox"/> Gynaecologist <input type="checkbox"/> STI treatment</p> <p><input type="checkbox"/> HIV care (pre ART or ART) <input type="checkbox"/> TB care/treatment</p> <p><input type="checkbox"/> HIV counselling <input type="checkbox"/> X-ray</p> <p><input type="checkbox"/> HIV testing (blood test)</p> <p><input type="checkbox"/> Laboratory test</p> </td> <td style="width: 50%; padding: 5px; vertical-align: top;"> <p>2. What is client referred for? (tick all that apply)</p> <p><input type="checkbox"/> Ante-natal care <input type="checkbox"/> Pap smear</p> <p><input type="checkbox"/> Child immunization <input type="checkbox"/> Pharmacy (drugs)</p> <p><input type="checkbox"/> Child welfare <input type="checkbox"/> PMTCT</p> <p><input type="checkbox"/> Counselling (general) <input type="checkbox"/> PNC for baby</p> <p><input type="checkbox"/> Family planning counselling (exam) <input type="checkbox"/> PNC for mother</p> <p><input type="checkbox"/> Family planning provision (exam) <input type="checkbox"/> STI counselling</p> <p><input type="checkbox"/> Gynaecologist <input type="checkbox"/> STI treatment</p> <p><input type="checkbox"/> HIV care (pre ART or ART) <input type="checkbox"/> TB care/treatment</p> <p><input type="checkbox"/> HIV counselling <input type="checkbox"/> X-ray</p> <p><input type="checkbox"/> HIV testing (blood test)</p> <p><input type="checkbox"/> Laboratory test</p> </td> </tr> <tr> <td colspan="2" style="padding: 5px;"> <p>Is this/are these: <input type="checkbox"/> Internal referral(s) <input type="checkbox"/> External referral(s) If external, where?</p> <p>_____</p> </td> </tr> </table>			<p>1. What is client seen for? (tick all that apply)</p> <p><input type="checkbox"/> Ante-natal care <input type="checkbox"/> Pap smear</p> <p><input type="checkbox"/> Child immunization <input type="checkbox"/> Pharmacy (drugs)</p> <p><input type="checkbox"/> Child welfare <input type="checkbox"/> PMTCT</p> <p><input type="checkbox"/> Counselling (general) <input type="checkbox"/> PNC for baby</p> <p><input type="checkbox"/> Family planning counselling (exam) <input type="checkbox"/> PNC for mother</p> <p><input type="checkbox"/> Family planning provision (exam) <input type="checkbox"/> STI counselling</p> <p><input type="checkbox"/> Gynaecologist <input type="checkbox"/> STI treatment</p> <p><input type="checkbox"/> HIV care (pre ART or ART) <input type="checkbox"/> TB care/treatment</p> <p><input type="checkbox"/> HIV counselling <input type="checkbox"/> X-ray</p> <p><input type="checkbox"/> HIV testing (blood test)</p> <p><input type="checkbox"/> Laboratory test</p>	<p>2. What is client referred for? (tick all that apply)</p> <p><input type="checkbox"/> Ante-natal care <input type="checkbox"/> Pap smear</p> <p><input type="checkbox"/> Child immunization <input type="checkbox"/> Pharmacy (drugs)</p> <p><input type="checkbox"/> Child welfare <input type="checkbox"/> PMTCT</p> <p><input type="checkbox"/> Counselling (general) <input type="checkbox"/> PNC for baby</p> <p><input type="checkbox"/> Family planning counselling (exam) <input type="checkbox"/> PNC for mother</p> <p><input type="checkbox"/> Family planning provision (exam) <input type="checkbox"/> STI counselling</p> <p><input type="checkbox"/> Gynaecologist <input type="checkbox"/> STI treatment</p> <p><input type="checkbox"/> HIV care (pre ART or ART) <input type="checkbox"/> TB care/treatment</p> <p><input type="checkbox"/> HIV counselling <input type="checkbox"/> X-ray</p> <p><input type="checkbox"/> HIV testing (blood test)</p> <p><input type="checkbox"/> Laboratory test</p>	<p>Is this/are these: <input type="checkbox"/> Internal referral(s) <input type="checkbox"/> External referral(s) If external, where?</p> <p>_____</p>	
<p>1. What is client seen for? (tick all that apply)</p> <p><input type="checkbox"/> Ante-natal care <input type="checkbox"/> Pap smear</p> <p><input type="checkbox"/> Child immunization <input type="checkbox"/> Pharmacy (drugs)</p> <p><input type="checkbox"/> Child welfare <input type="checkbox"/> PMTCT</p> <p><input type="checkbox"/> Counselling (general) <input type="checkbox"/> PNC for baby</p> <p><input type="checkbox"/> Family planning counselling (exam) <input type="checkbox"/> PNC for mother</p> <p><input type="checkbox"/> Family planning provision (exam) <input type="checkbox"/> STI counselling</p> <p><input type="checkbox"/> Gynaecologist <input type="checkbox"/> STI treatment</p> <p><input type="checkbox"/> HIV care (pre ART or ART) <input type="checkbox"/> TB care/treatment</p> <p><input type="checkbox"/> HIV counselling <input type="checkbox"/> X-ray</p> <p><input type="checkbox"/> HIV testing (blood test)</p> <p><input type="checkbox"/> Laboratory test</p>	<p>2. What is client referred for? (tick all that apply)</p> <p><input type="checkbox"/> Ante-natal care <input type="checkbox"/> Pap smear</p> <p><input type="checkbox"/> Child immunization <input type="checkbox"/> Pharmacy (drugs)</p> <p><input type="checkbox"/> Child welfare <input type="checkbox"/> PMTCT</p> <p><input type="checkbox"/> Counselling (general) <input type="checkbox"/> PNC for baby</p> <p><input type="checkbox"/> Family planning counselling (exam) <input type="checkbox"/> PNC for mother</p> <p><input type="checkbox"/> Family planning provision (exam) <input type="checkbox"/> STI counselling</p> <p><input type="checkbox"/> Gynaecologist <input type="checkbox"/> STI treatment</p> <p><input type="checkbox"/> HIV care (pre ART or ART) <input type="checkbox"/> TB care/treatment</p> <p><input type="checkbox"/> HIV counselling <input type="checkbox"/> X-ray</p> <p><input type="checkbox"/> HIV testing (blood test)</p> <p><input type="checkbox"/> Laboratory test</p>					
<p>Is this/are these: <input type="checkbox"/> Internal referral(s) <input type="checkbox"/> External referral(s) If external, where?</p> <p>_____</p>						

5th Provider seen: Consultation start time: :
 Consultation end time: :

1. What is client seen for? (tick all that apply)

Ante-natal care Pap smear

Child immunization Pharmacy (drugs)

Child welfare PMTCT

Counselling (general) PNC for baby

Family planning (exam)

Family planning PNC for mother

counselling (exam)

Family planning (exam)

provision STI counselling

Gynaecologist STI treatment

HIV care (pre ART or TB care/treatment

ART) X-ray

HIV counselling Other

HIV testing (blood test)

Laboratory test

2. What is client referred for? (tick all that apply)

Ante-natal care Pap smear

Child immunization Pharmacy (drugs)

Child welfare PMTCT

Counselling (general) PNC for baby

Family planning (exam)

Family planning PNC for mother

counselling (exam)

Family planning (exam)

provision STI counselling

Gynaecologist STI treatment

HIV care (pre ART or TB care/treatment

ART) X-ray

HIV counselling Other

HIV testing (blood Laboratory test

test)

Is this/are these: Internal referral(s) External referral(s)

If external, where?

Appendix 5: Health Facility Inventory

Assessing the Benefits of integrated HIV and Reproductive Health Services in Kenya

FACILITY ASSESSMENT

PRE-INTERVENTION (SEPTEMBER 2008)

FACILITY IDENTIFICATION

1. Nyeri District
 - A. Nyeri PGH
 - B. Ngorano HC
 - C. Warazo HC
2. Thika District
 - A. Thika DH
 - B. Ruiru HC
 - C. Igegania HC
3. Maragua District
 - A. Maragua DH
 - B. Kigumo HC
 - C. Kangari HC
4. Nyandarua District
 - A. Nyahururu DH
 - B. Engineer HC
 - C. Njabini HC

Signature: _____

Date _____

FACILITY CATEGORY

1. Hospital
2. Health centre
3. Dispensary
4. Private clinic

Date of assessment: Day/Month/Year:

Name of Data CollectorCode:

Time Started: (Use 24 hours clock)

Supervisor's review: Name _____

INSTRUCTIONS TO DATA COLLECTOR: This assessment should be completed by observing the facilities that are available and through discussions with the person in charge of MCH and /or ART unit on the day of the visit. IN ALL CASES, you should verify that items exist by actually observing them yourself. If you are not able to observe then code accordingly. Remember that the objective is to identify the equipment, supplies and facilities that currently exist and not to evaluate the performance of the staff or clinic. For each item, circle the response or describe as appropriate.

SECTION A: POPULATION

**Q101: What is the catchment population of this facility?
(Population served by the facility)?**

SECTION B: STAFFING

Q201: ASK: Please can you give an overview of the personnel in your health facility. Although we mainly focus on MCH and ART clinic information about the whole facility can give a more complete impression on staffing levels	ASK How many are assigned to work in MCH & ART unit (read the list)		
	Total in the Facility	No. in MCH/FP Unit	No. in ART clinic
a) Number of specialist doctors			
b) Number of medical officers			
c) Number of clinical officers			
d) Number of registered nurse midwives			
e) Number of enrolled nurse midwives			
f) Number of laboratory technologists and/or technicians			
g) Number of pharmacists and/or pharmacist technicians			
h) Number of associated medical staff (radiographers/radiologists, physiotherapists etc.)			
i) Number of lay counsellors			
j) Number of administrators			

Q202: Has any of the staff in MCH/FP received in-service training in any of the following?		Yes
a) PMTCT		Y
b) HIV counselling and testing		Y
c) How to do rapid HIV screening tests & controls		Y
d) STI symptomatic management and treatment		Y
e) Counselling for prevention of STIs		Y
f) Counselling for prevention of HIV/AIDS		Y
g) Counselling/social support for HIV/AIDS infected clients		Y
h) Medical management of HIV/AIDS infected clients		Y
i) Antiretroviral therapy for HIV infected clients		Y
j) HIV and infant feeding counselling		Y
k) Family planning		Y
SECTION 3: SERVICES OFFERRED		
Q301: Please ask to see the MCH/FP and ART clinic and indicate which of the following activities are routinely carried out there		
ASK: Is this (read a-o) service usually available to client at the MCH/FP section or VCT or CCC/ART clinic?	Available at MCH/FP unit (circle as appropriate)	Available in the VCT or CCC/ART clinic (circle as appropriate)
	Yes	Yes
a) Ante-natal care	Y	Y
b) PMTCT	Y	Y
c) Post-natal care	Y	Y
d) Family Planning	Y	Y
e) HIV/AIDS Counselling	Y	Y
f) HIV/AIDS testing services	Y	Y
g) CD4 count services	Y	Y
h) Antiretroviral therapy (ART)	Y	Y
i) STI counselling	Y	Y
j) STI laboratory services	Y	Y
k) STI Syndromic diagnosis	Y	Y
l) STI treatment	Y	Y
m) TB screening and testing	Y	Y
n) TB treatment	Y	Y
o) Screening for cancer of the cervix	Y	Y

Q302: ASK: Which of these FP methods are usually available to client at the MCH/FP section or VCT or CCC/ART clinic	Available at MCH/FP unit (Circle as appropriate)	Available in the facility VCT or CCC/ART clinic (Circle as appropriate)	
	Yes	Yes	
a) Combined pill	Y	Y	
b) Progestin only pill	Y	Y	
c) Injectable	Y	Y	
d) Male/female condom	Y	Y	
e) IUCD	Y	Y	
f) Hormonal implants	Y	Y	
g) Dual protection	Y	Y	
h) Female sterilization	Y	Y	
i) Male Sterilization	Y	Y	
j) LAM	Y	Y	
k) Natural FP methods	Y	Y	
l) Others	Y	Y	
m) Other Specify:			
Q303: Are these services routinely performed in the Family Planning Unit or ART clinic?			
<i>Please circle appropriate response</i>	FP Clinic	ART Clinic	
	Yes	Yes	
a) Conducting group health discussion sessions	Y	Y	
b) Weighing of clients	Y	Y	
c) Measuring blood pressure	Y	Y	
Q304: Are these procedures performed in the facility			
a) Female sterilization	Y		
b) Male sterilization	Y		
Q305: Where are these services routinely performed?			
	MCH/FP Clinic	VCT or CCC/ART clinic	Elsewhere
a) Urine test	Y	Y	Y
b) Pregnancy test	Y	Y	Y
c) HB testing	Y	Y	Y
d) VDRL or syphilis test	Y	Y	Y

Q306: Where are HIV tests conducted in this facility?			
a) In the outpatient unit			Y
b) In the MCH/FP clinic			Y
c) In the inpatient wards			Y
d) In PMTCT clinic			Y
e) VCT centre			Y
f) ART clinic			Y
g) Laboratory only			Y
SECTION 4: AVAILABILITY OF COMMODITIES, EQUIPMENT, SUPPLIES ETC			
Q401: ASK to see the stocks of the following commodities (supplies or equipment for performing...) are currently available at the MCH/FP section and the VCT or CCC/ART clinic?	MCH/FP unit (Circle as appropriate)		VCT or CCC/ART clinic (Circle as appropriate)
	Yes		Yes
a) Combined pill	Y		Y
b) Progestin only pill	Y		Y
c) Injectable	Y		Y
d) Male /female condom	Y		Y
e) IUCD	Y		Y
f) Hormonal implants	Y		Y
g) Dual protection	Y		Y
h) Female sterilization	Y		Y
i) Male Sterilization	Y		Y
k) Others	Y		Y
l) Other Specify			
Which of these are available at MCH/FP or CCC/ART clinic or anywhere in the facility	MCH/FP unit (Circle as appropriate)	VCT or CCC/ART clinic (Circle as appropriate)	Elsewhere
Q402: Testing Reagents			
a) Reagents for HIV (Elisa HIV-1)	Y	Y	Y
b) Reagents for HIV (Elisa HIV-2)	Y	Y	Y
c) Rapid reagents for HIV: UNIGOLD	Y	Y	Y
d) Rapid reagents for HIV: DETERMINE	Y	Y	Y
e) Reagents for anaemia test	Y	Y	Y
f) Reagents for TB tests	Y	Y	Y
g) Reagents for pregnancy test	Y	Y	Y

Which of these are available at MCH/FP or CCC/ART clinic or anywhere in the facility	MCH/FP unit (Circle as appropriate)	VCT or CCC/ART clinic (Circle as appropriate)
Q403: General supplies		
a) Disposable needles and syringes	Y	Y
b) Disposable gloves	Y	Y
c) Specimen bottles for urine	Y	Y
d) Specimen pots for sputum	Y	Y
e) Blood specimen pots	Y	Y
f) Reagents for UTI	Y	Y
Q404: Drugs		
g) Nevirapine tabs	Y	Y
h) Nevirapine syrup	Y	Y
i) Zidovudine (ZDV, AZT)	Y	Y
j) AZT syrup	Y	Y
k) Zidovudine + Lamivudine (Combivir)	Y	Y
l) Metronidazole tablets	Y	Y
m) Miconazole or clotrimazole pessaries	Y	Y
n) Ciprofloxacin oral	Y	Y
o) Erythromycin oral	Y	Y
p) Tetracycline oral	Y	Y
q) Benzathine Penicillin	Y	Y
r) Cotrimoxazole tabs	Y	Y
s) Cotrimoxazole syrup	Y	Y
t) List other HIV/AIDS drugs available in the facility	Y	Y
Q405: For the Family Planning Clinic, are the following items in the room or somewhere in the clinic?		
		Yes
a) Spotlight or flashlight or examination light		Y
b) Examination couch		Y
c) Sterile latex gloves		Y
d) Clean latex gloves		Y
e) Clean non latex gloves		Y
f) Decontamination solution (chlorine based) for clinical equipment		Y
g) Waste receptacle with lid and plastic liner		Y
h) Container for used sharps		Y
i) Single use hand drying towels or a functioning electric hand dryer		Y
j) Running water		Y
k) A working blood pressure machine		Y
l) A stethoscope		Y
m) A functional weighing scale		Y

n) Speculum (S)	Y	
o) Speculum (M)	Y	
p) Speculum (L)	Y	
q) Tenacula	Y	
r) Uterine sound	Y	
s) Autoclave	Y	
t) Cleaning solution e.g. betadine	Y	
u) Trocar	Y	
v) Gauze	Y	
w) Surgical scissors	Y	
x) Elastoplast	Y	
y) Kidney dishes	Y	
z) Sponge holding forceps	Y	
aa) Mosquito forceps - curved	Y	
bb) Mosquito forceps - straight	Y	
cc) Surgical blade - size 15 or 11	Y	
dd) Draping towels	Y	
SECTION 5: PAYMENT/FEES		
Q501: For each of the following items, indicate if there is routine fee and if yes the amount	Yes	Amount in Kshs
a) Fee for FP client records (card and file)	Y	
b) Fee for consultation	Y	
c) Pregnancy test	Y	
d) IUCD insertion	Y	
e) Oral contraceptives/pills	Y	
f) Male condom	Y	
g) Female condom	Y	
h) Injectable methods	Y	
i) Implants	Y	
j) Emergency contraceptives	Y	
k) Male sterilization	Y	
l) Female sterilization	Y	
m) Others	Y	
n) Other specify;		
SECTION 6: IEC MATERIAL		
Q601: Are any of the following visual aids for teaching available in the counselling rooms	FP Clinic	ART Clinic
	Yes	Yes
a) Samples of various FP methods	Y	Y
b) Visual aids for teaching about STIs	Y	Y

c) Visual aids for teaching about HIV/AIDS	Y	Y
d) Balanced counselling strategy cards	Y	Y
e) Model for demonstrating how to use condoms	Y	Y
f) Posters about FP	Y	Y
Q602: Are any of the following types of information booklets or pamphlets available in the counselling or consultation rooms for clients to take home	FP Clinic	ART Clinic
	Yes	Yes
a) Printed materials on FP	Y	Y
b) Printed materials on STIs	Y	Y
c) Printed materials on HIV/AIDS	Y	Y
SECTION 7: GUIDELINES, POLICIES AND STANDARDS		
Are any of the following protocols for delivery of services available in the consultation/counselling rooms	FP Clinic	ART Clinic
	Yes	Yes
a) FP policy guidelines for service providers	Y	Y
b) Guidelines for making a syndromic diagnosis of STIs and their treatment	Y	Y
c) PMTCT guidelines	Y	Y
d) Guidelines to Antiretroviral Drug Therapy (ART)	Y	Y
e) Clinical manual for ARV providers	Y	Y
f) Is there an official guideline/protocol on HIV testing procedures in this facility?	Y	Y
g) Is there a pre and post-test counselling protocol for HIV testing	Y	Y

SECTION 8: DATA COLLECTION TOOLS		
Are any of the following data collection tools available in the consultation/counselling rooms	FP Clinic	ART Clinic
	Yes	Yes
a) Is there a register where information on FP clients' visits or referrals is recorded? Show as subset question (If yes, for the register to be valid it must show client's status (new or revisit)	Y	Y
b) Do you have Family Planning Cards in stock	Y	Y
c) Is there a register where information on HIV clients is recorded? Show as subset question (if yes, for the register to be valid it must show status (new or continuing)	Y	Y
d) Do you have a referral document for the HIV positive clients e.g. referral form	Y	Y
SECTION 9: INFRASTRUCTURE		
Infrastructure available in FP and ART units	MCH/FP	ART clinic
	Yes	Yes
a) Waiting area is shaded and with seats	Y	Y
b) Private space for FP examination	Y	Y
c) Source of clean water in the clinic 24 hours	Y	Y
d) Power to ensure fridge remains functional 24 hours/day	Y	Y
e) Working autoclave/sterilization	Y	Y
f) Reliable lighting	Y	Y
g) Client toilets	Y	Y
h) Clean water for drinking	Y	Y
i) Clean cups/glasses for drinking water	Y	Y

Appendix 6: Client Provider Interactions

OBSERVATION OF CLIENT-PROVIDER INTERACTION

FAMILY PLANNING

Assessing the Benefits of integrated HIV (CT) and Family Planning Services in Kenya

CENTRAL PROVINCE - HEALTH FACILITY ASSESSMENT 2

FACILITY IDENTIFICATION		
Facility name: _____		
District	01=MURANG'A 02=NYERI 03=NYANDARUA 04=THIKA	[][]
Facility type	01=HOSPITAL 02=SUB DISTRICT HOSPITAL 03=HEALTH CENTRE 04=DISPENSARY	[][]
Designation of observed provider	01=ENROLLED NURSE/MIDWIFE 02=REGISTERED NURSE/MIDWIFE 03=BSC NURSE 04=CLINICAL OFFICER 05=MEDICAL OFFICER/DOCTOR 88=OTHER (SPECIFY)_____	[][]
OBSERVATION OUTCOMES		
OBSERVATION DATE (DAY, MONTH, YEAR E.G. 02/02/10)		[][]/[][]/[][][]
OBSERVATION RESULT	01=COMPLETED 02=PARTIALLY COMPLETED 03=REFUSED 88=OTHER (SPECIFY)_____	[][]
OBSERVER'S NAME		
SUPERVISOR EDITED BY ENTERED BY		
NAME	_____	_____
DATE	_____	_____

TIME OBSERVATION STARTED: **[RECORD TIME IN 24-HOUR CLOCK]** [][]:[][]

INSTRUCTIONS TO OBSERVER:

Obtain permission from the provider and consent from the client before observing the consultation. When observing, be as discreet as possible and on no account become involved in the interaction. Make sure that the provider knows that you are not there to evaluate her/him and that you are not an “expert” who can be consulted during the session. Try to sit in a position such that you are behind the patient but not directly in view of the provider. Make notes as quickly as possible. For each of the items, circle the answer that most appropriately reflects your assessment of what happened during the interaction. Use the appropriate section of the observation based on the reason for consultation.

SECTION 1: GREETING AND ASSESSING CLIENT

NO.	QUESTION	RESPONSE OPTIONS	CODES	SKIP
F100	Does the provider greet the client in a friendly/respectful manner? [CIRCLE THE APPROPRIATE CODE]	No	0	
		Yes	1	
F101	What was the MAIN PURPOSE of the visit as initially indicated by the client?	New user	1	
		Repeat/refill client	2	
		Review/ method check up	3	
		FP method switching	4	
		Gap in FP use	5	
F102	Are the following areas discussed/ mentioned during the consultation? [OBSERVE AND CIRCLE '1' FOR 'YES' IF MENTIONED; OTHERWISE CIRCLE '0']		Yes	No
		a) Client's age	1	0
		b) Marital status	1	0
		c) Ever been pregnant	1	0
		d) Number of pregnancies	1	0
		e) Number of children alive	1	0
		f) Desired number of children	1	0
		g) Age of youngest child	1	0
		h) Currently breastfeeding	1	0
		i) Timing of next birth	1	0
		j) Date of last menses	1	0
		k) Intercourse since last menses	1	0
		l) Previous use of FP	1	0
		m) Discussed family planning with spouse/ partner	1	0
n) Partner cooperation	1	0		
o) HIV sero-status	1	0		
p) History of medical conditions hypertension, anaemia, cardiac disease, malignancies, etc.	1	0		

SECTION 2: CLIENT COUNSELLING					
F200	Which information, education, and communication (IEC) materials does the provider use during the consultation? [OBSERVE AND CIRCLE '1' FOR 'YES' IF USED; OTHERWISE CIRCLE '0']		Yes	No	
		a) BCS job aids (algorithm, counselling FP method cards, brochures/pamphlets)	1	0	
		b) General brochures/leaflets	1	0	
		c) Contraceptive samples (pills, condom, etc.)	1	0	
		d) Posters	1	0	
		e) Anatomical models (e.g. Dildo)	1	0	
		f) Other counselling tools	1	0	
		g) Other (specify) _____	1	0	
F201	Does the provider take the client's blood pressure?	Yes	1		
		No	2		

F202	Which methods are discussed during the consultation? [OBSERVE AND CIRCLE '1' FOR 'YES' IF DISCUSSED; OTHERWISE CIRCLE '0']		Yes	No	
		a) Progestin only pill (microlut)	1	0	
		b) Combined pill (ovral, triphasil, nordett) (<i>Chaguo langu</i>)	1	0	
		c) IUCD	1	0	
		d) Male condom	1	0	
		e) Female condom	1	0	
		f) Injectables (depo or nuristerate)	1	0	
		g) Sterilization (btl/vasectomy)	1	0	
		h) Emergency contraception	1	0	
		i) Implants (norplant, jadelle, implanon)	1	0	
		j) LAM	1	0	
		k) Natural Family Planning methods (Standard Days Method etc.)	1	0	
F203	Does the provider promote or emphasize one method in particular?	Yes	1		
		No	2		
		Client is repeat user	3		Go to F205
F204	Which method does the provider emphasize? _____				
F205	Does the client mention a preferred method?	Yes	1		
		No	0		Go to F208
F206	Which method does the client prefer? _____				
F207	Does the client receive her preferred method(s)?	Yes	1		
		No	0		
F208	Which method(s) does she actually receive? [WRITE METHOD(S)] _____				IF 'NONE', GO TO F210

F209	For the method(s) the client receives, does the provider... [OBSERVE AND CIRCLE '1' FOR 'YES' IF DISCUSSED; OTHERWISE CIRCLE '0']		Yes	No	GO TO F300
		a) Explain how method works	1	0	
		b) Explain advantages/benefits	1	0	
		c) Explain disadvantages	1	0	
		d) Explain how to use method	1	0	
		e) Discuss practices affecting effectiveness	1	0	
		f) Discuss possible side effects	1	0	
		g) Discuss management of side effects	1	0	
		h) Discuss return to clinic if she has complications	1	0	
		i) Discuss possibility of changing method	1	0	
		j) Give oral or written follow-up instructions	1	0	
		k) Advise client when to return for re-supply	1	0	
		l) Discuss emergency contraceptive in case a client forgets to take her contraceptive or use a condom to prevent pregnancy	1	0	
F210	If client does not receive any FP method, WHY NOT? [OBSERVE AND CIRCLE '1' FOR 'YES' FOR REASONS; OTHERWISE CIRCLE '0']		Yes	No	
			1	0	
		a) Not appropriate method/contraindications)			
		b) Method not available	1	0	
		c) Told to return during/after menses	1	0	
		d) Changed mind after listening to provider	1	0	
		e) Suspect pregnancy	1	0	
		f) There is no operating room or surgeon	1	0	
g) Other (specify)	1	0			

SECTION 3: STI RISK ASSESSMENT AND CONDOMS				
F300	Does the provider discuss STI with the client?	Yes	1	
		No	0	
F301	Does the provider discuss HIV/AIDS with the client?	Yes	1	
		No	0	
F302	Does the provider discuss STI and/or HIV risk factors with the client?	Yes	1	Go to F304
		No	0	
F303	What risk factors does the provider discuss? [OBSERVE AND CIRCLE '1' FOR 'YES' IF DISCUSSED; OTHERWISE CIRCLE '0']		Yes	No
		a) Multiple partners	1	0
		b) STIs	1	0
		c) Unprotected sexual intercourse	1	0
		d) Not knowing partner's status	1	0
		e) Partner has multiple partners	1	0
		f) Other (specify) _____	1	0
F304	Does the provider give any of the following? [OBSERVE AND CIRCLE '1' FOR 'YES' IF GIVEN; OTHERWISE CIRCLE '0']		Yes	No
		a) Give information on symptoms of an STI?	1	0
		b) Advise to seek medical treatment if they notice any symptoms of an STI?	1	0
		10.8.1.1 c) Advise that an STI may be asymptomatic?	1	0
		10.8.1.2 d) Screen for STI	1	0
		10.8.1.3 e) Provide syndromic management of STIs	1	0
		f) Refer the client elsewhere for STI services	1	0
		g) Write in facility or unit if within same facility.....		

F305	Does the provider discuss the following on condoms? [OBSERVE AND CIRCLE '1' FOR 'YES' IF DISCUSSED; OTHERWISE CIRCLE '0']		Yes	No	
		a) Mention condoms?	1	0	
		b) Ask if client ever used condom?	1	0	
		c) Ask if client used condom at last sex?	1	0	
		d) Mention <u>explicitly</u> that condoms protect against STI and/or HIV?	1	0	
		e) Mention explicitly that condoms protect against pregnancy?	1	0	
		f) Encourage the use of condoms for STI/HIV prevention along with the use of another method?	1	0	
		g) Emphasize correct and consistent use of a condom?	1	0	
		h) Discuss how to negotiate use of condom with partner?	1	0	
		i) Give information on how to use a male condom?	1	0	
		j) Give information on how to use a female condom?	1	0	
		k) Mention EC as a backup for condom breakage?	1	0	
		l) Advise client where she can get more condoms	1	0	
F306	Does the provider give the client any condoms?	Yes	1		
		No	0		Go to F308
F307	How many male and female condoms	Number of male condoms	_____		
		Number of female condoms	_____		
F308	Does the provider discuss other STI/HIV prevention methods other than the condom?	Yes	1		
		No	0		Go to F400
F309	Which methods? [OBSERVE AND CIRCLE '1' FOR 'YES' IF DISCUSSED; OTHERWISE CIRCLE '0']		Yes	No	
		a) Abstinence	1	0	
		b) Monogamy	1	0	
		c) Partner monogamy	1	0	
		d) Knowing your partner's status	1	0	
		e) Knowing your own status	1	0	
		f) Other (specify) _____	1	0	

SECTION 4: HIV COUNSELLING AND TESTING

SECTION 4: HIV COUNSELLING AND TESTING				
F400	Does the provider do any of the following? [OBSERVE AND CIRCLE '1' FOR 'YES' IF DONE; OTHERWISE CIRCLE '0']		Yes	No
		a) Ask for history of signs and symptoms of RTIs/STIs	1	0
		b) Ask number of sexual partners	1	0
		c) Ask Partner's number of sexual partners	1	0
		d) Does the provider mention Counselling and Testing (CT) for HIV?	1	0
		e) Does the provider ask the client if she has already tested?	1	0
		f) Does the provider ask when she last tested for HIV?	1	0
		g) Does the provider discuss what the test can tell the client?	1	0
		h) Does the provider explain about the window period?	1	0
		i) Does the provider give the client information on where to get an HIV test?	1	0
F401	Does the provider offer the client counselling and testing for HIV?	Yes	1	
		No	0	Go to F405
F402	Does the provider ask if the client accepts to be tested for HIV?	Yes	1	
		No	0	
F403	Is the client counselled and tested for HIV in this session?	Yes	1	
		No	0	Go to F405

F404	How long is spent on each of the following? [WRITE DOWN IN MINUTES]	Pre-test	_____			Go to F410
		Testing	_____			
		Post-test	_____			
		Entire testing procedure	_____			
F405	Does the provider refer the client for counselling and testing?	Yes	1			Go to F500
		No	0			
F406	To which facility unit? [WRITE NAME OF FACILITY]	_____				
F407	Does the provider give the client a CT referral letter?	Yes	1			Go to F410
		No	0			
F408	Does the client raise specific issues regarding the referral letter?	Yes	1			Go to F410
		No	0			
F409	Which issues? [WRITE DOWN ISSUES RAISED]	_____				
F410	[FOR HIV POSITIVE CLIENTS ONLY (if diagnosed during the consultation or disclosed to provider)] Does the provider discuss the following? [OBSERVE AND CIRCLE '1' FOR 'YES' IF DISCUSSED; OTHERWISE CIRCLE '0']		Yes	No	N/A	
		a) Ask if client is on ART	1	0	8	
		b) Mention drug interactions between hormonal methods and ART	1	0	8	
		c) Discuss positive living for people living with HIV	1	0	8	
		d) Ask about the client's general state of health	1	0	8	
		e) Mention the need to prevent unintended pregnancies among women who are HIV-infected	1	0	8	

SECTION 5: OTHER ISSUES (ALL CLIENTS)					
F500	What other health issues are mentioned/ discussed with the client during the consultation? [OBSERVE AND CIRCLE '1' FOR 'YES' IF MENTIONED/ DISCUSSED; OTHERWISE CIRCLE '0']		Yes	No	
		a) Gynaecological exam	1	0	
		b) Pap smear	1	0	
		c) Cervical screening using VIA / VILLI	1	0	
		d) Pregnancy test	1	0	
		e) PMTCT	1	0	
		f) Gender-based violence/abuse	1	0	
		g) Breast examination	1	0	
		h) General health and well-being	1	0	
		i) Childhood vaccinations	1	0	
		j) Child growth monitoring	1	0	
		k) ART	1	0	
		l) Opportunistic infections in HIV positive clients	1	0	
m) Other (specify)	1	0			
F501	Does the provider do any of the following? [OBSERVE AND CIRCLE '1' FOR 'YES' IF DONE; OTHERWISE CIRCLE '0']		Yes	No	
		a) Gynaecological exam	1	0	
		b) Pap smear	1	0	
		c) Cervical screening using VIA / VILLI	1	0	
		d) Pregnancy test	1	0	
		e) Breast examination	1	0	
		f) Childhood vaccinations	1	0	
		g) Child growth monitoring	1	0	
		h) Other (specify)	1	0	
F502	Which services does the provider refer the client for? [OBSERVE AND CIRCLE '1' FOR 'YES' SERVICES CLIENT REFERRED FOR; OTHERWISE CIRCLE '0']		Yes	No	N/A
		a) Gynaecological complications	1	0	
		b) Pap smear	1	0	
		c) Cervical screening using VIA / VILLI	1	0	
		d) Pregnancy test	1	0	
		e) PMTCT	1	0	
		f) Breast examination/mammogram	1	0	
		g) STI services	1	0	
		h) ART clinic	1	0	
		i) TB clinic	1	0	
		j) Opportunistic infections in HIV positive clients	1	0	
		k) Support group	1	0	
		l) Other (specify)	1	0	
F503	Does the provider give the client a reminder, in writing, of when to return?	Yes	1		
		No	0		

F504	Does the provider do any of the following? [OBSERVE AND CIRCLE '1' FOR 'YES' IF DONE; OTHERWISE CIRCLE '0']		Yes	No	
		a) Use clients name when talking to her/him	1	0	
		b) Ask if client understood the information	1	0	
		c) Encourage client to ask questions	1	0	
		d) Use client record	1	0	
		e) See client in privacy where no one could hear the conversation	1	0	
		f) Ensure confidentiality	1	0	
		g) Look at client's health card during consultation	1	0	
		<i>h) Document data in the register</i>	1	0	
		i) Give the client a return date (verbal)	1	0	
		j) Record the return date on client's card	1	0	
F505	Any other comments/impressions (write overleaf if necessary)				
	<hr/>				

TIME OBSERVATION ENDED: [__|__:__|__]

[RECORD TIME IN 24-HOUR CLOCK]

THANK CLIENT.