UNIVERSITY OF KWAZULU-NATAL

Cost-effectiveness analysis of an HIV-adapted Training and Continuous Quality Improvement Supervisory Intervention for Community Caregivers

By

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A dissertation submitted in partial fulfilment of the requirements for the degree of Master of Commerce (Economics)

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2015

DECLARATION

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ACKNOWLEDGEMENTS

I would like to express my heartfelt gratitude to my supervisors Gavin George and Ralitza Dobreva for their support, guidance and extraordinary patience during the process of writing this dissertation.

Thanks are also extended to Elias Asfawe and Gerard Boyce for their invaluable feedback. Special thanks to Dr Jennifer Reddy, Jordache Chetty and Khumbuzile Sishi from 20,000+ Partnership for their time and willingness to assist me with information pertaining to the Nompilo Project. I would also like to express my appreciation towards Christiane Horwood, Lyn Haskins and Ntokozo Mtambo for their insights into the study.

My heartfelt thanks to Shamiso Mudzingwa,Tendai Kurwa, Denver Kawara, Collins Mucheuki Joel Baofo, John Nkume, Mfundo Dubula, Thina Ngubane, Kenneth Ngwenya, Christiane Thompson, Thobile Mshengu, Tamlyn McKenzie, Dr. Gerry Bokana, Sheri Badenhorst, Tamlyn Rautenberg, Edgar, Kundai Magaisa, Wadzanai Mudzingwa. All I can say is that you are all absolutely awesome you helped make this possible.

Finally thanks Mum and Dad for the overwhelming support you have given a maverick son over the years.

ABSTRACT

Background

It is argued that supportive supervision increases the performance of community health workers and this is evidenced by an increased uptake of interventions in health facilities located in the CHWs catchment area.

Method

A retrospective economic evaluation conducted from an implementer's perspective of a two-arm cluster randomised control trial (RCT) that was implemented during the period May 2012 – November 2013 by the Centre for Rural Health at the University of KwaZulu-Natal (CRH-UKZN) in the Ugu Health District located in the province of KwaZulu-Natal. This RCT compared the cost-effectiveness of the training and supervision of community caregivers (CCGs) provided by the KwaZulu-Natal provincial Department of Health relative to the HIV-adapted community case management (CCM) training and continuous quality improvement (CQI) supervision of community care givers (CCGs) implemented by Centre for Rural Health at the University of KwaZulu-Natal (CRH-UKZN). The behavioural changes under consideration were (i) prevalence of antenatal booking before 20 weeks have lapsed in a woman's pregnancy; (ii) prevalence of the number of women who present themselves for post-natal care within seven days of delivery; (iii) the prevalence of exclusive breast-feeding practice and the (iv) coverage of Human Immunodeficiency Virus Polymerase Chain Reaction (HIV PCR) testing of babies.

Results

The uptake of the target interventions were not statistically different between the control group and the intervention group; with the exception of the prevalence of exclusive breastfeeding. The intervention was more costly than the control in addition to being less cost-effective where the former was R19, 942 and the latter R8,389 per mothers practicing exclusive breast feeding.,

Conclusion

The health outcomes achieved did not justify the additional costs of frequent supervision in the intervention, but rather the focus should be on quality and consistency of the supervision.

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LIST OF ABBREVIATIONS AND ACRONYMS

ANC	Antenatal Clinic
ART	Antiretroviral Therapy
CEA	Cost-effectiveness Analysis
CRH-UKZN	Centre for Rural Health – University of KwaZulu-Natal
CCGs	Community Care Givers
CCM	Community Case Management
CHEERS	Consolidated Health Economic Evaluation Reporting Standards
CHWs	Community Health Workers
CORPS	Community Resource Persons
CRF	Community Rehabilitation Facilitators
CQI	Continuous Quality Improvement
DHS	District Health System
DOTS	Directly Observed Therapy Short-Course
DPSA	Department of Public Service and Administration
EBF	Exclusive Breast Feeding
HACs	HIV/AIDS Communicators
HBCs	Home Based Carers
HAART	Highly Active Antiretroviral Therapy
HIV	Human Immunodeficiency Virus
IMCI	Integrated Management of Childhood Illnesses
iCCM	Integrated Community Case Management.
ILO	International Labour Organisation
ISCOR	International Standard Classification of Occupations (ISCO)
MNCWH	Maternal Neonatal Child Women's Health
NDoH	National Department of Health
NHA	National Health Act
OSD	Occupation Specific Dispensation
ORS	Oral Rehydration Solution

PCR	Polymerase Chain Reaction
RCT	Randomised Control Trial
UNICEF	United Nations Children's Fund
Q.M.	Quality Mentor
T.B.	Tuberculosis
VHW	Village Health Worker
WHO	World Health Organisation

CHAPTER 1: INTRODUCTION

1.1 Task Shifting and the Health Human Resources Challenge

Health systems in developing countries are under significant strain as the supply of trained health workers struggles to meet with the rising demand for health care. In low-income countries, this demand for health care is driven by the rise in infectious diseases such as tuberculosis (TB) and HIV/AIDS and the increasing burden from chronic illnesses and cardiovascular diseases. The supply of health care workers in low income countries is compromised by pull factors such as brain drain where health care workers emigrate to countries that offer them better pay and working conditions. In terms of push factors, HIV/AIDS has significantly increased patient loads which coupled with the risk of occupational transmission have resulted in health workers leaving the public health system (World Health Organisation (WHO), 2008). The attendant problems associated with a health system under strain tend to be more acutely felt in low-income, under-resourced and isolated communities where access to health care is limited (Lehmann and Sanders, 2007).

In order to increase access to health care it is critical that the health system be strengthened by finding solutions that can expand the health workforce. This enables it to be staffed with adequate numbers of health workers who possess the correct skills and are placed in the right places. One of the primary constraints in the supply of health care workers is the rate at which the health workforce can be expanded due to the length of time it takes to train a health professional. In recognition of this bottleneck, task shifting has been employed as a strategy that allows for the rapid expansion of the human resources pool (WHO, 2008). Task shifting is defined as a “process whereby specific tasks are moved, where appropriate, to health workers with shorter training and fewer qualifications” (WHO, 2008, p7). According to the WHO, task shifting results in a more efficient use of qualified health care professionals as the most basic health care services are delegated to a cadre of health workers with limited and specific training, thereby reducing service delivery bottlenecks.

1.2 Community Health Workers

Under the Task Shifting III strategy, the WHO has recognised that community health workers (CHWs) may "assume some tasks previously undertaken by senior cadres (e.g., nurses and midwives, non-physician clinicians and medical doctors (WHO, 2007,,p.39). Lehmann and Sanders (2007, p.1) argue that the most basic tasks that are performed in a formal health facility can be delegated to community health workers who can administer them at a household level. Community health workers are defined as lay health workers who have received a limited amount of training on health care promotion and the provision of health care services to communities in which they reside. (Lewin et al, 2010; Bhattacharya et al (2001. p.19).

The International Labour Organisation (ILO) in its draft International Standard Classification of Occupations (ISCO-08) provides a functional definition of CHWs as "[providing] health education and referrals for a wide range of services, and provide support and assistance to communities, families and individuals with preventive health measures and gaining access to appropriate curative health and social services" (ILO, 2008, n.p). Some examples of services offered by community health workers in their communities include counselling on breastfeeding, managing simple childhood illnesses, and preventive health education on malaria, TB and HIV/AIDs.

Bhattacharya et al (2001. p.19) and Lehman and Sanders (2001, p.20) argue that the success of community health worker programmes depends on the presence of regular and reliable supervision. Lehmann and Sanders (2001, p.21) support this observation by asserting that supervision tends to be one of the weakest aspects of CHW programmes. This is further emphasized by the WHO (2012) which highlights that the nature of the supervision that is provided to CHWs and the skills of the individuals providing the supervision are imperative for the success of community health worker programmes. The WHO (2012, p.1) advocates that health workers should be provided with supportive supervision and mentoring. Supportive supervision is defined as a management process in which supervisors and CHWs collaborate on problem solving. This process relies on the coaching of health workers, and uses data to determine where to make improvements in the performance of health workers (2008b, p.1).

Successful implementation of supportive supervision depends on the practice of frequent and consistent supervision Lehmann (2008, p.25). It is argued that infrequent and inconsistent supervision of community health care workers generates feelings of under-appreciation, which are associated with a decline in motivation. The disadvantage of supportive supervision of CHWs is that it may be time intensive, however this is ameliorated by its advantage of generating consistent high levels of performance (ibid). Delegation of health care services to CHWs within health systems requires that quality assurance mechanisms be put in place. The WHO (2008, p25) asserts that the purpose of quality assurance programmes is to "improve performance and quality; to provide assurance that acceptable standards are achieved; and to improve accountability". This is particularly crucial as the failure of early CHW programmes post the Alma Ata Declaration have been attributed to the poor quality of care offered by CWHs and the high attrition rate of CHWs (Glenton et al, 2013, p6).

Whilst there are a number of advocates for the use of supportive supervision for CHWs, there is a paucity of information regarding its cost-effectiveness and its impact in a developing country setting with a high HIV/AIDS prevalence rate. Glenton et al (2008, p49) states that whilst economic arguments in favour of CHWs are made such as the potential cost reductions that may accrue as qualified health professionals are substituted for CHWs as the latter incur lower training and remuneration costs there is little cost data to support these assertions. Gilson et al (1989, p5) however point out that it is misleading to simply consider the cost per CHW. Rather the total cost of a CHW programme with supportive supervision needs to be reviewed instead. Gilson et al (1989) further highlight that the costs of supervision tend to be overlooked, even though the regular contact necessary to support CHWs effectively creates significant supervision costs.

In response to the gap in research relating to the economic evaluation of supportive supervision of CHW programmes, this study presents a cost-effectiveness analysis (CEA) of the Nompilo Project randomised control trial (RCT). Its aim is undertaken in order to determine the cost-effectiveness of supportive supervision of CHWs as

espoused through a continuous quality improvement CQI supervision methodology in a developing country and within a rural setting.

1.3 The Nompilo Project RCT

The Centre for Rural Health at the University of KwaZulu-Natal (CRH-UKZN) conducted a (RCT) in Ugu health district in KwaZulu-Natal in the period from May 2012 to– November 2013. The objective of the RCT was to study the effectiveness of implementing an HIV-adapted training community case management (CCM) curriculum and the use of continuous quality improvement (CQI) in the supervision of community caregivers (CCGs) in a high HIV prevalence setting. The effectiveness was measured by considering how many mothers who were counselled by CCGs adopted the key interventions outlined in the updated WHO guidelines on HIV and infant feeding (WHO, 2002c). The key health outcomes of interest included the number of pregnant women who presented themselves for their first antenatal booking 20 weeks before their due date; the number of women who presented themselves to a clinic for post-natal examination within seven days of delivering their baby; the number of women practicing exclusive breastfeeding; and the number of infants who have been exposed to HIV and have undergone an HIV polymerase chain reaction (PCR) test. CRH-UKZN measured the health outcomes in both the intervention and control group in the pre-intervention and post-intervention period.

The HIV-adapted CCM training and CQI supervision method was compared against the routine CCM training and supervision provided by the provincial Department of Health which was the control in the RCT. The routine CCM training had a lesser HIV focus relative to the enhanced CCM training. In addition, the form of supervision differed between the groups in the two arms of the RCT. CCGs in the control arm were supervised by an enrolled nurse based at a local health facility. In the intervention arm the CCGs were supervised by a Quality Mentor whose full time job was supervision and mentoring and was not based in a local health care facility. .

As a motivation for the RCT the CRH-UKZN (2014, p.3) argues that the current supervision practiced by the provincial Department of Health may not be highly

effective and as a result CCGs lack adequate support in their daily activities. The CCGs' link to the formal health system are community health facilitators who are expected to provide supportive supervision to CCGs, which can be in the form of problem solving, listening to challenges CCGs are facing in the community, and providing emotional support and mentoring. CRH-UKZN argues that the CCG to health facilitator ratio is high, thus undermining the level of supervision provided. It is also important to note that whilst community health facilitators are required to supervise CCGs, they still have patient caseloads that need to be attended to in the context of staff shortages and poorly resourced health facilities. In light of these factors, CRH-UKZN (2014, p.4) suggests that the roles of health facilitators have been reduced to primarily collecting "basic information and reports from CCGs, rather than providing mentoring and supervision in their daily activities". It is therefore implied that the community health worker programme in KwaZulu-Natal suffers as a result of inadequate supervision and exists within a weak health system.

Continuous quality improvement (CQI) management and supervision was found to be successful in the formal health sector particularly in increasing the uptake of prevention of mother to child transmission (PMTCT) interventions among pregnant women (Doherty et al, 2009). This study found that the use of a CQI management intervention in clinics resulted in the uptake of "CD4 testing of HIV positive mothers increasing from 40% to 97%, maternal nevirapine from 57 to 96% and infant nevirapine from 15% to 68%" (Doherty et al, 2009 p5). The CRH-UKZN therefore decided the study the effectiveness of a CQI in the management and supervision of CCGs. The (CQI) methodology that CRH-UKZN implemented in the intervention arm of the RCT introduces a Quality Mentor (QM) in the supervision of CCGs. The Quality Mentor was a retired professional nurse who was hired by CRH-UKZN to supervise and mentor CHWs on a full time basis. The Quality Mentor was a professional nurse with management experience who supervised CCGs on a full time basis. The role of the Quality Mentor is to supervise CCGs on a full time basis and relied primarily on "supportive supervision". This type of supervision is characterised by regular and consistent meetings that have a strong mentoring component.

The primary difference in the treatment of the two groups of CCGs was the intensity of supervision. CCG supervisors in the control group met once a month with their health facilitators with the primary goal of delivering basic information and reports. The intervention group on the other hand held two types of meetings as follows (i) a twice monthly meeting which consisted of a CCG supervisor and a CCG from each CCG team (ii) a meeting held every four months in which all CCGs participated.

Among the key outcomes in the study CRH-UKZN found that mothers who were served by CCGs in the intervention arm were statistically more likely to report having exclusively breastfed their infants for the first six weeks of life in the post intervention survey. They however did not find any significant statistical differences in the other key outcomes between mothers in the intervention and control arm. Therefore, this study focuses on the number of women practicing exclusive breastfeeding (EBF) as an outcome of the CEA. .

1.4 Objectives

This study is a cost-effectiveness analysis of a two-armed cluster randomized control trial (Nompilo Project RCT), aimed at promoting an increase in the uptake of exclusive breastfeeding in Ugu Health District in KwaZulu-Natal province by CCGs who have undergone HIV-adapted CCM training and CQI supervision and management in comparison to the routine provincial CCM training and health facilitator led supervision.

The research questions to be answered in this study are:

1. What is the cost and cost-effectiveness of an HIV-adapted and CQI management and supervision model of CCGs?
2. Is the HIV-adapted and CQI management and supervision model of CCGs more cost-effective than the standard CCM training and health facilitator driven supervision model?

1.4 Chapter Outline

This dissertation begins with a background view of the health system in South Africa and the role of CHWs as frontline health workers in the delivery of primary health care. Chapter Three then reviews the literature on agency theory with particular focus on the effect on supervision on the intrinsic motivation of agents and how it affects their performance. The literature review also considers previous studies that have conducted cost-effectiveness studies of CHW programmes from a local South African and international perspective that focus on supervision and its economic cost. .

Chapter Four describes the economic evaluation methods that are used to evaluate the Nompilo Project RCT. Chapter Five then outlines the methods used in the calculation of the costs and cost-effectiveness for the intervention and control arm respectively. This is followed by Chapter Six which presents the results of the cost and cost-effectiveness analyses Chapter Seven considers the implications of the results of the cost-effectiveness analysis and identifies possible sources of inefficiencies in the Nompilo Project RCT. Chapter Eight concludes this thesis by summarizing the research findings and making recommendations for further study

CHAPTER 2: BACKGROUND LITERATURE

This chapter begins by looking at the National Department of Health's Strategic Plan for 2012-2016 and the role of CHWs in its implementation Public Health Care system. Section 2.2 outlines the defining characteristics of primary health care in light of which the contribution of CHWs are regarded as a delivery strategy (Avula et al, 2013) for primary health care in communities. Section 2.3 represents the general characteristics of CHWs programmes in developing countries are described such as the training and supervision, compensation, educational qualifications and their socio-economic background. This section also looks at the reasons behind the shift from using generalist to specialist CHWs. Section 2.4 considers CHWs programmes in South Africa with particular reference to the North West province in order to understand the outreach activities that CHWs engage in and to gain a sense of CHWs programmes in South Africa. This study references the North West as it was the only province that provided comprehensive information on the day-to-day activities of CHWs and how they relate to the formal health system (Ogenmefun et al, 2011) In this section we have relied extensively on Ogunmefun et al, (2011) which is a report on an audit on CHWs that was conducted in the North West province health districts in order to build a picture of the characteristics and activities of CHW programmes in South Africa. It should be noted that the results of this audit were responses provided by CHWs in the North West province. This stance is adopted as this appears to be the most comprehensive document on CHWs that could be found. This has been a limitation of the study with regards to KwaZulu-Natal Province on which this study is based.

Section 2.5 identifies and defines the various forms of community case management (CCM) as carried out by CHWs in developing countries. Finally section 2.6 provides a brief overview of the Nompilo Project RCT project design such as time frames and the participants in the study.

2.1 Primary Health Care in South Africa

Community health workers and nurses are central to the provision of primary level health care. The two cadres of health workers are frontline health workers in the delivery of PHC services as they are the first point of contact that people have with the health system. Nurses are based in nurse driven primary health clinics where they are

responsible for the diagnosis and management of communicable diseases such as TB, sexually transmitted diseases and HIV. In addition clinic nurses provide preventive care such as the immunisation of children and the monitoring of their growth. Maternal health care services such as antenatal and postnatal care are also provided by clinics. Clinics also provide curative services for acute chronic conditions such as hypertension and diabetes (Doherty, 2009). CHWs are linked to a health facility via the supervision they receive from nurses based at these facilities. Nurses located in clinics provide the link between the CHWs and the formal health system,

2.2 Maternal Neonatal Child and Women's Health (MNCWH)

In 2012 the Department of Health launched the Strategic Plan for maternal neonatal child and women's health (MNCWH) and Nutrition in South Africa 2012 – 2016. The goals of this plan are to reduce the maternal mortality ratio (MMR), neonatal mortality ratio (NMR), infant mortality rate (IMR) and the child mortality rate by 10%. In order to meet these targets the Strategic Plan prioritises the delivery of key interventions to women, mothers and children at the community, primary health care clinics and hospitals (HST, 2012). Maternal health care interventions that have been identified include "Basic Antenatal Care (4 visits for very pregnant women starting in the first trimester,…Initiation of HIV testing and antiretroviral therapy (ART) during pregnancy as well as other services which support the prevention of mother-to-child transmission (PMTCT) of HIV,…post-natal care within 6 days of delivery" (HST, 2012, p2).

Newborn health interventions that are identified in the strategic plan health include the "[promotion of] early and exclusive breastfeeding, ensuring safety of newborns exposed to HIV, provision of PMTCT services,…post-natal visits within 6 days offering newborn care and support for exclusive breastfeeding" (ibid). The strategy also mentions child health interventions which include the promotion of exclusive breastfeeding and complementary feeding practices for infants and young children. The child health interventions also include preventive services such as "immunisation, growth and promotion…. in addition to the correct management of childhood illnesses using the Integrated Management of Childhood Illness (IMCI) case management process (ibid). In terms of delivering these interventions at a community level, the

strategic plan advocates the use of CHWs in the provision of community based MNCWH health care intervention packages.

2.3 General Characteristics of Community Health Worker Programmes

CHWs have traditionally been categorised as either being generalist or specialist health workers. General CHWs are associated with the delivery of a range of interventions within a community which included both health care related and "developmental functions" (Lehman et al, 2014, p.11) which require skills in crisis management and leadership (Koon et. al, 2013), examples of which are village health workers (VHWs) and community resource persons (CORPS). The specific interventions delivered by generalist CHWs have included "treatment of diarrhoea, simple wound treatment, immunisation, family planning, health education, malaria control, identification and referral of problem cases and environmental sanitation" (p.11). There has however been a shift from generalist to specialist CHWs who are trained to implement focused interventions which address specific health issues (Koon et. al, 2013).

Lehmann and Sanders (2007, p.9) suggest that the move towards the use of specialist CHWs has been motivated by a need to find an optimal mix of the functions performed by CHWs. Bhattacharya (2001, p.5) argue that CHWs may feel overwhelmed by performing many tasks and therefore risk becoming demotivated as might occur with generalist CHWs. Gilson et al (1989, p3) also points out that early CHW programmes which used generalist CHWs had unrealistic expectations with regards to the functions that CHWs were expected to carry out. In addition the advent of task shifting may also be a contributor to the rise of specialist CHWs. This allusion is based on the understanding that the shifting of specific tasks that were once performed by professional health care providers requires more focused training for CHWs and is thus more likely to limit the scope of tasks or activities that they engage in. This appears to be supported by Koon et al, (2013, p.9) who observes that specialist CHWs have a narrowly defined set of skills which is largely determined by either the population for example women and children in relation to MNCWH or by disease e.g.

HIV/AIDS and tuberculosis (TB). This is in contrast to general CHWs who attempt to deliver primary health care needs to the whole community.

Lehmann and Sanders (2007, p.12) in a literature review of CHWs in Africa, found that specialist CHWs where primarily used in interventions such as MNCWH care which included reproductive health and family planning, tuberculosis care, malaria control, HIV/AIDS care and the treatment of acute respiratory infections. Lehmann et al (2004, p2) provides examples of specialist CHW cadres which include community rehabilitation facilitators (CRFs), community based directly observed therapy short-course (DOTS) supporters, HIV/AIDS communicators (HACs) and home based care workers (HBCs).

Lewin et al (2010, p.6) observes that CHWs tend to come from low socio-economic backgrounds and may act as CHWs on either a paid or voluntary basis (Lewin et al, 2010, p.6). Lehmann and Sanders (2007, p24) however contest the assumption that there is a large pool of volunteers and argue that because CHWs come from low income backgrounds they most likely require an income. They argue that CHW programmes that rely on volunteers tend to have high attrition rates thus highlighting the necessity of compensating CHWs. The form of financial compensation that CHWs receive for delivering health care services varies from a fixed monthly salary, a stipend, payment by the hour or according to the number of patients they have received. Glenton (et al, 2013) asserts that in instances where CHWs are not salaried they may still receive financial and non-financial stipends such as lunch money, transport money and access to microloans and equipment such as bicycles.

In terms of qualifications CHWs in general possess little or no secondary school education and do not have a tertiary education (Lehmann and Sander, 2001; Glenton, 2013). The training that CHWs undergo is of a much shorter duration and limited curriculum relative to that of health care providers such as nurses. In a review of CHW programmes that were implemented in Africa, Lehmann et al. (2004, p5) observed that training was provided by non-governmental organisations (NGOs) and the Department

of Health. The type of training that CHWs received varied across programmes, for instance some CHWs receive training that is restricted to prevention and health care promotion roles. Whereas some CHWs received training that prepares them to play a curative role as in the case of integrated Community case Management (iCCM). This core training is also supplemented by refresher or additional courses that are introduced in response to shifts in government policy. The training that CHWs receive is generally approved of by the country's health department and certification authority but it is not considered to be a degreed tertiary certificate.

Kok et al (2014, p11) makes the observation that whilst studies mention the existence of supervision of CHWS, there is a dearth of information regarding the organisational structures and processes related to the implementation of CHW supervision of CHWs.The WHO (2012, p.37) brings to the fore the inconsistent nature of supervision of CHWs which ranges from sporadic to confrontational. In instances where CHWs were supervised by health staff based at health facilities such as hospitals and health clinics the supervision was not ideal. This is attributed to various factors such as overburdened health staff who resent the additional responsibilities, health staff who do not understand the role of CHWs and their own role with regards to the supervision of CHWs. An illustration of the flaws of supervision is highlighted by Gilson et al (1989, p520) regarding a case study of a CHW programme in Botswana where CHWs were imposed on nurses without prior consultation. The nurses reacted to this development by distorting the role of CHWs and using them as assistants instead. This resulted in CHWs spending the majority of their time in the health facility rather than in the community thus limiting the effectiveness of their role.

Lehmann et al (2004, p20) point out that health facility personnel are orientated towards curative treatment and do not necessarily have a strong appreciation for primary health care interventions that are delivered by CHWs. The effect of this is that clinic staff consider CHWs as "lowly aides" (Lehmann et al, 2004, p20). These perceptions of CHWs are further reinforced by the view that it is inappropriate to expose CHWs to the decision making process with regards to patient health care. Where health facility based advisers do not understand the work of CHWs, supervision

simply becomes an inspection exercise where CHW activities are simply ticked off a checklist without any feedback or mentoring provided (Lehmann, 2004). Table 1 summarises the distinction between CHWs and health facility based nurses.

Table 1: Distinction between CHWs and Clinic Based Nurses

Community Health Workers	Clinic Based Staff (Nurses).
Training ranges from 5 days to 6 months	Ranges from 1 year to 4 years
Minimum educational qualification is a grade 8.	Must have at least a senior certificate.
Do not have a tertiary education	Are in possession of either a Bachelor's Degree, Nursing Diploma, Higher Certificate or an Advanced Diploma in midwifery
Must live in the communities that they service	Do not have to reside in the communities that they serve.
Nurses in health facilities are responsible for supervising the conduct of CHWs.	Clinic based staff are supervised by a clinic manager.
Conduct monthly home visits.	Primarily based at a health facility although mobile clinics are available which can provide health care services at a community level.
Are employed by the Provincial Department of Health and receive a receive a monthly stipend.	Permanently employed by the Provincial Department of Health and receive a salary.
Primarily perform promotion and prevention health care services.	Provide promotion, prevention and basic curative health care service.

Source: Own

2.4 Community Health Workers in South Africa

CHWs in South Africa are referred to by a variety of names across different provinces. In the Free State they are referred to as Ancillary Health Workers (AHW), Community Based Health Workers (CBHWs) in Mpumalanga, Community Care Workers (CCWs) in the Western Cape and Community Care Givers (CCGs) in KwaZulu-Natal, whilst the National Health Insurance (NHI) draft legislation, which is integral to the PHC reengineering initiative uses the term Community Health Worker. Colloquially, CHWs are referred to as Onompilo. In addition, CHWs are not considered health care providers as the National Health Act (NHA) of 2003 confers this status on health workers who operate under a legal framework and are recognised as being a part of the formal health system. For example, doctors operate under the Health Professions Act of 1974, nurses are regulated by the Nursing Act of 1978 whilst paramedics are

governed by the Allied Health Professions Act of 1978 (NDoH, 2004). The NHA of 2003 refers to lay health workers as health workers, which are defined as “any person who is involved in the provision of health services to a user, but does not include a health care provider” (NDoH, 2004, p.14).

CHWs can be found in both urban and rural areas and are in possession of a high school education (Ogenmefum, 2011). These interventions include providing treatment adherence support to patients who have communicable diseases such as TB and HIV/AIDS through directly observed short therapy course (DOTS) and the tracing of defaulters. CHWs are also responsible for health promotion through health education activities such as TB or HIV/AIDS awareness, and distribution of male condoms. Home based care services (HBCs) provided by CHWs are targeted toward patients who are terminally ill particularly those living with HIV/AIDs and other chronic illnesses and it includes the cleaning of households, visiting patients daily and ensuring adherence. Other services provided by CHWs include mother, neonatal and child health (MNCH) interventions which included the integrated of management of childhood illness (IMCI) and nutrition services.

In terms of their daily activities CHWs identify patients at the community level when they perform daily visits or door to campaigns at people’s homes. Once a CHW identifies a patient, the CHWs fills out a referral form which includes reasons for referring the patient to the health facility and in some instances, the CHW actually accompanies the patient to the clinic in a process known as upward referral. In some instances, particularly with treatment defaulters the patient is actually identified at the facility level. At the facility’ nurses receive the records, compiles lists and determine what actions CHWs should take in relation to these patients in a process that is known as downward referral. According to Ogenmefun et al (2011, p55), patients who are likely to be identified for referral purposes include treatment defaulters, bed ridden patients and those who require general monitoring.

2.5 Community Case Management

The World Health Organisation in collaboration with UNICEF developed a training curriculum for CHWs that is known as the Community Case Management of Childhood Illnesses (CCM) (WHO/UNICEF, 2012). The objective of CCM is to enable CHWs to detect the early onset of childhood illness of children aged between 2-59 months of age and ensure that these children are referred to a health facility. Early detection of childhood illness symptoms contributes to a reduction in childhood mortality.

CCM has been implemented in developing countries including Nepal, Malawi, Zambia and Ethiopia where CHWs administer basic curative treatment to childhood illnesses such as pneumonia, diarrhoea and malaria. In these countries CHWs are trained on how to administer oral rehydration solution (ORS) and zinc tablets; antibiotics for pneumonia and antimalarial drugs. This differs from South Africa where the curative role of CHWs is limited to educating mothers on the administration and preparation of oral rehydration solutions (ORS). In South Africa the CCM package of interventions is primarily based on prevention and detection of illnesses in addition to promotion of health care. Thus CCM as practiced in South Africa is based on creating demand for health care facilities.

CHAPTER 3: THEORETICAL FRAMEWORK

This section is based on the understanding that the intervention group in the Nompilo Project RCT was characterised as having experienced a greater intensity of supervision and training of CCGs. Intensity in this context is described as a longer training period for CCGs and more frequent meetings with Quality Mentors. The Nompilo Project therefore provides an opportunity to investigate the effect of increased supervision and longer training periods of CCGs on the uptake of a complex MNCWH intervention by mothers. Section 3.1 begins by looking at traditional agency theory and how the impact of increased supervision increases worker's efforts. Section 3.2 presents definitions of intrinsic and extrinsic motivation and how this relates to an agent's work effort level. Section 3.3 introduces the concept of intangible costs and how these arise in the presence of increased supervision. In section 3.4 the signaling effect of increased supervision is considered and its impact on motivation and subsequently work effort level. Section 3.5 considers supervision from the perspective of whether agents view it as being legitimate or not. Section 3.6 looks at agents as having reciprocity preferences and how this affects their behavior in light of increased supervision. Section 3.7 considers arguments of how supervision level signal the group norm and therefore influence the behavior of conformist agents. In section 3.8 cost effectiveness studies of CHW programmes in Kenya, South Africa and Uganda with a particular focus on the supervision costs.

3.1 Agency Theory and the Effect of Supervision

Agency theory is the primary theoretical framework that is used in this study as it pertains to supervision. This discourse is used on the basis that an agency relationship exists between CCGs and CRH-UKZN, where the former are identified as the agents and the latter as the principal. Traditional agency theory allows us to focus on the role of supervision as it advocates that in instances where the principal cannot or does not use financial incentives to align the agent's interests with their own, the principal should then rely on increased supervision of the agents work effort level. In the Nompilo Project..

Walker and Jan (2005, p.222) present the argument that CHW programmes are "heavily influenced by institutional factors such as altruism, volunteerism, community

norms, reciprocity and duty [which] tend not to be reflected well in estimates of cost-effectiveness". This section therefore uses agency theory to highlight how increased supervision can potentially introduce additional intangible costs to a CHW programme, in terms of its effect on CCGs motivation levels. This study argues this has an impact on the final results of a cost-effectiveness analysis as the CCGs motivation levels have an impact on the outcomes of the MNCWH interventions that are being promoted.

3.2 Supervision and the "Crowding Out" of Motivation

The identification of intrinsic motivation as a contributor to agent effort level is attributed to Libenstein (1966) who identified instances in which factories were able to increase their output in the absence of any changes to processes or increases in knowledge. This increase in productivity was attributed to managerial practices that increased worker motivation, thereby revealing the relationship between worker output and levels of intrinsic motivation.

Intrinsic motivation has been described by Greenspan et al, (2013, p.2) as being driven by an individual's "personal motives and values…..and these motivators include empathy, altruism, pride and a desire for self-fulfilment".. This is contrasted with extrinsic motivation which is a function of "external rewards and includes money and opportunities for employment, non-monetary material rewards (such as bicycles and uniforms), and non-material rewards such as heightened social status and increased knowledge" (ibid). The primary focus of this study is on supervision and its impact on intrinsic motivation.

3.3 Supervision as an Incentive for Shirking

Frey (1993), Dickinson and Villeval (2008, p57) contend that greater monitoring of agents does not actually increase the agent's work effort level, but rather it leads to the "crowding out" of motivation. Under Frey's (1993), theory of "crowding out", the increased supervision creates distrust in the agent towards the principal. The agent perceives the increase in supervision as a signal that the principal no longer trusts the agent to put forward the accepted effort level, hence the agent responds by supplying a lower effort level. The agent's behaviour is explained by the argument that there are

implicit contracts of trust entered into between an agent and the principal and that the breaking of these contracts reduces the marginal benefit the agent derives from work. Instead, the broken contract causes the agent to seek to increase his marginal utility from shirking. Frey (ibid) introduces the argument that supervision has intangible costs which is a reduced level of motivation which is contrasted to traditional agency theory which only considers the explicit costs of supervision such as installation of cameras in workplaces or the hiring of more supervisors to monitor agents which can easily have a monetary value attached to it.

3.4 Intrinsic Motivation and Signalling in Agency Theory

Benabou and Tirole (2003, p.503) introduce a principal agent model based on reciprocity in order to illustrate the effects of supervision on an agent's level of intrinsic motivation. Falk and Fischbacher (2006, p.294) define reciprocity as "a behavioural response to perceived kindness and unkindness, where kindness comprises of both distributional as well as fairness intentions", where a reciprocal agent is one whose work effort levels increase when they work in an environment with low supervision.

Falk and Kosfeld (2006, p1612) argue that in the context of reciprocal agents, increased supervision signals that the principal has low expectations with regards to the agent's work effort level. Increased supervision is perceived as an unkindness resulting in the agent putting forward a low work effort level which is referred to as the hidden cost of supervision (Frey, 1993). On the other hand a low level of monitoring is perceived as a kindness and positively signals that the principal trust the agent to act in his interest and does not crowd out the agent's levels of intrinsic motivation thereby resulting in the principal's preferred work effort level.

Dominguez-Martinez and Sloof (2014; p301), however, contend that increased supervision does not crowd out and agent's intrinsic motivation in cases where the principal and the agent's interests are in full alignment. Under such circumstances the hidden costs of supervision do not arise as the increased monitoring is perceived as

a kindness and signals that the principal is willing to share the costs in ensuring the agent's success.

3.5 Legitimacy of Control

Apart from alignment of interests, concerns about whether the principle's chosen degree of supervision is driven by legitimate motives influences its effectiveness. Schnedler and Vadovic (2011, p.985) suggest that agents are concerned with whether the supervision is driven by a legitimate purpose or not. The authors define supervision as legitimate when it its objective is to prevent unwanted behaviour such as theft or shirking, however they acknowledge that the legitimacy of an action is always situational. This means that perceptions of legitimacy depend on the agents' judgement of whether it is justified or not. If agents believe that the degree of supervision is justified, they will give a positive effort level and as a result there are no hidden costs of monitoring. However in instances where agents do not consider supervision to be justified, hidden costs of supervision arise in the form of a low effort level. The model presented by Schnedler and Vadovic (ibid) suggests it may be worthwhile for principals to incur costs in convincing agents of the legitimacy of the increased monitoring. This is colloquially referred to as "worker buy-in", and may explain the effectiveness of "bottom-up" participatory management. Such an approach to management may have higher frictional costs from a decision making perspective, but these are likely to be more than offset by the lower hidden costs of supervision because the actions taken by the principal are legitimised.

3.6 Supervision and Heterogeneity in Reciprocity Preferences

In light of the CCGs functioning as teams, Von Siemen (2013,p56) argues that increased supervision does not result in the hidden costs of supervision as teams consist of individuals with heterogeneous reciprocity preferences which are categorised as being either be high, medium or low. Von Siemen (ibid) claims that when agents who have a high level of reciprocity are in the presence of selfish workers the former will perceive low supervision as an unkindness, since it provides selfish workers with an opportunity to shirk. Agents with a medium reciprocity preference will always provide a medium effort level regardless of the level of supervision. Agents

with a low reciprocity preference do not behave differently from selfish workers and will exert a minimum effort if they are not controlled. Von Siemen (2013, p58) contends that when information asymmetry exists, where the principal does not know the agents' reciprocity preferences, a greater degree of supervision is preferred to lower, as it increases the workers' effort levels of the agents with the low and high reciprocity levels respectively.

3.7 The Effect of Supervision on the Conformists Agent

Sliwka (2007, p.1008) considers teams as consisting of conformist agents whose actions are dependent on the group norm which is either selfishness or reciprocity. The model assumes that agents in a team cannot perfectly observe each other's actions introduces uncertainty with regards to how the conformists are likely to behave. This makes it costly for an agent to be selfish if the group norm is to be fair, thus a conformist agent's "utility is maximised when their effort level is equal to the effort level chosen by the median agent" (Sliwka, 2007, p.1008). Hence, Sliwka (ibid) argues that a low level of supervision signals that the group norm is not biased towards selfishness but rather reciprocity, which leads the conformists to increase their effort level. Sliwka (ibid) in effect argues that a high level of supervision results in the hidden costs of supervision.

The literature suggests that the ambiguous consequences of increased control by the principal are underpinned by the existence of information asymmetry where the principal is not aware of the agent's type, which results in the problem of adverse selection. Prendergast (2008, p.201) argues that this problem of adverse selection can be solved by the screening of individuals.

3.8 Summary of Supervision and Agency Theory

The theory considered in this review highlights that the effects of increased supervision of agents are rather indeterminate, as a result of information asymmetry with regards to agent perceptions of increased supervision and the principal not knowing the agents' propensities for reciprocation. On the one hand, increased supervision of agents creates hidden costs through its effect of crowding out motivation, as it creates

feelings of distrust, results in workers feeling like outsiders and creates an environment of low expectations. On the other hand, increased supervision may result in increased motivation, as it reflects that the principal is supportive and wants the agents to succeed; it also reduces the incentive for some workers within a group to shirk, which promotes team spirit. Hence, the effect that prevails in practice becomes an empirical question. Studies containing related cost estimates of programmes with a supervision component of community health workers (CHWs) are discussed briefly in the following section.

3.9 Supervision Studies of CHW Interventions

3.8.1 Cost-effectiveness of CHWs in Promotion of MNCWH Interventions in Rural Kenya

Akinyi et al (2014, p40) considered a cost-effectiveness analysis of an MNCWH complex health care intervention in rural Kenya. This study was conducted across two sites which were the intervention and the non-intervention site respectively. Both sites were composed of mothers who were between the ages of 15 – 49 years. The intervention site used CHWs to promote the uptake of maternal health services consisting of antenatal care and health facility based delivery, whilst in the non-intervention site mothers used their own initiative to seek these intervention. Akinyi et al (2014, p.41) found a statistically significant increase in the proportion of women who attended an antenatal clinic and had a health facility based delivery. However in the non-intervention site there was no statistically significant uptake in the uptake of interventions. Akinyi et al, (2014, p42) found that the intervention which utilised CHWs was more costly than the non-intervention resulting in a positive incremental cost-effectiveness ratio (ICER) for the utilisation of CHWs. Although the ICER was positive Akinyi et al (2014, p42) judged that the intervention was cost-effective on the basis of “more effective and more costly, with the added benefit worth the added cost”. This conclusion appears to be based on the argument that an intervention in which additional costs are incurred and also brings additional benefits in comparison to the non-intervention is more cost effective.

3.9.2 Costing of the Promise EBF Trial in South Africa

Nkonki et al (2014, p3) determined the "costs of establishing and running a peer-counselling intervention to promote exclusive infant feeding". The study sought to determine the cost of promoting exclusive breast feeding (EBF) for up to three months amongst new mothers in three South African communities. These areas were namely a peri-urban farm area (Paarl), a rural area (Ritvlei) and an urban township (Umlazi), which have high antenatal HIV prevalence rates (Nkonki et al, 2014, p5). The study was conducted alongside a cluster randomised control trial among HIV positive and negative women who were identified and supported in carrying out EBF or exclusive formula feeding (EFF) whereby peer supporters conducted one antenatal home visit and four visits postpartum. In the control expectant mothers also received visits but these did not focus on feeding rather they focused on assessing social grants. No treatment was provided in either the control or the intervention group. Supervision of peer counsellors was performed by peer supervisors, this supervision was conducted either telephonically or face-to-face. Supervisors also made visits with peer counsellors where they would observe them counselling expectant mothers.

Nkonki et al, (2014, p3) used a combination of an activity based costing and ingredients approach in their determination of programme costs. The four major categories of activities that were identified were the programme set-up, training of peer counsellors, peer support and peer support supervision. Nkonki et al (2014, p5) found that the main cost drivers of the programme was peer support supervision which was responsible for 55% of the costs. Personnel costs were responsible for 80% of the supervision costs. It was determined that peer support activity was the second largest contributor to costs, representing 27% of the costs, with personnel costs accounting for 75% of costs related to peer support. The training of peer supporters and supervisors amounted to 6% of programme costs. Overhead costs which consisted of office rentals and vehicle rentals contributed 10% as a proportion of final costs.

3.9.3 Costing of the Promise EBF in Rural Uganda

Chola et al (2011, p2) conducted a cost-analysis of a peer support intervention in a rural area located in Uganda whose objective was to increase the prevalence of

mothers practicing of babies for up to three months of age. EBF of babies up to three months postpartum. In the intervention arm mothers were visited by a peer supporter at least five times during the antenatal and postnatal and the peer supporter did not provide any treatment. Mothers in the control group did not receive any counselling by a peer supporter but rather were encouraged to attend regular antenatal and postnatal clinics and as in the intervention group no treatment was provided. As in Nkonki et al (2014) peer supporters where supervised by peer supporter supervisors and who were in turn monitored by a study coordinator. In this cost analysis, Chola et al (2011, p3) adopted a provider's perspective and used an activities based costing methodology. Chola et al (2011, p5) found that the highest proportion of costs was attributed to peer supervision (58%), of which personnel costs accounted for 48%. Peer support which included peer counsellor's personnel costs, bicycles and field materials contributed 26% of final programme costs. Overhead costs which encompassed communication, utilities and office rent accounted for 8% of total programme costs (Chola et al, 2011, p5).

3.10 Conclusion

Agency theory considered in this review highlights that the effects of increased supervision of agents are rather indeterminate as a result of information asymmetry. Increased supervision has the potential to either reduce agent's intrinsic motivation. This occurs in instances where the increased supervision is perceived by agents as signalling that the principal has low expectations with regards to the latter's work effort; when the supervision is perceived as illegitimate; and when it signals that the group norm work effort level is low resulting in conformist agents also adopting a low work effort level. On the other hand increased supervision may not necessarily crowd out motivation when agents perceive it as a signal that the principal is willing to share the costs of ensuring the agents success; when the increased supervision is perceived as legitimate; and in a team setting where agents with a high level of reciprocity perceive it as fair in terms of raising the work effort level of agents with a low level of reciprocity. Supervision costs appear to be the largest contributor of costs to CHW programmes and are driven by personnel costs, whilst overhead costs were the lowest contributors to total programme costs.

CHAPTER 4 – THE NOMPILO PROJECT STUDY DESIGN

4.1 The Nompilo Project Study Design

This section outlines the aims, procedures, and outcomes of the Nompilo Project RCT. The programme description was obtained from a final draft report of the Nompilo Project titled "The Nompilo Project. An Evaluation of Community Case Management of Childhood Illness Training and Quality Improvement Supervision for Community Caregivers to Support Maternal Neonatal Child and Women's Health Intervention in KwaZulu-Natal, South Africa. Further programme descriptions were obtained from interviews with Christiane Horwood, Lyn Haskins, Khumbuzile Sishi, Ntokozo Mtambo and Jordache Chetty. The Nompilo Project was funded by the Centers for Disease Control and Prevention (CDC) and The WHO via its Department of Child and Adolescent Health and Development. The Nompilo Study Partners consisted of the 20000 + Partnership, CRH-UKZN, KZN DoH, Institute for Health Care Improvement and Boston Children's Hospital.

The aim of the Nompilo Project was to evaluate the effectiveness of an HIV-adapted CCM training curriculum and the implementation of CQI as a management and supervision method for CCGs in the delivery of MNCWH interventions in an area with a high HIV prevalence rate. As has been aforementioned CHWs are called CCGs in KwaZulu-Natal, and henceforth these two terms will be used interchangeably. The interventions include antenatal care, postnatal care and infant feeding support in addition to improved coverage of PMTCT interventions and early access to ART for mothers and infants in line with the NDoH's (2012) strategic plan for MNCWH at the community level. The context of the Nompilo Project is based on the recognition that South Africa has made limited progress in reducing mother and child mortality rates. CRH-UKZN (2014, p2) argues that these deaths occur despite the public health system being in possession of well-defined and evidence-based packages of interventions at a primary health care level (CRH-UKZN, 2014). It is therefore argued that the coverage of key interventions needs to be improved in order to effect a reduction in mortality amongst mothers and children.

This complex health care intervention was carried out in Ugu Health District in KwaZulu-Natal province. In 2011, the district was estimated to have a population of 764 576 with 76% of the population living in rural areas. Ugu District's mortality rates where above the provincial averages for the infant, child and maternal mortality rates although all three indicators showed declines from the previous year. In the same year (2011), the under-1 mortality rate was 8.9% which was above the provincial average of 7% and the national average of 6.8%. The under-5 mortality rate was 6.8% which was still higher than the provincial average of 4.8% and national average of 4.3% respectively. From a maternal health perspective, the maternal mortality rate was 177.9 per 100 000 births, above the national average 144.9 per 100 000 births. Out of KwaZulu-Natal's ten health districts, Ugu health district had the lowest rate of mothers who had an antenatal visit before 20 weeks into their pregnancies at 34.7% (Massyn et al, 2013, p279). There are 47 fixed primary healthcare clinics, 14 mobile clinics, three district hospitals, one regional hospital, and one specialised hospital local in the district (CRH-UKZN, 2014).

The study used a two-arm cluster randomised controlled trial (RCT) to test the hypothesis that implementation of an integrated HIV-adapted CCM training and supervision for CCGs was effective in improving the uptake of key interventions outlined in the updated WHO guidelines on HIV and infant feeding as well as in the South African PMTCT guidelines.

The study population included CCG supervisors, CCGs and mothers of infants delivered in the 12 months prior to conducting the baseline survey. The intervention conducted two surveys, one prior to the intervention and the other following implementation of the intervention. Mothers who were included in the study population were of age 18 years and had given birth 12 months before the first survey. Thus the study population included CCGs supervisors, CCGs and mothers of infants. The duration of the intervention was 15 months and this comprised of three months lead time in which to set up groups and undertake the training of CCGs and 12 months of quality improvement mentoring and support. The mentoring and support entailed (i) developing record keeping skills (2) understanding how to use data in order to for the

CCGs to effectively carry out their tasks (3) repeated reviewing of knowledge and skills obtained after training and ensuring that CCGs delivered consistent and appropriate messages to households (see Table 2 on page 46) The criterion for CCGs was that they had to have been working in the Ugu Health District.

In the study CCG supervisors were randomised into an intervention and control arm, with arm each comprising 15 CCG supervisors respectively. CCG supervisors are CCGs who have been given this position based on their years of experience and they are responsible for ensuring the performance of the CCGs. Four CCGs per supervisor were then randomly selected to form a team of five (four CCGs and their supervisor). Groups were assigned to either the intervention or control arms of the study according to which arm the supervisor had been assigned to. Each arm of the study consisted of 15 such CCGs and their supervisors. In the intervention arms received enhanced CCM training, and the teams were supported through continuous quality improvement (CQI) supervision. It is important to note that in the RCT, the ratio of supervisor to CCGs was reduced relative to the pre-intervention period where it was one supervisor to 25 CCGs thereby introducing complexity into the interventions.

The enhanced CCM training that CCGs in the intervention group received followed WHO recommendations on prevention of HIV transmission, so that implementation of CCM could offer a mechanism to improve the coverage and uptake of specific PMTCT interventions in a high HIV prevalence setting. It included specific adaptations such as information on the importance of HIV testing and early initiation of ARVs in pregnancy, PMTCT information; antenatal counselling on HIV testing, safe sex during pregnancy and infant feeding and changes to the post-natal visiting structure which involved CCGs accompanying patients on two post-natal visits to the clinic.

The CQI methodology used in the intervention arm was based on identifying measurable aims at the outset of the intervention and then developing tests of changes that could lead to improvements in MNCWH service packages uptake among participating mothers. The tests were refined and then implemented in the CCGs

working environment. This then allowed successful changes to be scaled up and rapidly shared between groups of CCGs through the use of peer learning and support. The intervention group also had Quality Mentors (QMs) who were professional nurses with specific expertise in CQI, who played an instrumental part in the training, mentoring meetings and learning sessions conducted in the intervention arm. The Quality Mentors were not part of the health care facility instead they were full time staff hired by CRH-UKZN to provide mentorship and support to CCGs (CRH-UKZ, 2014, p19).

The HIV-adapted CCM training that CCGs and their supervisors underwent was led by four professional nurses over a two week period. Based on the training received, CCGs were expected to conduct four visits to pregnant women which involved, among other things, encouraging early ante-natal clinic (ANC) attendance, provide advice on infant feeding, encourage HIV testing and PMTCT interventions and provide mothers with advice about home care during pregnancy. CCGs undertook four visits to new mothers and neonates where they would check for danger signs in mothers and infants; support exclusive breastfeeding; encourage mother to attend clinics for postnatal checks; and support postnatal PMTCT interventions.

There was also separate CQI training for 15 CCG supervisors and one additional CCG from each of the 15 groups on CQI supervision and management philosophy. The training covered teaching CCG supervisors on leading and facilitating teams; use of CQI tool such as root cause and bottleneck analysis; information and data use. The supervisors were trained in CQI supervision methods in order to enhance their supervision capabilities.

The intervention further included mentoring sessions where the 15 intervention CCG groups attended fortnightly sessions with the Quality Mentor over a period of 15 months. The purpose of these meetings was to provide supervision and support to CCGs post the CCM training and to mentor CCGs supervisors in providing support to CCGs in their groups. These meeting would facilitate the review of the progress made

towards meeting their primary and secondary objectives. This also brought CCG groups together in order to encourage peer learning and the sharing of experiences across CCG groups. CCGs and CCG supervisors were compensated for the transport costs they incurred in order to attend these mentoring and learning sessions.

In the control arm of the RCT, CCGs received standard provincial CCM training which was not specifically adapted for use in areas with a high HIV/AIDS prevalence. Control CCGs and their supervisors continued to receive routine training or support provided by the KZN DoH in the district. The CCG supervisors in the control group played an administrative role which was to primarily collect basic information and reports from CCGs rather than mentoring and supervising their daily activities. CCGs in the control arm relied on the health facilitators who were enrolled nurses based at the local hospital (CRH-UKZN, 2014).

Table 2: Comparison of the Control and Intervention Arms

Status Quo	Control Arm	Intervention Arm
1 supervisor : 25 CCGs	1 Supervisor: 5 CCGs	1 Supervisor : 5 CCGs
Provincial CCM Training	Provincial CCM Training	Provincial CCM Training
Provincial MNCWH Training	Provincial MNCWH Training	Provincial MNCWH Training
		Additional HIV-adapted CCM and CQI training (training and mentorship).
Mentorship by a Health Facilitator (enrolled nurse)	Mentorship by a Health Facilitator (enrolled nurse)	Mentorship by a Quality Mentor (professional nurse)
Monthly meetings with health facilitator	Monthly meetings with health facilitator	Fortnightly mentorship sessions (training and mentorship)
		Quarterly Mentorship Sessions (training and mentorship)

Source:CRH-UKN, 2014

The primary objectives of the Nompilo Study were to assess the impact of HIV-adapted CCM training and CQI supervision on the following outcomes, prevalence of antenatal booking before 20 weeks have lapsed in a woman's pregnancy; prevalence of the number of women who present themselves for post-natal care within seven days of

delivery; the prevalence of exclusive breast-feeding practice and the coverage of HIV PCR testing of babies born to HIV positive mothers within six weeks postpartum.

Table 3: Outcomes of the Nompilo Project

	Pre-Intervention			**Post-Intervention**		
	Control	**Intervention**	**%ge**	**Control**	**Intervention**	**%ge**
Attended ANC four or more times during last pregnancy	302 (81.6%)	289 (79.0%)	**-4%**	252 (81.3%)	243 (82.1%)	**-4%**
Went to the clinic on the 1st Week after delivery	303 (82.8%)	318 (87.1%)	**5%**	271 (88.3%)	265 (91.7%)	**-2%**
Baby had a PCR Test	93 (83.8%)	80 (82.8%)	**-14%**	83 (91.6%)	80 (88.8%	**-4%**
Referred for ART Initiation	110 (46.4%)	99 (47.4)	**-10%**	84 (72.6%)	80 (75.0%)	**-5%**
Mothers practicing EBF children < 6 weeks	226 (72.4%)	207 (65.3%)	**-8%**	181 (65.1%)	194 (76.7%)	**7%**
Mothers practicing EBF with children < 6 months.	50 (25.1%)	45 (30.4%)	**-10.0%**	27 (17.8%)	45 (30.4%)	**27%**
Mothers living with HIV practicing EBF	8 (14.8%)	6 (10.9%)	**-25%**	7 (17.5%)	8 (18.6%)	**14%**

Source: CRH-UKZN, 2014

In evaluating the Nompilo Project RCT, CRH-UKZN determined that the uptake of the target interventions were not statistically different between the control group and the intervention group; with the exception of the prevalence of exclusive breastfeeding. It was found that mothers in the intervention group were more likely to breast feed their children than mothers in the control group at the time when the post implementation survey was conducted. These results inform the decision to conduct a cost-effectiveness analysis (CEA) based on exclusive breast feeding only as an output. The results of the pre-intervention and post-intervention are shown in Table 3 where the percentages differences are calculated relative to the control

In the post intervention period the HIV-adapted CCM training and CQI supervision is shown to be the most effective relative to the standard provincial DoH training. The lowest changes in health outcomes were identified amongst the cohort of mothers who are HIV positive and the highest percentage change was observed amongst mothers with children between the ages of six weeks and six months. The intervention appears to be most effective for mothers with children below the age of six months.

CHAPTER 5: METHODS

Section 4.1 explains cost analysis as a precursor to performing a cost-effectiveness analysis (CEA). The concepts highlighted in the section are the role of economic, financial and opportunity costs in an economic evaluation. Section 4.2 provides a description of the cost-effectiveness analysis as a measure of technical efficiency between competing interventions. It also presents the limitations of using CEA from an allocative efficiency perspective.

5.1 Cost Analysis

Economic evaluations are built on the basis that the observed prices of goods are not always a true reflection of their economic value. It is important to distinguish financial from economic costs when conducting a cost analysis. The financial costs of a good are usually clear, as they are a record of monetary transactions that can be obtained from the project budget (WHO, 2002). Financial costs are primarily used to compare expenditure against budget allocations, which means that in instances where goods are not paid for, the financial costs is zero (UNAIDS, 2000). An economic evaluation, in contrast, utilises the economic definition of costs where goods and services are valued by their opportunity cost, especially in instances where the prices of goods do not reflect their true market value, such as with subsidies, donation or the use of a capital good (UNAIDS, 2000, p.38; Johns et al, 2003, p.1). An economic evaluation therefore ensures that a "value is placed on all resources consumed by an intervention" (Johns et al, 2003, p.2). The implication of using financial costs is that the total economic costs, as calculated in an economic evaluation, will not be equal to the financial costs contained in the programme budget.

Cost analysis is normally the initial step taken when conducting a full economic evaluation and it involves the" systematic collection, categorization and analysis of programme or intervention costs" (CDC, n.d). A cost analysis is regarded as an adequate economic evaluation method in instances where only one programme is being assessed or where two interventions are equally effective. It is referred to as a cost minimisation analysis because the objective is to identify the intervention with the lowest costs. A cost analysis also assists in calculating the cost of reducing or expanding an intervention via the tracking of expenses. Unlike a CEA, a cost analysis

does not consider the effectiveness of the programme and therefore does not give investors insights as to whether it is a worthwhile project to invest in (Word Health Organisation, 2002).

The terminology with regards to resource costs appears to be contentious, with different meanings to the same terms (Gold et al, 1996; Drummond, 2005). According to Gold et al, (ibid) resource costs tend to fall under three categories, which are direct costs, indirect costs and intangible costs. The costs under consideration in an economic evaluation are highly dependent on the perspective that has been adopted. This study has adopted the implementer's perspective, therefore it is direct costs which are the most relevant.

Direct costs are defined as "the value of all goods, services, and other resources that are consumed in the provision of an intervention or in dealing with the side effects or other current and future consequences linked to it" (Gold et al, 1996, p.179). Thus, direct costs include the costs required to provide the intervention, which would be normally contained within a health facility. Gold et al (ibid) further subdivide direct costs into direct health care costs and direct non-health care costs.

According to Meunnig (2008, p.7), indirect costs do not involve the use of goods and services and are associated with productivity, morbidity and mortality costs. Productivity costs emanate from a patient's health state which results in a "lost or impaired ability to work or to engage in leisure activities due to morbidity" (Gold et al, 1996, p181). These costs are normally determined by estimating the opportunity costs of an individual's time off work using the wage they would have earned if they had been in a healthy state. Morbidity and mortality costs, which are also known as intangible costs, attempt to attach a monetary value to the pain, suffering, stigmatisation or life years experienced by an individual and can be very subjective (Meuning, 2008).

5.2 Cost-Effectiveness Analysis

A CEA illustrates the relationship between the resources used in an intervention and the subsequent benefits. The resource usage is reflected by the cost of the inputs which are measured in monetary terms. The outcomes are, however, measured in

natural units such as the number of women practicing exclusive breastfeeding or number of children vaccinated (Shemilt et al, 2002, p.188; Fox-Rushby and Cairns, 2005, p.10). A CEA is used to address issues of technical efficiency as it provides a method that allows for the comparison of competing interventions that produce the same outcome, for instance when comparing two different programmes that seek to encourage the practice of exclusive breastfeeding among mothers (Hutubessy et al, 2003).

The technical efficiency of the competing intervention is observed via the cost-effectiveness ratio, which shows the cost of obtaining one unit of health outcome - for example, the cost per child vaccinated (Gold et al, 1996, p.3). The intervention that produces the lowest cost per unit of health outcome would be reflected as the "most efficient way of improving health", as it indicates that maximum outputs are being produced within a given budget (Gold et al, 1996, p.4; Shemilt et, al, 2002, p.196; Fox-Rushby and Cairns, 2005, p.13).

When comparing two competing complex interventions that may have different intensities, such as length of training of health care workers, an incremental cost effectiveness ratio (ICER) would be the most appropriate tool to use. Bambha and Kim (2004, p.519) define the ICER as the ratio of the "difference in cost between two medical interventions to the difference in outcomes between the two interventions". The ICER provides a summary measure of the incremental cost per unit of health gained in adopting one medical intervention in place of another, which in most instances tends to be the current existing intervention. Drummond et al (2005, p.8) caution against the use of an ICER, by pointing to a prevailing weakness with most cost-effectiveness analyses: the existing treatment or practice, which the intervention is being compared against, may not be the most cost-effective treatment in the first place. They reason that there may have been other more cost-effective alternatives that were ignored when the current treatment was implemented. The crux of this argument is that it may not be helpful to compare a new intervention against a non-optimal existing treatment. However in the absence of a cost-effectiveness analysis

the weaknesses in the control cannot be uncovered thereby perpetuating the status quo.

A common criticism against CEA is that its value tends to be limited if the interventions have different health outcomes, meaning that its usefulness as a decision making tool is only relevant within individual intervention areas such as in a RCT (Lorgelly, 2010). It has been argued further that it ignores issues of allocative efficiency, with its sole focus being on technical efficiency instead. The implication is that whilst an intervention may indeed be efficient, it may not necessarily be what society desires (Elliot and Payne, 2005, p.16).

4.3 Study

The study is a retrospective CEA conducted on a randomised control trial, which was implemented by CRH-UKZN in the Ugu Health District located in the province of KwaZulu-Natal during the period May 2012 – November 2013. This cost-effectiveness analysis compares the training and supervision of CCGs provided by the KwaZulu-Natal provincial DoH, relative to the HIV-adapted CCM training and CQI management and supervision of CCGs implemented by CRH-UKZN. The where the latter is the control and the latter is the intervention arm respectively. The health outcome under consideration is the number of women with children under one year who are practicing EBF.

CHAPTER 6: RESEARCH METHODOLOGY

6.1 Overview

This study is designed as a retrospective CEA of a two-armed matched cluster randomised control trial comparing an HIV adapted CCM training and CQI management and supervision techniques to the standard training curriculum of CCGs provided by the KwaZulu-Natal DoH. The former is referred to as the intervention whilst the latter is the control arm of the RCT.

We seek to answer the question of whether the health outcomes obtained are justified by the increased costs in supervision incurred by the intervention. By considering agency theory and performing a CEA of the intervention this study brings awareness to the existence of intangible and explicit costs of supervision of CHWs. The approach used in this section will attempt to adhere to the Consolidated Health Economics Reporting Standards (CHEERS) Good Reporting Practices (ISPOR, 2012) as a framework for in this section.

This chapter of the dissertation begins by describing the data collection process, followed by a description under which the data analysis will occur. The framework identifies aspects of the CEA such as the comparator, the time horizon and the discount rate used in the study. The subsequent section describes the methodology that was used to classify and estimate resource inputs and costs. This section concludes by discussing the calculation and the significance of the ICER and sensitivity analysis respectively.

6.2 Data Collection

Quantitative data is obtained primarily from CRH-UKZN's programme budget and the Nompilo Project report (CRH-UKZN, 2014). Other quantitative data which comprises information pertaining to discounts, subsidies and donations that the programme may receive were obtained from interviews . Analysis of the interviews assisted in providing additional information that was absent in the programme budget and project report. Information on economic indicators, the market value of discounted resource inputs is gathered from the internet (Makro Wholesalers, 2015).

The Nompilo Project report provides information on how the randomised control trial was carried out such as training duration, resource inputs used, number of participants and the efficacy of the CCM training, CQI management and supervision intervention. This document lays out the experimental research strategy that seeks to test the hypothesis that the implementation of a CCM training and CQI management and supervision technology for CCGs will increase the uptake of MNCWH interventions amongst mothers in rural area that has a high HIV prevalence rate. .

6.3 Framework for Data Analysis

The economic evaluation method used is an incremental cost effectiveness analysis. An economic evaluation is defined as “the comparative analysis of alternative courses of action in terms of both their costs and consequences” (Drummond et al., 2005, p.9). From the aforementioned definition it is noted that an economic analysis generally consists of two parts, the first one consisting of fulfilling the basic requirements of identifying, measuring and valuing the costs related to the activities required to achieve the stated health outcomes. The second part consists of identifying and measuring the actual outcomes of the study. An economic evaluation is appropriate in the Nompilo Project as it involves the comparison of two courses of action or programmes which are the standard training and supervision that CCGs receive from the KZN-DoH versus that implemented by CRH-UKZN. This dissertation will use the same terminology as CRH-UKZN and refer to the former as the control arm and the latter as the intervention arm. The comparison of these two courses of action is achieved through the use of a cost-effectiveness analysis (CEA).

CEA is an economic evaluation technique that assists decision makers determine whether they are maximising a particular health outcome in the presence of a limited budget. It seeks to answer efficiency questions in terms of whether the course of action is achieving the most health output given the cost of resource inputs that have been consumed (Meunnig, 2008, p.3). A CEA has been selected in this analysis as it lends itself to comparing two programmes with the same objectives. Whilst the health objectives are the same, efficacy outcomes from the RCT indicate that the two respective programmes had different levels of success in addition to differential costs

(Drummond, 2005, p.12). In the presence of these differences, a cost effectiveness ratio expressed in terms of “cost per unit of effect e.g. life years gained per rand spent” (ibid). It does bear reiterating that this investigation will also undertake an incremental cost-effectiveness analysis.

Another way of looking at the intervention arm of the Nompilo Project is to consider it as the control arm with additional training and supervision activities added onto it. It is the addition of these extra inputs that attempts to generate greater health outcomes. This is similar to the concept of marginal cost however in cost-effectiveness it is referred to as an incremental value and it is expressed as a ratio of where the numerator is the difference in total cost between the intervention and the control and the denominator is the difference in health outcomes respectively. The incremental cost-effectiveness ratio will be used to determine the additional costs required on the existing CCG programme in order to produce one extra unit of health benefit.

This analysis is retrospective meaning that information related to the activities in the intervention were obtained after the RCT was completed, thus costs and outcomes had already been incurred. . In terms of health outcomes the cohort under analysis is the proportion of women who exclusively breastfed their children as this was the only significant outcome of the RCT. This approach has been chosen for reasons of practicality and feasibility in that CRH-UKZN did not consider conducting a prospective cohort analysis.

This economic evaluation identifies costs from an implementer’s perspective on the basis that CRH-UKZN is the immediate implementer of the project. The perspective in CEA sets the context in terms of determining which costs and health outcomes the evaluation will include and exclude. It is acknowledged that the introduction of this health intervention gives rise to externalities which impact society’s welfare as a whole and thus precipitate arguments for the use of a societal perspective (Byford and Raftery 1998, p.1529).

This study does not adopt the societal perspective which considers all benefits and costs that flow from the intervention regardless of whether the individual or organisation was directly involved in it or not (Gold et al, 1996). This viewpoint is not adopted as the implementing organisation limited the scope of the analysis to "costs and outcomes relevant to their needs" (Muennig, 2008, p.21). The implementer's perspective is much narrower as only costs incurred by CRH-UKZN in implementing this intervention are calculated (McIntosh et al., 2014, p.279).

Costs to both the government and the patient are excluded in this evaluation, such as transport and medication costs. Start-up costs related to the Nompilo Project are also excluded from this study, where the start-up period is defined as the "time between the decision to implement an intervention and starting delivery to the first person" (Johns et al, 2003). Start-up costs such as costs of research, development of the training module and the recruitment of participants were not considered in this study. Rather the control and intervention arm are evaluated and compared in the post start-up period, which included typical activities that CCGs and QMs are engaged in when the intervention has been fully implemented. In other words the intervention is compared to the control as if it is operating under steady-state conditions.

6.4 Comparator

There is only one comparator under consideration which is the Provincial DoH programme where CCGs did not receive the additional HIV adapted training and CQI supervision. The control uses enrolled nurses who are referred to as CCG facilitators and their role is to liaise with CCGs and assist them with health related queries that they may encounter. The CCG facilitators are not full time resources and still perform other duties in the primary health facility and have to allocate time to CCG activities. There are monthly administrative meetings between the CCG facilitator and the CCG supervisor, during these meetings, CCGs hand over data that they would have collected from their household visits.

6.5 Time Horizon

The time horizon under consideration in this study is from May 2012 to November 2013 as it was during this period that the intervention was implemented. CRH-UKZN

provided training to CCGs in the intervention arm between May and August 2012. Implementation of the CCM and CQI training occurred from September 2012 to November 2013. It was during this period that cost directly related to the training and supervision of CCGs were incurred by the implementing organisation. In addition health outcomes were tracked during this period.

6.6 Choice of the Discount Rate

This economic evaluation selected a discount rate of 3% for the discounting of costs and benefits accruing to the intervention based on the need to allow for comparison with a wider range of published studies (Gold et al. 1996; WHO, 2003). This discount rate is used to "convert future costs to their present value, thus reflecting the fact that individuals have a positive rate of time preference for consumption" (WHO, 2003, p.45). Whilst Gold et al (ibid) argues that a discount rate of 5% should be used for sensitivity analysis, this study will use 8% instead.

This choice is based on the understanding that the 8% discount rate has been used in similar South African studies and thus allows for comparison with studies in similar settings (Nkonki et al., 2014 and Cleary et al., 2006). The discount rate of 8% was based on the rate of return on long term South African government bonds and the WHO (ibid) promotes the use of country specific discount rates for sensitivity analysis purpose.

6.7 Health Outcomes

This study will express health outcomes in natural units such as the number of women practicing exclusive breastfeeding. Natural units are useful because they describe the exact outcomes that an intervention sought to introduce. (Johannesson, 1996, p.150). In the Nompilo Project RCT it is possible to assume a direct causal relationship between the activities of CCGs and the change in the in the uptake of an intervention. The limitation however of expressing health outcomes in natural units is that they only allow comparisons between interventions whose outcomes are expressed in the same units (Johannesson, 1996; Drummond, 2005; Meunnig, 2008).

6.8 Estimating Resources and Costs

In this analysis, the valuing of inputs used in the Nompilo Project RCT consists of both economic and financial costs. This distinction is necessary in order to emphasise that resource costs are not equal to the programme budget. Unless otherwise stated, financial cost information used in this study is obtained from the Nompilo Project RCT programme budget which reflects the actual price paid for the resource inputs used.

In estimating resource use and costs incurred in the Nompilo Project RCT this paper utilises a direct measurement micro-costing approach which is also referred to in the literature as the "bottom-up approach" (Phillips, 2008, p.46) or the "ingredients approach" (Johns et al, 2003). This method attempts to measure activities that occur within an intervention and then assigns market prices to them. The use of the direct measurement micro-costing method is feasible in this cost analysis due to the availability of information pertaining to the activities that occur in the RCT. In addition, the costs of the resource inputs that were used in the intervention are clearly identifiable from the programme budget. In summary, this method considers the activities and the resource usage that occurred in the intervention.

As a consequence of adopting the implementer's perspective, this economic evaluation only considers costs that are directly related to the costs incurred by CRH-UKZN in the training, mentoring and supervision of CCGs. As a result only direct costs are considered which are formally defined as "the value of all goods, services, and other resources that are consumed in the provision of an intervention or in dealing with the side effects or other current and future consequences linked to it" (Gold et al, 1996, p.179). Typical resources consumed in the Nompilo Project RCT would include, personnel, equipment, office space and utilities. Other direct health care costs such as medical costs that arise due to patients being provided with treatment as a result of the advice of CCGs, are not considered as this data was not available.

6.9 Classification of Resource Inputs

Following the recommendation made by Gorsky (1998, p.221) the cost analysis of the intervention will begin with the construction of a resource inventory table which represents the cost per unit of resource consumed in the intervention. Unit costs allow

decision makers to make estimates and determine whether the programme can be applied within a different setting (Johns et al, 2003). Each row in the table represents the resources consumed in the activities which take place in the intervention, which include material, supplies, transportation, equipment and office space or buildings. The columns in the table represent the number of units consumed, the cost definition of the unit of resource and the calculated cost per unit of resource consumed respectively within the programme's life. .

All costs are expressed in constant 2012 prices in order to adjust for the effects of inflation. 2012 was chosen as a base year because Statistics South Africa (Stats SA) in 2013 decided to rebase CPI indices, so that December 2012 equals 100 (Stats SA, 2013, p.1). The other proffered reason behind this reason is that the intervention was initiated in 2012 when costs where initially incurred, thus any costs incurred in 2013 (CPI = 112.2) are rebased to 2012 prices. For example the payment of salaries extended from 2012 to 2013, thus all salaries earned in the latter period are deflated to 2012 prices.

Following the establishment of a resource inventory table, costs are classified using the line item method of classification. This classification system ensures that the costs associated with the various resource inputs are mutually exclusively allocated to various activities of an intervention thereby preventing the overlapping of costs WHO (2002; 2004).

6.10 The Line Item Method of Classification

This method of classification is also known as the input system and is based on demarcating costs on whether they are recurrent or capital items. Capital inputs are also referred to as non-recurrent inputs and are defined as assets that are used over a long period of time, which is normally defined as a period of more than one year and are purchased infrequently (Drummond, 2005; Creese & Parker, 1994). Capital goods represent physical inputs such as equipment, building space and vehicles which tend to wear out and depreciate over time (Drummond, 2005, p.64). Non-recurrent activities are also considered to be capital goods such as initial staff training as its benefits are enjoyed over time (Creese & Parker, 1994). Recurrent inputs on the other hand are

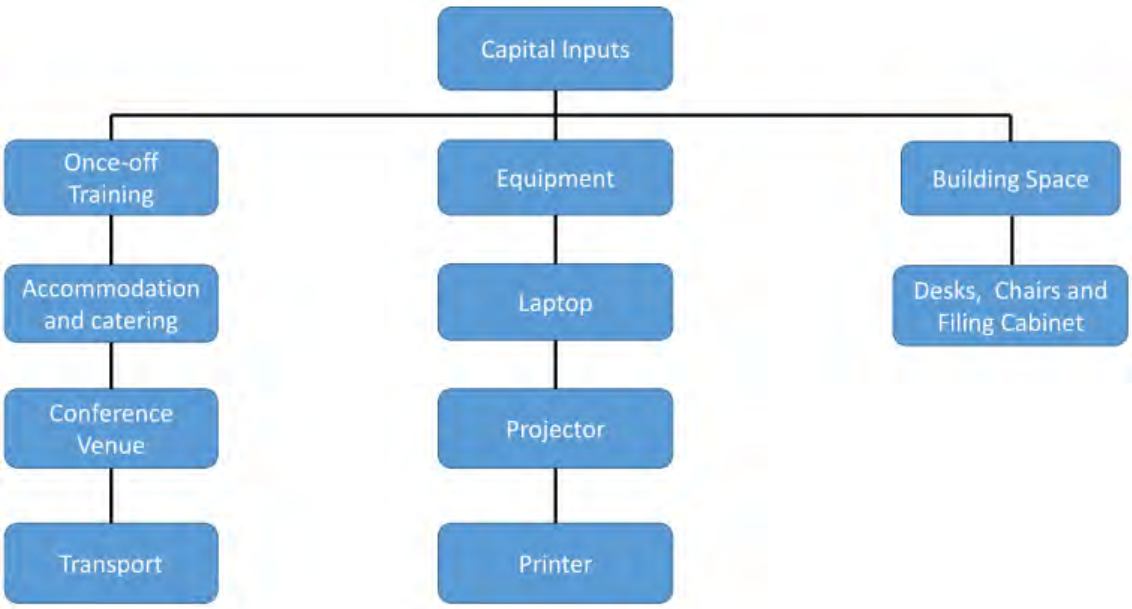
defined as “those inputs that are used up in the course of a year and are usually purchased regularly” (UNAIDS, 2000, p.41).

6.11 Non-recurrent Inputs

All costs associated with capital inputs have been annualised based on the assumption that the resource inputs have a useful clinical life of five years and a salvage value of zero rands. The annualisation of non-recurrent inputs is premised on the understanding that a non-current asset yields service or benefit flows over its useful life and that costs need to be allocated to each period in which these benefits are realised. The equivalent annual cost is achieved by fully amortising the value of the capital good over a five year period (Drummond, 2005, p.74).

A five year period was chosen based on the understanding that the majority of tangible capital goods consists of electronic equipment primarily laptops, printers and projectors. Vehicles are not included under the capital goods as the implementer did not use any of their vehicles for operational purposes during the intervention. Figure 1 represents a taxonomy of the capital resource inputs that were consumed in the in the intervention arm of the Nompilo Project RCT.

Figure 1: Capital Resource Inputs



6.11.1 Non-recurrent Inputs – Once-Off HIV-adapted CCM and CQI Training and Supervision

The initial CCM and CQI training that CCGs and their supervisors underwent was a once-off activity that was not repeated during the course of the intervention and is therefore treated as a non-recurrent input. The once-off training costs aggregates all the cost elements involved in the administering of the once-off training and treats them as a lump sum. This means that transport, training venue, accommodation and catering costs incurred in the delivery of the once-off CCM and CQI training are added together and placed under the category of non-recurrent once-off training costs (Creese & Parker, 1994, p.35).

Training venue costs were waived by the owners of the venue as a result these were recorded as zero financial costs. The waiving of these costs can be viewed as either a donation or a discount and does not reflect the true market price of the venue where the training was conducted. In the determination of the economic costs of the CCM and CQI training, the market price of hiring the training venue was ascertained and added to the financial costs incurred in administering the training (Creese and Parker, 1994, p.58).

6.11.2 Non-recurrent Inputs – Equipment

Under the line items categorised as equipment are laptop computers, digital projectors and a printer which were purchased in 2012 as a result their prices were not deflated The economic costs for this period were obtained by annualising the book values of the equipment. CRH-UKZN however received a discount for the projectors and as a result their financial cost is not a true reflection of their market value. This is remedied by using the replacement value of the projectors in order to estimate their economic cost. The replacement value is calculated by using the prevailing prices of similar items based on 2013 prices (WHO, 2003; UNAIDS, 2000). The replacement value of the projectors was then deflated to 2012 prices. The equipment was used across 2012 and 2013resulting in the total economic costs being an aggregate of the annualized costs of both years

6.11.3 Non-recurrent Inputs – Building Space

The cost of the building space used by the Quality Mentors has been obtained by getting an estimate of the annual price charged for renting a similar unfurnished office space (Creese and Parker, 1994, p.35). The Nompilo Project RCT did not incur any financial costs with regards to building space as it was provided the KZN DoH at no cost. This method is used as it depends on the available market rates and it also incorporates both the depreciation and opportunity cost of the office space. The rental prices of similar office space were obtained from various real estate websites.

6.11.4 Non-recurrent Costs Office Furniture

Office equipment was provided free of charge by the KZN DoH thus its market price was not reflected. This study used the replacement value of similar items to estimate their costs which were obtained from various office furniture vendors. The office equipment consisted of two office desks and chairs; and a single filing cabinet.

6.12 Recurrent Inputs

Recurrent inputs in the Nompilo Project RCT have been identified as personnel, supplies, buildings operations and maintenance and the fortnightly mentoring sessions. The costs associated with these are inputs referred to as either recurrent or operating costs. Figure 2 highlights the recurrent resource inputs that were consumed by the Nompilo Project RCT.

Figure 2 - Recurrent Costs

Source: Own

6.12.1 Recurrent Inputs – Personnel

The personnel that have been identified in the operations of the Nompilo Project RCT include the three Quality Mentors, 60 CCGs and the 15 supervisors and a single administrator. The decision to present at this level of detail is based on the need to be able to categorise staff in terms of those who are directly involved in the intervention such as Quality Mentors and CCGs compared to support staff such as administrators (Creese and Parker, 1994, p.35).

The three Quality Mentors employed in the intervention arm were professional nurses. .The Quality Mentor's salary is inclusive of tax, fringe benefits, allowances and bonuses as this is an economic evaluation. CRH-UKZN paid the Quality Mentors market related salaries thus the economic costs of employing the Quality Mentors were identical to the recorded financial costs. The control and intervention arms each consisted of fifteen CCG teams that were made up of four CCGs and a supervisor. The CCGs and their supervisors are not paid a salary but rather a monthly stipend of R1200 and R1400 respectively. This monthly stipend is not taxed and there are no bonuses or allowances that are awarded to CCGs (NDoH, 2011, p.11).

The monthly stipend is taken directly from the programme budget and is recorded under the line item; personnel. It is argued that this is an accurate representation of the economic cost of employing CCGs within a South African context. This economic evaluation has avoided valuing the CCGs labour via the use of market wage rates based on formal employment or what they would have earned had they been engaged in non-market production activities such as subsistence farming activities' on the basis that South Africa's relatively high unemployment rate and the low educational qualifications of CCGs do not justify the use of shadow labour prices (UNAIDS 2000).

The salary paid to the administrator has been identified as a joint or shared cost in the Nompilo Project RCT. This has been motivated by the fact that the administrator was not a resource input that was employed exclusively for the purposes of the Nompilo Project RCT but rather had to divide their time between the intervention and other programmes run by CRH-UKZN. The direct allocation method basis was used to determine the costs attributed to the administrator in the intervention (Drummond, 2005, p.69). This method relies on estimating the percentage of time the administrator

spent on activities related to the Nompilo Project RCT which is then multiplied by the administrator's annual salary which included a bonus and allowances and then allocating this amount to the programme costs. The administrator estimated that 15% of their time was dedicated to the Nompilo Project (CRH-UKZN, 2014).

6.12.2 Recurrent Inputs – Fortnightly Mentoring Sessions

The intervention arm of the Nompilo Project RCT comprised of fortnightly mentoring sessions with of 15 CCG supervisors and 15 CCGs respectively resulting in a total of 30 participants. Since these sessions occurred frequently they have been categorised as a recurrent input. The mentoring sessions where held at the Quality Mentors offices so there were no venue costs incurred. However CRH-UKZN did pay for the participants transport costs over a period of 15 months. The financial costs of the fortnightly mentoring sessions was made up entirely of transport costs which were obtained from the programme budget. However the economic costs will consider the opportunity cost of the participants attending the mentoring sessions in place of their daily programme activities. Thus the economic cost of the fortnightly mentoring sessions has been determined by estimating the CCGs daily wage and adding the value of these lost production days to the transport costs.

6.12.3 Recurrent Inputs – Quarterly Learning Sessions

The intervention conducted three quarterly learning sessions in the period October 2012 to November 2013. One session was held in 2012 and the remainder in 2013. The cost of training sessions held in 2013 were deflated to 2012 prices and the opportunity costs of attending these sessions were accounted for. The opportunity cost is calculated by determining the equivalent cost of employing a CCG for three days, which is the number of days of normal operational activities that CCGs have missed as a consequence of attending the learning sessions. The opportunity cost is taken into consideration because the implementer is still paying the CCGs for normal operational activities on the days when they are attending the learning sessions. It is noted that the economic costs of the quarterly learning sessions include transport costs for CCGs, venue hire costs and the opportunity cost of attending the learning sessions.

6.12.4 Recurrent Inputs – Telephone, Internet Data, Stationery

The telephone expenditure costs attributed to the Nompilo Project RCT are not a reflection of the programme costs and as a result needed to be adjusted to reflect usage by the Quality Mentors. Two Quality Mentors were provided with a cellphone airtime allowance whilst the other utilised the CRH-UKZN office telephone. The challenge is that the latter's telephone expenditure has been subsumed into CRH-UKZN's total expenditure which includes the costs of other programmes. The direct allocation method could not be used to allocate telephone costs to the Nompilo Project RCT due to the absence of information pertaining to the actual units of airtime used. The decision was taken to use the cellphone allowance as a relatively accurate estimate for all three Quality Mentors. As in the case of the telephone costs, the same circumstances applied with regards to internet data and stationary costs. The costs are estimated by assuming that all Quality Mentors incurred identical costs.

6.12.5 Recurrent Inputs – Utilities

As has been mentioned earlier Quality Mentors were provided with an office located in a government building, thus utilities such as water and electricity were paid for by the provincial DoH. However there remains an overhead cost that needs to be allocated to the Nompilo Project RCT. Utility costs have therefore been estimated based on the annual utility expenditure costs of a similar sized office that would be located in a similar area.

6.13 Incremental Cost-Effectiveness Analysis

This paper performs an incremental cost-effectiveness analysis which allows for a comparative analysis between the control and the intervention arm of the Nompilo Project. This comparison of two programmes, whose outcomes are expressed in the same units, which is the number of mothers practicing exclusive breastfeeding, allows for the calculation of an incremental cost-effectiveness ratio (ICER). This ratio is defined as the additional costs introduced by the intervention divided by the additional benefits (Meunnig, 2008, p.27). In order to perform the incremental cost-effectiveness analysis the additional resource inputs used and outcomes obtained in the intervention, relative to the control arm, are identified and are consequently valued. This is then followed by the calculation of the ICER which is expressed in terms of cost

per unit of outcome which is identified as the cost per additional mother practicing EBF.

A significant limitation of the Nompilo Project RCT is resource usage, activities and costs in the control arm where not tracked, as the primary focus has been the efficacy of the intervention relative to the control arm. In performing an incremental CEA the costs that are common to both programmes are not considered as it is concerned with the incremental costs. For instance all, CCGs in the control and intervention underwent the standard training provided by the KZH DoH, hence the costs incurred in this training are not considered when calculating the ICER, as subtracting these common costs yields an incremental cost of zero.

Table 3 illustrates the incremental costs that are considered for calculating the ICER. It has been assumed that a CCG health facilitator based at a public health facility allocates 10% of their time to CCG related activities as they are enrolled nurses who still have a daily patient workload to contend with. This estimate was determined from consultations with CRH-UKZN staff. The CCG health facilitator's salary is assumed to be that of a full time staff nurse. The value of the health facilitator's salary is obtained from the Department of Public Service and Administration, Occupation Specific Dispensations (OSD). It is further assumed that the control arm had three health facilitators which is equal to the number of Quality Mentors.

CCGs in the control arm did not undergo additional HIV-adapted CCM and CQI training therefore the incremental cost is the full cost of the training. CCGs supervisors in the control attended monthly meetings with CCG health facilitators. CCG supervisors paid their own transportation costs when attending these monthly meetings. In the intervention arm the CCG teams would attend bimonthly meetings with the three Quality Mentors and their transportation costs were paid for by CRH-UKZN.

In this paper the assumption is made that subtracting the incremental costs from the total costs of the intervention enables the economic costs of the control to be approximated. Calculating the economic costs of the control arm makes it possible to calculate its cost-effectiveness ratio (CER). The need to calculate the CER of both the

control and the intervention arms allows the two respective programmes to be ranked in terms of their cost-effectiveness. The programme that produces the lowest cost per mother practicing EBF will be regarded as the most efficient way of producing health.

***Table 4*: Incremental Cost of the Intervention**

Control	Intervention	Incremental Cost
Health facilitators are a shared resource as they perform other function in the health facility. Estimates approximately 10% of time to CCG related matters.	Quality Mentor paid on a full time tme basis.	Difference between a quality mentor's salary and 10% of the health facilitator's salary.
Not applicable	Training of HIV-adapted CCM curriculum	Identical to the costs of the HIV-adapted CCM training.
Not applicable	CQI supervision training.	Identical to the costs of the CQI supervision training.
Once a month meeting per 15 CCG supervisors.	Fortnightly mentoring sessions per 75 CCGs.	Difference between costs of the recurrent meetings in the respective arms of the RCT (100% of the costs).
Not applicable	Quarterly Learning Sessions	Identical to the cost of the quarterly learning sessions.

Source: Own

6.14 One Way Sensitivity Analysis

This paper has selected the discount rate of 3% in favour of the 8% rate. The decision to select the former discount rate raises uncertainty in this model as to whether the correct rate has been selected in this model (Drummond, 2005, p.39). In acknowledging the uncertainty, a sensitivity analysis was carried out which determined the extent to which the results of the cost-effectiveness analysis was sensitive to the range of values that the discount rate can adopt. This paper will conduct a one way sensitivity analysis in which the value of the discount will be varied at 3%, 5% and 8% whilst keeping the values of the other resource inputs constant.

The base case estimate in this sensitivity analysis was the 5% discount rate. This base line discount rate was selected based on the recommendations contained in the Guidelines for Pharmacoeconomic Submissions (NDoH, 2012). The robustness of the

model was determined by analysing the extent to which the final CEA results are sensitive to changes in the discount rate. This model is labelled as robust if the final cost-effectiveness results were insensitive to the changes, signifying that seeking to obtain a more accurate estimate of the discount rate may not be necessary (Drummond, 2005, 108; Muennig, 2008, p.138).

Other variables are not used in this sensitivity analysis as they are either known with a high degree of certainty especially the values of financial costs that were obtained directly from the programme budget. This paper asserts that other variables that have been obtained via estimation such as the telephone, internet data and stationery do not have a significant effect on the cost-effectiveness results. A threshold analysis was not conducted in this paper.

6.15 Limitations of the One Way Sensitivity Analysis

A one way sensitivity analysis has been criticised on the basis that there may be several resource input variables that contribute to a combined variability in the cost-effectiveness ratio. Drummond (2005, p.43) argues that these other variables should not be ignored as they may significantly contribute to the overall uncertainty relative to the single key parameter that is varied, thus obviating the total effects of the other resource input costs.

6.12 Conclusion

This section highlighted the resource inputs that were consumed by the Nompilo Project RCT and the activities are associated with these inputs. The activities that were looked at included training, supervision, CCG outreach activities. A mixture of ingredients and activity based costing was used to perform the cost analysis. The ingredients micro-costing approach relied on identifying each resource input and then separating these input costs into recurrent and non-recurrent costs. The resource inputs and the associated activities in the intervention arm are known with a fair amount of certainty as these were obtained from the programme budget and interviews and the programme budget with stakeholders involved in the implementation of the RCT.

However there was a significant amount of uncertainty associated with the control as not all resource inputs and costs were tracked, thus assumptions were made such as in estimating the shared costs of health facilitators. A sensitivity analysis was conducted using a range of discount rates from three, five, and eight percent with the five percent rate being chosen for the base case scenario. The next chapter focuses on the results obtained from the application of the methodology outlined in this chapter.

CHAPTER 7: RESULTS

This chapter begins by presenting the programme resource unit costs of the Nompilo Project RCT and shows the contribution of each resource input cost to the final programme costs. This is then followed by illustrating the costs from an activity based costing methodology where the cost of each activity in the intervention which include supervision, outreach and training are calculated and considered in terms of their contribution to the final programme costs. The results of the CEA are then calculated and this is followed by an analysis of the ICER. The chapter concludes by performing the one-way sensitivity analysis where the decision variable is the discount rate.

7.1 Nompilo Project Programme Unit Costs

Table 5 represents the unit costs of the resource inputs used in the programme as they are consumed during the intervention where the financial cost exceeded the economic cost of the Nompilo Project RCT by 20%. Table 4 illustrates that the percentage difference between financial and economic costs emanated from annualising the costs of capital goods and deflating costs that were incurred in 2013. The economic costs of employing Quality Mentors and CCGs are lower than their respective financial costs, as a portion of the salaries that were incurred in 2013 were deflated to 2012 prices. The administrator's shared costs have been added to the economic costs of the programme whereas they were ignored in the programme budget. The economic cost of the once-off HIV-adapted CCM and CQI training for CCGs was lower than the financial costs because its costs have been annualised to reflect that this is a non-recurrent activity.

The economic costs of the fortnightly mentoring and quarterly learning sessions respectively, were lower than their financial costs, as the latter were also deflated to 2012 prices, with the majority of these fortnightly meetings taking place in 2013. These learning sessions included the opportunity costs of "lost production" days as a consequence of attendance at the meetings.

Table 5: Nompilo Project RCT: Cost per Unit of Resource Input Used

For Resource	Quantity	Units	Cost Definition	R/Unit (Financial Costs)	R/Unit (Economic Costs)	%ge Difference
Quality Mentor	3	Each	Salary + fringe benefits	R585,036 per Quality Mentor	R543,242 per Quality Mentor	-7%
CCG Supervisor	15	Each	Stipend	R21,0000	R19,500 per CCG	-7%
Community Care Giver	60	Each	Stipend	R18,000 per CCG	R16,714 per CCG	-7%
Administrator	1	%ge time	Salary + fringe benefit	R0	R26, 464 per administrator	-100.0%
Once-off Training	75	Each	Cost to programme	R10,743 per CCG.	R2,639 per CCG.	-78%
Fortnightly Mentorship meetings	75	Each	Cost to programme	R7,253 per CCG	R6,639 per CCG.	-8%
Quarterly Learning Sessions	75	Each	Cost to programme	R1,550 per CCG	R1327 per CCG	-14%
Building space	1	15 months	Rent	R0	R62, 679 for 15 months	-100.0%
Office Furniture	2	Items	Cost to programme	R0	R1557 per QM.	-100.0%
Lap top Computer	3	Items	Cost to programme	R5000 per laptop	R117 per laptop	-78%
Printer	1	Items	Cost to programme	R450 per printer	R196 per printer.	-78%
Projector	3	Items	Cost to programme	R1800 per projector	R2215 per projector	-37%
Cellphone Airtime Cost	3	15 months	Cell phone company charges	*R3000 per QM	R2,786 per QM	-7%
Internet Data	3	15 months	Cell phone company charges	*R2500 per QM	R2,406 per QM	-4%
CCG Supplies	75	Items	Cost to programme	R209 per CCG	R209 per CCG	0%
Stationery	3	15 months	Cost to programme	*R6312 per QM	R6,083 per QM	-4%

Utilities (water and electricity)	1	15 months	Water and electricity	R0	R16,191 per year.	100%

Source: Own Calculations

The building space's economic cost exceeded its financial cost by 100% because the former considers the opportunity cost of renting a similar building space. The economic costs of the office furniture consider the shadow price of similar furniture resulting in economic costs exceeding financial costs by 100%. The laptops, projectors and printer costs are annualised, thus reflecting a lower economic cost relative to their book value. The annualised replacement value of a single projector was 19% lower than its financial cost, as the former reflects its market value which is annualised whilst the latter is the price of the projector after receiving a discount. Telephone, internet data stationery, CCG supply costs that were incurred in 2013 were deflated to 2012 prices resulting in lower economic costs relative to the financial costs.

7.2 Line Item Classification of the Nompilo Project Costs

Table 6 shows the line item classification of the economic costs of resource inputs consumed in the Nompilo Project RCT, where costs are predominantly divided into current and recurrent costs. Programme costs in the Nompilo Project RCT comprise recurrent costs at 92.8% and non-recurrent costs at 7.2%. Resource input costs ranged from R13, 357 for annualised equipment costs to R2, 951, 548 for personnel costs.

7.2.1 Recurrent Costs

The greatest proportion of recurrent costs is personnel, contributing 75.8% of the total economic cost of the programme as a whole. These costs are analysed in section 6.2.3. The mentoring and the quarterly meetings that CCGs and supervisors attended, have a combined contribution of 15.4% and are the second highest contributor as shown in Table 6. CCGs attended an average of 22 mentoring sessions that were conducted at the Quality Mentor's office. The costs of the mentoring sessions are entirely made up of the transport fares that were paid to CCGs to attend the meetings. Three quarterly sessions were held for the duration of the intervention and the costs attributed to these included venue hire and transport costs.

7.2.2. Non-Recurrent Costs

Under the category of non-recurrent items, the largest proportion of costs is attributed to HIV-adapted CCM training and CQI supervision at 7.6%. The HIV-CCM adapted and CQI training are inclusive of transport, accommodation, training venue and catering costs incurred during the training of CCGs. The costs are largely a function of the number of CCGs who underwent training. Building space for the Quality Mentors was primarily influenced by the location of the office which is in a peri-urban area, which would normally attract lower rentals in comparison to an urban area. .

***Table 6*: Cost Profile of the Nompilo Project**

Cost Category	Total Cost (Rands)	Per CCG (N= 75)	Total Cost (%)
Non-recurrent Inputs			
Once-off Training	R179,919	R2,399	4.7%
Building Space (incl. office furniture)	R67, 350	R898	1.7%
Equipment	R6,867	R92	0.2%
Total Non-recurrent Costs	**R254,135**	**R3,388**	**6.6%**
Recurrent Cost Inputs			
Mentoring/supervisory sessions	R497, 925	R6,639	12.9%
Quarterly Meetings	R99,525	R1,327	2.6%
Personnel	R2,951,548	R39,354	75.8%
Telephone and Data Costs	R15,575	R216	0.4%
Utilities	R16,191	R215	0.4%
Stationery	R18, 249	R243	0.5%
CCG Supplies	R15, 675	R186	0.4%
Recurrent Costs	**R3,612, 953**	**R34,671**	**93.4%**
Total Costs	**R3,886,831**	**R56,611**	**100%**

Source own: Calculations, (format adapted from Creese and Parker, 1994, p102)

7.2.3 Analysis of Personnel Costs

Table 7 illustrate that the salaries paid to Quality Mentors make up the highest proportion of personnel costs (55%) although as a proportion they account for only four percent of total personnel in the programme. The Quality Mentors salary was high as these are highly skilled professional nurses who had management experience and were paid market related salaries. The second highest contributor to personnel costs is the CCG's stipend costs (44%). The high CCG personnel costs are a function of the number of CCGs in the programme rather than a reflection of their skills base.

The CCG costs are attributed to the number of CCGs who make up the Nompilo Project RCT, where CCGs who make up 95% of the total personnel in the programme account for 44% of total programme cost. The administrator as a proportion of total personnel was one percent and their salary also contributed one percent of total personnel costs. The low personnel costs associated with the administrator are attributed to the fact that this was shared resource.

***Table 7*: Disaggregated Personnel Input Costs**

Personnel Type	Number of units	Personnel costs	%ge Personnel Cost
Quality Mentor	3	R1,629,726	55%
CCG Supervisor	15	292,500	34%
CCG	60	1,002,857	10%
Administrator	1	R26,464	1%

7.3 Activity Based Costing of the Nompilo Project RCT.

There are three activities that were identified with regards to the intervention aspect of the Nompilo Project RCT. These include CCG supervision, CCG Training and CCG outreach activities. Table 8 reflects the aforementioned activities and the resource inputs consumed by these activities. CCG support supervision is an activity which

comprised 61% of all programme costs and included all resources necessary for the successful supervision of CCGs. These included personnel directly responsible for supervision which include Quality Mentors and support staff such as the administrator.

Overheads which were primarily used by the Quality Mentors in their supervision of CCGs are included, such as utilities, telephone and data, building space and stationery. In addition the quarterly learning and fortnightly mentoring sessions are included as part of supportive supervision.

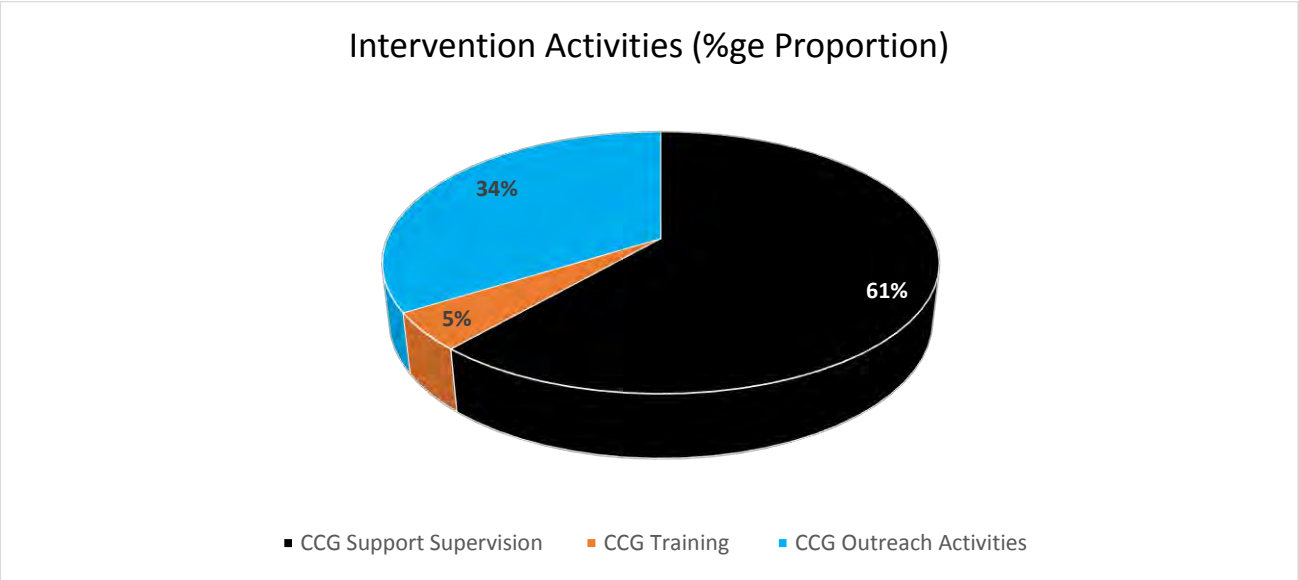
Costs associated with the CCG outreach activities included CCG stipends and supplies and these contributed 34% of total programme costs. The once-off HIV-adapted CCM and CQI training contributed 5% to the total programme costs. Supervision costs were the biggest contributor of total programme costs in the Nompilo Project RCT. The programme costs of the control were estimated by calculating the incremental costs of the intervention and subtracting these from the intervention arm. Incremental costs are used in order to show the additional costs that the complex intervention incurs relative to the control arm.

Table 8: Activity Based Costing of the Nompilo Project RCT

Programme Activity	Resource Input Costs	Activity Cost
CCG Support Supervision	Quality Mentor salaries	R 2,384,362
	Administrator salary	
	Fortnightly mentoring sessions	
	Quarterly learning sessions	
	Building space	
	Equipment	
	Utilities	
	Telephone and data costs	
	Stationery	
CCG Training	Once-off training costs	R 197,925
CCG Outreach Activities	CCG stipend and supplies	R1,309,307

Source: Own Calculations

Figure 3:Distribution of Intervention Activities Costs



Source: Own Calculations

7.4 Estimating the Control Programme Costs

The training and the supervision in the intervention was more intensive in comparison to the control arms, as a result it consumed more resources and consequently was more costly. . The incremental costs provide an estimate of how much more additional expenditure is required to implement the intervention. In the Nompilo Project RCT the additional activities included the introduction of the Quality Mentors, the quarterly learning sessions and the fortnightly mentoring sessions as is illustrated in Table 9.

In the control arm supportive supervision was provided by the health facilitator who is an enrolled nurse employed on a full time basis and earning an annual median salary of R 164, 643 (DPSA, 2012) compared to a Quality Mentor earning an annual salary of R439, 972. Over the duration of the Nompilo Project RCT the health facilitator's total salary was estimated to be R205, 810. Assuming that the health facilitators allocated 10% of their time to CCG activities, it is then estimated that their cost with regards to the control arm is R20, 581. Thus the incremental cost of introducing Quality Mentors is the difference between the costs of using a health facilitators versus that of Quality Mentors for the duration of the Nompilo Project RCT and is calculated to be R1,567,983.

Table 9: Incremental Costs

Resource Input/Activity	Control Arm	Intervention Arm	Incremental Cost
Mentoring	Shared Resource – R61, 743	Full time health facilitator in the form of a Quality Mentor – R1,629,726	R1,567,983
CCG stipend	R1,295,357	R1,295,357	Zero rands
Administrator	R26,464	R26,464	Zero rands
Monthly Meeting	R10, 500	R497,925	R487,425
HIV-adapted CCM and CQI Training	Zero rands	R197, 925	R197, 925
Learning sessions	Zero rands	R99,525	R99,525
Building space (incl. office furniture)	R67,350	R67,350	Zero rands
Equipment (laptops, printer, projector)	R6,867	R6,867	Zero rands
Stationery	R12, 166	R12, 166	Zero rands
CCG supplies	R15, 675	R15, 675	Zero rands
Telephone and Data	R7218	R7218	Zero rands
Utilities	R15575	R155575	Zero rands
Total	**R1,628,175**	**R3,886,831**	**R2,340,936**

Source: Own Calculations

The CCG facilitator in the control arm met with CCG supervisors on a monthly basis, where the latter paid for their own transport costs unlike in the intervention arm. As a result the KZN DoH which is the implementer of the control did not incur any explicit costs, however, there was an opportunity cost associated with these meetings as supervisors where not engaged in outreach activities. Therefore the incremental cost of the fortnightly meetings is calculated as the cost of the fortnightly mentoring sessions minus the opportunity cost of attending the monthly meetings in the control arm. There were no quarterly learning sessions in the control arm, thus the incremental cost in this instance is the full cost of providing the quarterly learning sessions in the intervention arm. The assumption is that the administrator, building space, equipment,

CCG supplies,stationery telephone and data costs are similar between both arms of the Nompilo Project RCT resulting in the incremental cost being zero. Table 9 provides a summary of the incremental costs incurred in the implementation of the intervention.

Incremental costs were calculated at R2,340,936 which is an estimation of the additional economic costs required to introduce the intervention in a similar study setting. This amount is also interpreted as an average of R31, 212 required per CCG in order to implement the intervention in a similar study setting. The programme costs of the control arm are at approximately 40% of the total costs of the intervention arm. The largest proportion of incremental costs was the Quality Mentors salaries which accounted for 60% of the additional costs required to implement the intervention.

7.5 Effectiveness

Table 10 shows the EBF outcomes of the Nompilo Project RCT in the post intervention evaluation period (CRH-UKZN, 2014). The intervention arm showed higher outcomes across all cohorts of women who practiced EBF in comparison to the control arm. The greatest difference in outcomes between the intervention arm and the control arm occurred among mothers with children below the age of six months who were practicing EBF. The lowest difference in outcomes in EBF outcomes was among mothers living with HIV.

7.6 Cost-effectiveness

The cost per mother practicing exclusive breast feeding is calculated in order to determine the cost-effectiveness of the standard provincial DoH training and supervision relative to the HIV-adapted CCM training and CQI supervision. This is obtained by dividing the total cost of the programme by the number of mothers practicing exclusive breast feeding. This is obtained by dividing the total cost of the programme by the number of mothers practicing exclusive breast feeding. Table 11

illustrates the cost-effectiveness of both programmes across the three different cohorts of mothers.

The total costs of the intervention were calculated to be R3,868,823 intervention arm's cost-effectiveness ratio is R19,942 per mother with a child less than 6 weeks of age practicing EBF in comparison to the control which is R8,389. In the cohort of mothers with children less than 6 months of age the cost-effectiveness ratio is R85,974 per mother practicing EBF in the intervention arm compared to the control arm where it is R60,279 per mother practicing EBF. In the cohort of mothers living with HIV, the cost-effectiveness ratio is R483,603 per mother practicing EBF in comparison to the control arm which is R232,504. The incremental cost-effectiveness ratio has been calculated by subtracting the control arm CER from that of the intervention arm CER as illustrated in Table 11 below.

Table 10: Cost Effectiveness Analysis Ratio (CER) for Nompilo Project RCT

	Control Arm	Intervention Arm	ICER
Mothers practicing EBF children < 6 weeks	R8,389 per mother practicing EBF.	R19,942 per mother practicing EBF.	R11,553 per additional mother practicing EBF.
Mothers practicing EBF with children < 6 months.	R60,279 per mother practicing EBF.	R85,974 per mother practicing EBF.	R25,695 per additional mother practicing EBF.
Mothers living with HIV practicing EBF	R232,504 per mother practicing EBF.	R483,603 per mother practicing EBF.	R251,099 per additional mother practicing EBF.

Source: Own Calculations

7.7 Sensitivity Analysis

The sensitivity analysis is conducted in order to determine the robustness of the model with regards to the different assumptions made regarding the discount rate. The range of discount rate that is being tested are the 3%, 5% and 8%. The 3% discount rate is the low case estimate, whilst the 5% is the base case estimate and the 8% is the high value estimate. Table 11 shows the different CERs for the three respective cohorts of mothers when the 3%, 5% and 8% discount rates are applied. A higher discount rate

results in a higher CER in terms of absolute numbers as greater future costs are being discounted to 2012.

Table 11: CER across EBF Cohorts by Discount Rate

	Cost-effectiveness Ratio		
	Cost per mother practicing EBF at 6 weeks	**Cost per mother practicing EBF at 6 weeks**	**Cost per HIV positive mother practicing EBF**
Low Value (3%)	R19,942	R85,974	R483,603
Base Case Scenario (5%)	R19,997	R86,211	R484, 934
High Value (8%)	20,089	R86,604	R487, 147

Source: Own calculations

Table 13 shows the results of the sensitivity analysis which has been calculated by determining the magnitude from which the low and high value scenarios respectively vary from the base case scenario. The results indicate that the model developed to determine the cost-effectiveness ratio of the Nompilo Project RCT is robust in terms of changes to the discount rate. This is reflected by the narrow range of -0.3% to -0.5% from which the low and high discount values diverge from the base case estimate, which indicates that the model used to calculate the Nompilo Project CER is insensitive to changes in the discount rate parameter (Pannel, 1997). The robustness of the model increases confidence that the selected discount rate of three percent used in the Nompilo Project RCT does not preclude its results from being compared to similar studies conducted in South Africa such as Nkonki et al (2014) and Cleary which used an eight percent discount rate.

Table 12: Divergence of CER Estimates from Base Case Scenario

	Percentage Divergence from Base Case Scenario		
	Cost per mother practicing EBF at 6 weeks	**Cost per mother practicing EBF at 6 weeks**	**Cost per HIV positive mother practicing EBF**
Low Value (3%)	-0.3%	-0.3%	-0.3%
Base Case Scenario (5%)	-	-	-
High Value (8%)	0.5%	0.5%	0.5%

Source: Own Calculations

7.8 Conclusion

This study has determined that the highest unit costs in the intervention arms are the Quality Mentor salaries which reflect their high skill level. Using a line classification method, it was recurrent costs account for 3.7 million rands of total programme costs in the intervention arm. The main drivers of the total programme costs in are personnel costs and the fortnightly mentoring sessions. When activity based costing is used the cost of supportive supervision accounted for 61% of total programme costs, followed by CCG outreach activities (34%) and CCG HIV-adapted CCM training contributing 5% of total programme costs. The cost of the control arm is estimated as costing 37% of the intervention arm costs. The intervention arm is considered to be less cost-effective than the control as it has higher cost-effectiveness ratios across all three cohorts of mothers who are practicing EBF. The results of the sensitivity analysis where the discount rate was varied as a parameter indicated that the model used to discount capital costs is insensitive to changes.

CHAPTER 8: DISCUSSION

This chapter begins by considering how economic evaluation tools such as cost-minimisation and CEA are applied in the decision making process of selecting whether an interventions should be selected or not, which in this context is the HIV-adapted CCM training and CQI supervision methodology. This is followed by section 7.2 which seeks to determine sources of inefficiencies in the intervention arm and deciding on their removal or reduction. This section also compares the results of the Nompilo Project RCT with similar studies that have been conducted. Section 7.3 considers the effectiveness of supportive supervision in relation to its costs with the objective of determining whether the CQI supervision of CCGs is cost-effective in its current form. Section 7.4 of this chapter considers the intrinsic motivation of CCGs within South Africa in an attempt to provide a possible explanation for the output obtained in the complex health intervention arm. The body of this chapter is concluded by considering the limitations of the study such as the possible impact of team size effects, the inherent problems that accompany a retrospective economic evaluation and a discussion on the appropriateness of the duration of the intervention.

8.1 Choice between the Intervention and the Control Arm

The intervention and the control arm are compared where it is observed that the former had a greater intensity of supportive supervision and training than the latter. As a result, the intervention arm of the Nompilo Project RCT is associated with higher economic costs in comparison to the control arm. However, outcomes related to the uptake of MNCWH interventions such as the prevalence of antenatal bookings, the number of women who presented themselves for postnatal care within seven days of delivery, the coverage of HIV PCR testing of babies born to HIV positive mothers within six weeks postpartum were not statistically significantly different between the control and the intervention arms. However a statistically significant difference between the control and intervention arm occurred in the outcome regarding the prevalence of EBF rates between the two arms. There was a significantly higher rate of mothers in the intervention arm practicing EBF in comparison to mothers in the control arm.

Consideration of the MNCWH interventions where there was no statistically significant difference in the outcomes between the control and intervention arm implies that the standard provincial training and supervision of CCGs is as equally effective as the HIV-adapted training and CQI supervision. As a result of this observation, a cost minimisation is used to determine which training and supervision method to select. When using cost minimisation as an economic evaluation tool, it is recommended that the KZN-DoH training and supervision of CCGs is selected as it achieves the primary and secondary objectives of the Nompilo Project RCT at the lowest cost in comparison to the HIV-adapted training and supervision.

With regards to the uptake of EBF a cost-effectiveness analysis is used as the preferred economic evaluation tool due to the difference in EBF prevalence rates between the two arms of the Nompilo Project RCT. The programme that has the highest CER is judged to be the least cost-effective and in this RCT it is the intervention arm. Based on the CER alone, it is recommended that the KZN-DoH training and supervision of CCGs should be selected as it is the more cost-effective of the two programmes.

The result of the cost-effectiveness analysis suggest that the HIV-adapted CCM training and CQI supervision is less efficient in its use of resource inputs in comparison to the standard provincial training and supervision. The inefficiencies are determined by identifying which resource inputs or activities contribute the greatest proportion of costs by either looking at the unit costs or the incremental costs. Identification of these resource inputs allows for a decision to be made regarding whether to remove or provide them at a much cheaper cost (Creese and Parker, 1994).

8.2 Employment of Full Time Quality Mentors

In terms of the intervention arm, personnel costs accounted for 76.3% of total programme costs, the Quality Mentors salaries accounted for 42.1% of costs. It is further observed that the Quality Mentor's salaries account for 65% of total incremental costs. This proportion of personnel costs confirms the assertion made by Creese and

Parker (1994, p.35) and UNAIDS(2000;20004) that personnel costs tend to be the single largest cost contributor to health programmes that rely on peer-to-peer interactions in order to effect a behaviour change intervention

When Activity Based Costing is used, the proportion of costs attributed to the supportive supervision of CCGs in the intervention arm are similar to those observed by Nkonki et al (2014) and Chola et al (2011) where supportive supervision of CCGs by Quality Mentors accounts for the highest proportion of programme costs. This reveals that the costs of supervision of CCGs are an area that needs to be investigated. The second highest proportion of costs is attributed to the mentoring sessions in much the same way as the Promise EBF peer support meeting (Nkonki et al, 2014; Chola et al, 2011). Unlike Nkonki et al (ibid) where the peer support meetings accounted for 27% of total programme costs, the fortnightly meeting mentoring sessions accounted for 13% of total programme costs in the intervention arm.

The personnel costs can be lowered by in the long run by reducing the number of Quality Mentors employed or employing a cheaper cadre of nurses. Walker et al (2002, p.50) argues that the nature of skills initially required for establishing new methods of peer review activities will have a significant impact on total costs in the short run. However in the medium to long term as the new methodology is embedded the likelihood of the transfer of supervisory skills and knowledge to a local, less expensive cadre of nurses increases, thereby leading to a decrease in personnel costs. This implies the existence of an learning curve where costs will decrease as less expensive health care workers gain experience in the implementation of CQI supervision and management as a result of developing improved ways of implementing CHW outreach programmes (Day and Montgomery, 1983).

8.3 A Relook at Supportive Supervision

The results of the Nompilo Project RCT appear to suggest that increasing the frequency of supervision exclusively does not always result in increased effectiveness of CHWs as the outcomes of the intervention and control arm were similar. This supports the argument presented by Hill et al (2014, p3) that the quality of supervision

appears to be a more important determinant in the supervision of CCGs in comparison to frequency of supervision. These results appear to indicate the Quality Mentor's marginal productivity of labour approaches zero when there is a high frequency of meetings. Therefore, it is crucial that the optimal number of mentoring sessions should be determined before diminishing marginal returns of productivity begin to set in.

An implicit assumption in the above argument is that the Quality Mentor's marginal productivity of labour is a function of the CHWs intrinsic motivation. It is contended that the adoption of CQI as a supervision and management method required CCGs and supervisors to learn new skills which implies the existence of a learning curve. This implies that high levels of supervision do not crowd out intrinsic motivation at the initial stages of CQI implementation as CCGs have not gained sufficient experience. There is a high likelihood that CCGs regard increased supervision at this stage as being legitimate (Schnedler and Vadovic, 2011) in their interest as they are being assisted in implementing this new methodology and in the process they accumulate experience and this is accompanied by high productivity gains (Dominguez-Martinez and Sloof, 2014).

However, with greater accumulation of experience after successive periods of time, a high frequency of supervision very likely acts as a negative incentive as espoused by Frey (1994), Benabou and Tirole (2003); Falk and Kosfeld (2006); and Falk and Fischbacher (2006). The argument that is espoused here is that the relationship of CCGs intrinsic motivation levels and frequency of supervision should be considered as having a bounded solution thereby explaining the similar outcomes between the intervention and control arm. This supports the conclusion that the frequency of supervision reflected by the fortnightly mentoring sessions can be reduced without affecting the effectiveness of CCGs as the number of days per mentoring session cycle are important determinants for cost-effectiveness, as they account for 13% of total programme costs.

8.4 The Intrinsic Motivation of CCGs

Pendergast's (2008, p2) recommendation that a principal should select agents who have extreme preferences suggests the existence of a linear relationship between the frequency of supervision and CCGs who have an altruistic nature and are thus highly intrinsically motivated. An assertion is made that CCGs in South Africa may not exhibit this relationship, as Greenspan (2013) observed that they are motivated by a mix of intrinsic and extrinsic motivators. It is argued that this observation alludes to a relationship where the increase in frequency supervision results in CCGs marginal productivity increasing at a decreasing rate. It implies that there is a region in the curve where the altruistic nature of CCGs responds positively to increased supervision, however there is a turning point where the CCGs motivation becomes extrinsic where they start considering their effort level in relation to the stipend they are paid. Kironde and Bajunirwe (cited in Lehmann et al, 2004) argue that extrinsic motivators actually have a stronger effect on CCGs effort level than intrinsic motivation particularly in a context where there is a high unemployment and poverty rate. It is observed that the R1200 stipend that CCGs received is comparable in value to the old age pension grant of R1350 which has been observed to support household expenditure in rural communities; thus it is argued that the stipend is the primary motivator of CCGs. (Tangwe and Gutura, 2013). The argument presented here implies CCG motivation is mutable with less effort being exerted as the frequency of supervision increases which supports the recommendation of a lower frequency of supervision. It is argued that a programme with a high frequency of supervision will yield higher outcomes if CCGs are initially screened and only CCGs with an extreme preference for community care work are selected as is argued by Prendergast (2008;p1).

8.6 Limitations

8.6.1 Ignoring Team Size Effect

It is observed that CCG team sizes differed in the pre-evaluation and post evaluation period. Under normal circumstances the team size ratio was one supervisor to 25 CCGs. Under study conditions the team ratio is one supervisor to 5 CCGs. The argument presented here is that the RCT was a complex intervention as more than one variable was responsible for the outcomes achieved.. The three variables were the HIV-adapted training, CQI supervision and a change in team size. The control arm

represented a change in team size whilst the intervention arm represented all three changes. The importance of team size is supported by the observation made by Liang et al (2008, p799) that larger teams are harder to monitor from a performance perspective and are associated with problems related to coordination and difficulties in communication. Kozlowski and Bell (2001, p12) argue that large teams are associated with losses in motivation caused by a "dispersion of responsibility". It is argued that smaller teams do not have these problems and that the reduction of teams introduced efficiencies in both the control and the intervention arm. Liang et al (2008, p805) further argue that in attempting to save costs, it is more optimal for firms to decrease team size and hire a lower quality manager whilst keeping the quality of the workers fixed.

8.6.2 Limitations of a Retrospective Cohort Analysis

Retrospective cohort analysis is particularly subject to recall bias as it requires participants to attempt to recall activities that occurred in the past (Drummond, 2005; Muennig, 2008). In addition, Gold et al. (1996, p75) asserts that retrospective cohort analysis may not collect data pertaining to costs and outcomes in a way that is useful to the cost analysis**.** In this study, this is particularly evident when considering that discounts and the time allocated to shared resources have not been recorded. The collection of financial costs was accurate, the true costs of goods and services was not systematically recorded, and in particular discounts, received for equipment. This highlights a shortcoming of a retrospective relative to a prospective cohort analysis. In a prospective analysis the required cost and health outcomes information is determined prior to the implementation of the intervention, thus avoiding issues related to the capturing of incomplete information required for a CEA.

8.6.3 "Thin" Information on the Supervision of the Control

CRH-UKZN's primary motivation when implementing the RCT was to determine the effectiveness of the intervention relative to the status quo. Effectiveness in terms of the number of women exclusively practicing EBF and an increase in knowledge levels of CCGs were recorded in both the intervention and the control group. Unfortunately information pertaining to the monitoring and supervision of CCGs in the control group was "thin". It would have been more beneficial to have had an in-description of the

supervision process in the control arm in order to make more accurate comparisons between the control and the intervention arm.

8.6.4 Duration of the Intervention

It is argued that the 15 month time horizon of the RCT was not sufficient in terms of determining the cost-effectiveness of the intervention. Possibilities do exist that with the initial implementation, its initial cost-effectiveness ratio may significantly decrease at a later date. This can be attributed to the theory of learning by doing where the effect of the experience gathered by CCGs over time results in a more efficient production of health outcomes. It infers that once CCGs have inculcated the principles of CCM and CQI management they may require less supervision resulting in declining costs over time. Counte and Meurer (2001) argue that firms are quick to discount the benefits of CQI without understanding that it is a long term management process.

This process takes time based on Roger's (cited in Counte and Meurer, 2001) Theory of Diffusions of Innovation which argues that firms go through five steps in the adaption of an innovation. These steps are acknowledgement of a need; an evaluation of how the innovation can solve the problem; the decision stage where team accepts or refuses the innovation; testing the applicability of the innovation; and finally the confirmation stage where there is continued adoption of the new methodology. It is argued that the RCT was terminated at the fourth stage of Roger's (ibid) steps which is the implementation stage where the focus was on problem solving. It is argued that the confirmation stage was not achieved which is characterized by continuous improvement.

In highlighting how long it takes to embed CQI a process, Counte and Meurer (2001) argue that it takes at least five to seven years to actually implement a CQI management and supervision system although an important caveat is that this is in the context of a large firm with several reporting structures. Whilst the implementation of CQI is expected to take a much shorter period of time in the Nompilo Project RCT which has a much flatter reporting structure, it is important for an organization to understand at what phase of the CQI implementation process they are operating in.

8.6.5 The Limitations of Relying on a CEA

Zangwill and Kantor (1998, p913) highlight that the CQI method of focusing on specific actions that have improved in a process, relies on implicit assumptions. These are that the improvements made are separate and distinct, and will not have an impact on each other or furthermore "should not cause any decreased effectiveness other parts of the process". CCGs have reported an increase in confidence and knowledge as a result of the support and training that they received in the intervention. They stated that they were able to prepare better for their interactions with members of the community. It would have been helpful to determine whether this new found confidence resulted in CCGs increasing the duration of their counselling sessions with mothers in the community and whether this did not affect the number of clients they could have seen. This highlights the short comings of using natural units as a measure of outcomes as a trade-off may exist where the quality of the interaction between CCGs and mothers has improved whilst the number of mothers reached decreases, thus reducing the cost-effectiveness of the intervention.

8.7 Conclusion

Whilst we acknowledge that the intervention was not sufficiently cost-effective we argue sources of inefficiency need to be considered with particular regard to the role of Quality Mentors and how screening can be used to enhance supervision levels. We contend that the duration of the RCT may have been too short for any meaningful results to be obtained. It is possible that a RCT conducted for a longer period may actually yield different results and that research should be conducted as to where in the Theory of Diffusion of Innovation the intervention was when it was terminated. A significant short coming is the measure of outcomes that has been used as CCGs have been trained to also improve the quality of their delivery strategy, therefore, it should not simply be based on quantities only.

As a result of the similar outcomes in three out of four primary objectives between the control and the intervention arm, a cost minimization study is used to select the control arm as the preferred training and supervision method as it is the less expensive of the two interventions. A CEA is used with regards to the primary objective that sought to increase the prevalence of EBF, and the intervention arms is determined to be less cost-effective in comparison to the control arm, as a result it is recommended that the

provincial CCM training and health facility based supervision should be adopted over the HIV-adapted CCM training and CQI supervision. Possible areas of inefficiency in the intervention arm are the personnel costs associated with Quality Mentors which account for 42% of total programme costs.

It is recommended that the frequency of mentoring s should be reduced based on observations made by Hill et al (2014) that the quality of supervision is a much more important determinant of CHW effectiveness than the frequency of supervision. Frequent supervision is beneficial at the initial stages of the learning curve and thereafter it becomes less effective as CHWs become more comfortable with the supervision technology. It is also argued that CCGs motivation is made up of both intrinsic and extrinsic motivation where the latter initially responds positively to increased supervision but then this occurs less and less as this frequency of supervision increases until a turning point is reached where CCGs are only extrinsically motivated by the stipend that they receive.

The limitations of the intervention arm do not increase the probability of the HIV-adapted CCM training and CQI supervision of CCGs becoming cost-effective in comparison to the provincial CCM training and supervision of CCGs. The team size effects, omissions of possible costs and the interaction effects of actions in CQI actually serve to reduce the cost-effectiveness of the intervention arm. It is concluded that in the Nompilo Project RCT the intervention arm is less cost-effective in comparison to the control arm.

CHAPTER 8: CONCLUSION

The study set out to determine the cost-effectiveness of HIV-adapted CCM training and CQI supervision of CCGs provided by the provincial department of health. It has identified resources, activities and the cost data associated with additional training, supervision and outreach activities of CCGs in rural KwaZulu-Natal. In addition it has also sought to identify possible areas of inefficiencies in the intervention. There is a paucity of studies undertaking a cost-effectiveness analysis of supportive supervision' although there are a number of studies that endorse its implementation as a means of increasing the performance of CHWs. The study sought to answer the following questions:

1. What is the cost and cost-effectiveness of an HIV-adapted and CQI management and supervision model of CCGs?
2. Is the HIV-adapted and CQI supervision and management of CCGs more cost-effective than the standard provincial CCM training and health facilitator driven supervision model?

Chapter Three introduced agency theory and how supervision affects the levels of intrinsic motivation of agents which is reflected by their effort level. It is argued that the outcomes of the Nompilo Project RCT are a function of the CCGs levels of motivation. There are arguments that increased supervision can be seen as a negative incentive which gives rise to "hidden costs" that are reflected by a reduction in agent's motivation levels, thereby illustrating that costs need not be exclusively monetary. The success of supportive supervision which relies on frequent and consistent supervision can be affected by how CCGs perceive the motive of the supervision in the presence of information asymmetry. The literature argues that perceptions of how the CCGs view the increased frequency of supervision in terms of legitimacy or fairness will affect their levels of intrinsic motivation and therefore the outcomes of their outreach activities. The negative aspects of increased supervision can be ameliorated by the by screening CCGs and only hiring those who have high levels of altruism as the probabilities are higher that they may perceive the increased supervision as being in their interest.

The cost distribution in this study was similar to that of the Promise EBF study where it has been determined that CCG supervision is the largest cost driver in terms of total programme costs, whilst CCG support activities such as the mentoring sessions is the second largest contributor to programme costs. CCG programmes that that seek to increase the frequency of supervision should be cognisant of how this activity significantly increases the total programme costs. These high supervision costs are driven by the salaries that are paid to skilled health workers who have experience in supervision.

This study suggests that the increased costs invested in the implementation of supportive supervision does not lead to significantly greater outcomes. This however appears to be consistent with the theories of the hidden cost of supervision presented by Frey (1993), Benabou and Tirole (2003); Falk and Fischbacher (2006). This appears to be in contention with Dominguez-Martinez and Sloof (2014); and Schnedler and Vadovic (2011) as there is no significant increases in effort levels.

Whilst task shifting is a positive strategy for low income resource constrained countries the interpretation and strategic implementation of supportive supervision as consisting of a high frequency of supervision is not cost-effective. Rather than focusing on frequency it is the quality and consistency of the supervision that has the potential to increase the performance of CCGs.

It is suggested that future research should look at the following:

- The application of screening tools in order to reveal CCGs extreme preferences and determine whether this correlates with a higher level of performance in comparison to those who do not.
- Research on the optimal size of CCG teams.
- The effectiveness of aides versus the application of supportive supervision in terms of increasing CCGs performance.

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