PRESCRIBING COTRIMOXAZOLE PROPHYLACTIC THERAPY (CPT) BEFORE AND AFTER AN ELECTRONIC MEDICAL RECORD SYSTEM IMPLEMENTATION IN TWO SELECTED HOSPITALS IN MALAWI

by

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DECLARATION

I declare that PRESCRIBING COTRIMOXAZOLE PROPHYLACTIC THERAPY (CPT) BEFORE AND AFTER AN ELECTRONIC MEDICAL RECORD SYSTEM IMPLEMENTATION IN TWO SELECTED HOSPITALS IN MALAWI is my own work and that all sources that I have used or quoted have been indicated or acknowledged by means of complete references and this work has not previously been submitted for any other degree or to any other institution.

SIGNATURE
( Oliver Jintha Gadabu)

28 November 2013
DATE
ABSTRACT

Introduction
Opportunistic infections (OIs) have been identified as a leading cause of poor outcomes in the ARV therapy (ART) programme. In order to reduce OIs, the Malawi, MoH introduced routine prescription of cotrimoxazole preventive therapy (CPT) in 2005. The MoH also started scaling up a point-of-care electronic medical record (EMR) system in 2007 to improve monitoring and evaluation.

Objectives
This study had the following objectives: i) to quantify prescription of CPT before and after implementing EMR; ii) to compare the difference in CPT prescription before and after implementing EMR.

Methods
A historically controlled study design was used to compare CPT prescriptions one year before, and one year after implementation of the EMR at two health facilities.

Results
The data indicated that there was a significant (P <0.001) decrease in CPT prescribing at one health facility and a significant increase in CPT prescription at another.

Key words
Point-of-care EMR; clinical practice guidelines; cotrimoxazole prophylactic therapy; clinical decision support; electronic medical record; adherence; processes; opportunistic infections; resource limited setting; clinicians.
“The fear of the Lord is the beginning of wisdom”. I thank God for giving me the opportunity to do this work.

- I would also like to acknowledge the assistance rendered to me by my colleagues, Mwatha “Iceman” Bwanali, Soyapi Mumba and Zach Landis-Lewis. Your contributions gave shape to this study.

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- I would also like to sincerely acknowledge the steadfast encouragement of my wife, Maggie, who stood by me throughout this study and encouraged me all the time. You are a real team player.
Dedication

I dedicate this work to improved health care delivery.

The interaction between the patient and health care-provider can benefit from an electronic medical record (EMR).

This work is a contribution to meaningful EMR implementation in resource-limited settings.
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LIST OF ACRONYMS

AIDS        Acquired Immune Deficiency Syndrome
AMPATH      Academic Model Providing Access to Healthcare
ART         Antiretroviral Therapy
ARVs        Antiretrovirals
CD4         Cluster of Differentiation 4
CMHIV       Clinical Management of HIV
CPGs        Clinical Practice Guidelines
CPT         Cotrimoxazole Prophylactic Therapy
DREAM       Drug Resources Enhancement against AIDS and Malnutrition
EMR         Electronic Medical Record
HIV         Human Immunodeficiency Virus
ITN         Insecticide-treated Nets
MoH         Ministry of Health
NIMART      Nurse Initiated and Managed Antiretroviral Treatment
OI          Opportunistic Infections
PLWHIV      People Living With HIV
p-value      Probability Value
UNAIDS      Joint United Nations Programme on HIV and AIDS
UNISA       University of South Africa
WHO         World Health Organization
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CHAPTER 1
ORIENTATION OF THE STUDY

1.1 INTRODUCTION

Cotrimoxazole prophylactic therapy (CPT) is a low-cost antibiotic that can significantly increase survival and improve quality of life for people living with the Human Immunodeficiency Virus (HIV) (people living with HIV [PLWHIV]) (Suthar, Granich, Mermin, & Van Rie, 2012:313). In Malawi, the prescribing of CPT to PLWHIV is done in accordance with national guidelines for the clinical management of HIV (Clinical management of HIV [CMHIV]).

Since CPT prescription was included in the Malawi antiretroviral therapy (ART) treatment guidelines, it forms part of standard care that should be delivered to patients enrolled in the ART programme. Patient care is defined as an interdisciplinary process centred on the patient (Edward & Cimino 2006:564). As an interdisciplinary process, mechanisms are required in order to make sure that the care the patient must receive is given. A case coordinator is required to make sure that patients receive the necessary care (Edward & Cimino 2006:565). However, if this is left to chance, the patient might not get the care that they should be receiving. As a way of ensuring that standard care is being offered to patients, several approaches have been adopted. One such method is the use of clinical practice guidelines (CPGs) or pathways in order to make sure that health care practitioners provide care that patients should receive (Edward & Cimino 2006:10). Clinicians are thus given training on management of PLWHIV in accordance to the Malawi ART guidelines to ensure standard of care.

Although the prescription of CPT is part of the established ART treatment protocols, there is a need to make sure that it is consistently prescribed. Adherence to CPGs increases in the event that reminders are presented to health care providers (Iyengar 2009:4). Malawi’s CMHIV guidelines are supported by a national electronic medical record (EMR) system for CMHIV that features a CPT reminder. The EMR is used at 31 HIV clinics in Malawi. However, the effect of use of the EMR on clinicians’ adherence to CPT prescribing guidelines has not yet been evaluated.
This report therefore measured clinicians' adherence to prescribing CPT 12 months before implementing an EMR and 12 months after implementing an EMR in two selected ART clinics in Malawi.

1.2 BACKGROUND TO THE RESEARCH PROBLEM

1.2.1 Source of the research problem

A research problem can arise from many sources such as clinical practice, literature, interactions with colleagues and from funding opportunities (Burns & Grove 2005:72). The research problem in this study came from interactions and observations experienced by a medical informatician in the ART clinic setting, and were therefore derived from clinical practice.

1.2.2 Background to the research problem

Millions of children and adults die every year in low-resource settings because of poor adherence to guidelines by health care workers (Rowe, Savigny, De Lanata & Victoria. 2005:1). It has however been demonstrated that adherence to clinical practice guidelines improves quality of care through the integrated management of childhood illnesses guidelines (Arifeen, Blum, Hoque, Chowdhury, Khan, Black, Victoria, Bryce 2004:1599). HIV/AIDS has reached pandemic level in Malawi, with a prevalence of 11 percent. The Malawi Ministry of Health (MoH) established a national programme to scale up ART in 2004. This programme has followed a public health approach to ensure that there are no drug stock-outs and to ensure that patients are receiving care, as stipulated by the Malawi ART guidelines.

CPT prescribing was introduced as part of standard ART treatment in Malawi, in 2005 (Lowrance, Makombe, Harries, Yu, Aberle-Grasse, Eiger, Shiraishi, Martson, Ellerbrock & Libamba 2007:56). This was introduced in order to reduce opportunistic infections (OIs) and hence improve quality of life in people living with HIV.

To ensure that the ART programme is on track, the MoH put in place a monitoring and evaluation framework using paper-based records (patient Master Cards) to document
patient visit details at all health facilities where patients receive ART care and treatment. These records form the basis for quarterly and cumulative cohort reports, prepared at each health facility, and audited during quarterly (every three months) supervision visits by the HIV/AIDS department.

In addition to the monitoring and evaluation, the MoH gives standardised training to all clinicians working in the ART clinic. This training ensures that patients get standard treatment and care during clinic visits.

In 2006 an EMR was locally developed, based on the Malawi MoH’s monitoring and evaluation tools and ART clinical guidelines. The EMR employs a touch-screen user interface (no keyboard or mouse), and is deployed at the point of contact between the health care provider and the patient. It is thus used in real time when the patient is being examined. In this way, the system allows for alerts and reminders to be delivered to the health care provider at the point of care. This is done in order to improve patient care through adherence to the Malawi ART clinical guidelines, as well as to meet the reporting needs of the Malawi MoH, through generation of quarterly reports (Douglas, Gadabu, Joukes, Mumba, McKay, Ben-Smith, Jahn, Schouten, Landis Lewis, Van Oosterhout, Allain, Zachariah, Berger, Harries & Chimbwandira 2010:2). The system thus prompts the clinical staff to prescribe CPT at every patient visit.

The system introduced by the Malawi MoH differs from many systems that have been introduced in Africa and other regions in the sense that this system is used at the point of care and has alerts delivered during consultation.

The system was adopted by the Malawi MoH in 2007, and is now being rolled out at ART clinics in Malawi managing more than 2,500 patients receiving ART. The system currently manages the care and treatment for more than 175,000 patients receiving ART.

1.3 PROBLEM STATEMENT

An EMR has been recommended as a tool to improve the accuracy of monitoring and evaluating data in high burden ART sites in Malawi (Makombe, Hochgesang, Jahn,
Tweya, Hedt, Chuka, Yu, Aberle-Grasse, Pasulani, Bailey, Kamoto, Schouten & Harries 2008:314). Given that an EMR was developed, based on the Malawi ART CPGs, the researcher anticipates there may be some impact on clinicians' prescription of CPT when using the EMR. CPT has been identified to improve the quality of life for patients that meet its prescription criteria (Lowrance et al. 2007:56). There has been no formal assessment of the change in adherence to CPT prescription in clinics that have adopted the EMR. There is rich descriptive literature on systems that have been developed and implemented in developing countries and a famine of how these systems affect clinical practice (Blaya, Fraser & Holt 2010:244).

This study thus measured the proportion of patients that met prescription of CPT criteria and for whom CPT was prescribed in two selected health facilities 12 months before implementation of the EMR and 12 months after implementation of the EMR.

1.4 PURPOSE OF STUDY

The purpose of this study was to determine the impact of the EMR on adherence to CPT prescribing in two selected ART clinics in Malawi.

1.4.1 Research question

This study featured the following question:

• What is the impact of the EMR on clinicians' adherence to prescribing CPT in ART clinics at Zomba Central Hospital and Dedza District Hospital in Malawi?

1.4.2 Research objectives

The research objectives of this study were:

• **RO1**: To measure the adherence to CPT prescribing in two ART clinics in Malawi during the 12-month period immediately preceding the introduction of the EMR system
• **RO2**: To measure the adherence to CPT prescribing in the same two ART clinics during the 12-month period immediately following the introduction of the EMR system

• **RO3**: To compare the extent in changes in adherence to CPT prescribing in two ART clinics before and after introduction of the EMR system and make an assertion as to the likelihood that any change in adherence is a result of the introduction of the EMR system, using a statistical test

1.5 SIGNIFICANCE OF STUDY

The Malawi MoH is rolling out the EMR to all ART sites managing more than 2,500 patients. Clinics with more than 2,500 patients ever registered are classified as high burden sites. These clinics account for over 50 percent to of all patients receiving ART in the country (Government of Malawi Ministry of Health 2012:6). It was thus critical to determine the impact of the introduction of the EMR on clinicians’ adherence to prescribing CPT at sites using the EMR.

The study has benefited the Malawi ART clinics in the implementation of patient care guidelines, with regard to CPT prescribing. It has also benefited the medical professions in the improvement of patient care ART monitoring. Although the use of EMRs can increase adherence to CPGs, implementation of EMRs is expensive (Were & Meslin, 2011:1504). This study has contributed to the body of evidence on the impact of EMR on adherence to CPGs by health care providers and provided data that would allow the magnitude of the change in adherence to be quantified.

1.6 DEFINITION OF KEY CONCEPTS

A concept is a high-level term that abstractly describes an object, idea or phenomenon, thus providing it with a separate identity or meaning (Burns & Grove 2005:122). Definition of concepts in a study is important in order to have consistent meaning of ideas that are discussed in that research. Key concepts that were used in this study are listed below:
• Impact

This refers to the effect of an information resource on health care usually expressed as changes in the actions or procedures undertaken by health care workers or as outcomes such as patient morbidity or mortality (Friedman & Wyatt 2000:6). In this study impact referred to “clinician's adherence to prescribing of CPT”. This was the dependent variable. The independent variable was “EMR system” and had two levels: with EMR system and without EMR system.

• Electronic medical record

This is a longitudinal collection of health records for and about a person for immediate electronic access to person and population level information by authorised users at a single institution (Committee on Quality of Health Care in America 2001:4). In this study EMR refers to the Malawi MoH ART module developed by Baobab Health Trust and deployed at Dedza District Hospital and Zomba Central Hospital ART clinics.

• Point-of-care system

This is a hospital information system that includes bedside terminals or other devices for capturing and entering data at the locations where patients receive care (Edward & Cimino 2006:971). In this study a point-of-care system refers to the touch-screen based workstation that runs an ART EMR and is used during the patient and clinician encounter.

• Clinical practice guidelines (CPGs)

These are systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances (Edward & Cimino 2006:924). In this study CPGs referred to the Malawi ART treatment guidelines.
Cotrimoxazole prophylactic therapy (CPT)

This is a simple to administer, well tolerated and cost-effective intervention that can extend and improve the quality of life for people living with HIV, including those on antiretrovirals (ARVs) (Date, Vitoria, Granich, Banda, Fox & Gilks 2010:253). In this study CPT referred to its prescription by health care providers.

1.7 CONCEPTUAL THEORETICAL FRAMEWORK

A theoretical framework is defined as a logical structure of meaning that guides the development of a study and enables a researcher to link the findings of the research to a body of knowledge. Critiquing a study or developing further questions for a study requires the ability to identify and evaluate a framework (Burns & Grove 2005:121).

1.7.1 Care framework

A quality of care framework (depicted in as annexe 2) is defined by identifying structure, processes and health outcomes as essential elements that influence quality of care (Peabody, Taguiwalo, Frenk & Robalino 2006:194). They proceed to argue that each of these elements can influence the quality of care that is given to patients in different ways. Care framework elements are further defined as below (Peabody et al. 2006:194):

- **Structure** refers to stable, material characteristics (infrastructure, tools, technology) and the resources of the organisations that provide care and the financing of care (levels of funding, staffing, payment schemes, and incentives).
- **Process** is the interaction between caregivers and patients during which structural inputs from the health care system are transformed into health outcomes.
- **Outcomes** can be measured in terms of health status, deaths, or disability-adjusted life years – a measure that encompasses the morbidity and mortality of patients or groups of patients. Outcomes also include patient satisfaction or patient responsiveness to the health care system.
Of these elements, the most sustainable element that can influence quality of care has been singled out as processes. Processes can be strengthened in different ways, one of which is the establishment of CPG.

Processes are difficult to measure since they occur between the doctor and the patient with limited documentation, especially in developing countries (Peabody et al. 2006). Introduction of EMRs in health facilities provides an opportunity to assess the impact that they have on adherence to CPGs. The introduction of the EMR represents both a structural and a process change. The EMR equipment represents a structural change since this entails introduction of new infrastructure. The ART health care providers in the ART clinics use this equipment to interface with the patient. The EMR embedded guidelines represent a change in the processes since clinical practice guidelines are facilitated through the system. The clinical practice guidelines in the EMR hence mapped to processes in the quality of care framework. Health care providers undergo a week-long training to understand how the guidelines are implemented in the EMR.

Several studies have assessed the impact of EMRs on clinicians’ adherence to CPGs. A study was carried out where an EMR was assessed in terms of improving performance of health care providers. Improved performance was defined as reflecting accurate and detailed information about actionable, evidence-based indicators of health care outcomes and indicators. Care standards from reviewed literature on diabetes were then identified. These care standards were assessed, using two implementations of EMRs in which one EMR had alerts and reminders attached to an encounter and the other did not. Performance of these two implementations was then compared (Cebul 2008:66).

A similar study to the one above was carried out in the ART setting that entailed an assessment of the impact of providing CD4 reminders on caregivers carrying out CD4 tests at the required time. This was a prospective study that compared the findings to instances when reminders were not being provided in the clinical setting (Were, Changyu, Tierney, Mamlin, Biondich, Li, Kimaiyo & Mamlin 2011).

An evaluation of reminders that are delivered in a point-of-care setting on clinicians’ behaviour has also previously been done (Shojania, Jennings, Mayhew, Ramsay,
Eccles & Grimshaw 2010). This was a quasi-experimental study that assessed the impact of reminders on adherence to care practices in cases where reminders are delivered at the point of care.

Provision of CPGs in health facilities with limited professionally trained health personnel can result in an improvement of quality of care delivered to patients.

In the light of the studies that have been cited above, this study thus resolved that there was a possibility of an EMR changing clinicians’ adherence to prescription of CPT. The quality-of-care framework as suggested by Peabody et al. (2006:194), was thus used for this study to assess the impact of EMRs on clinicians’ adherence to prescription of CPT.

1.8 RESEARCH DESIGN AND METHOD

A quantitative study paradigm, with a historically controlled (before and after) study design was used (Friedman & Wyatt 2000:199). The research design is explained in detail in chapter 3.

1.9 CONCLUSION

The chapter gave an overview of this study. The source of the problem statement was discussed. The research question and research objectives were also presented. These were presented in the context of a quality of care framework. An overview of the research paradigm was also provided. The next chapter will present the literature review.
CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The research question of this study was to determine whether an EMR has any effect on the CPG of prescribing CPT by health care providers in selected health facilities. The purpose of this question was to gather evidence to support the notion that an EMR can improve adherence to prescription of CPGs by using the example of CPT. In view of this, journal articles and books that assess the impact of EMR on care delivery that uses CPGs were reviewed and synthesised.

2.2 PURPOSE OF LITERATURE REVIEW

A literature review is the process of taking stock of existing knowledge in order to make informed choices about policy, practice, research direction and resource allocation (Joubert, Ehrlich, Katzenellenbogen & Karim 2007:66). Literature review for this study was thus done in order to understand impact studies of EMRs on adherence to CPGs that have been done before. The literature review was also done to help to put into context the findings of this research, in relation to previous research that has been done in this area.

Peer reviewed journals, textbooks, the World Health Organization (WHO) website and the Malawi Ministry of Health documents were accessed to find relevant information on implementing EMRs and their effect on care processes.

2.3 OVERVIEW OF EMR IMPLEMENTATIONS IN HEALTH FACILITIES

Implementation of purpose-built EMRs can improve patient care and monitoring and evaluation in developing countries (Forster, Bailey, Brinkhof, Graber, Boulle, Spohr, Balestre, May, Keiser, Jahn & Egger 2008:2). EMR development has thus progressed to address various needs in health facilities. Although implementation of EMR in
developing countries started with aggregation systems, most countries are now moving towards implementing complete patient record EMRs (Fraser & Blaya 2010:236).

Whilst the implementation of EMRs in developed countries has been influenced by health insurance programmes, disease burden in developing countries has influenced the development of EMR. This has seen the spawning of several programmes that require better management of patient care records. HIV/AIDS is a pandemic that has prompted significant changes in the health delivery system. Of particular importance has been the need for better management of clinic resources using innovative approaches since the HIV/AIDS pandemic has given rise to additional burdens on care delivery. EMR has been the innovation adopted by most ART programmes in resource constrained settings (Were et al. 2011:150). An example can be found in nutritional feeding for HIV/AIDS patients that requires correct identification and prescription of foodstuffs for all eligible patients. This experience has necessitated the development of an EMR to manage food supplies in Kenya. The system has seen the programme’s ability to manage patients grow from 2000 to 30,000 per week (Lim, Yih, Gichunge, Tierney, Tung, Le Zhang, Lawley, Tomeka, Petersen & Mamlin 2009). However, despite its success, this system is used retrospectively and may, therefore, not have a direct impact on patient care. All the same, it does impact on identification of eligible patients and managing logistics for food distribution.

Other implementations of EMRs in developing countries have been influenced by research studies (Fraser, Thomas, Garcia, Lecca, Murray & Becerra 2012:2). This has been the case in Peru where an EMR was extended to collect data for a multi-drug-resistant tuberculosis study. This is a different approach to implementing EMR because the data were collected from part of an already existing EMR. Fraser et al. (2012:8), further argue that this presents an opportunity to build on the patient record for other observations that the patient might have at a facility during the course of the study. However, like the EMR implemented in Kenya by the AMPATH group above, this system is used retrospectively and hence does not provide a chance to evaluate the impact of the information resource on patient care in real time. Fraser & Blaya (2010:234), next point out that patient care can be improved with this setup owing to faster data entry and subsequent decision support that can be presented to clinical staff.
on paper forms. However, delays in back data entries make harnessing of this advantage almost impossible.

Drug Resources Enhancement against AIDS and Malnutrition (DREAM) is a project that strives to facilitate holistic management of patients enrolled in the ART programme by matching it with the gold standard for managing patients enrolled in the ART programme (Nucita, Bernava, Bartolo, Pane Masi, Giglio, Peroni, Pizzimenti & Palombi, 2009:2). The implementation focuses on patient epidemiological analysis in order to improve patient management in the ART clinics and find better ways of dealing with patients enrolled in the ART programme. The system also integrates with tele-consultation with HIV/AIDS specialists to enable physicians in low-resource settings to access expert advice on managing complicated cases. This system was influenced by a vision of providing optimum care to patients enrolled in the ART clinics.

2.4 IMPACT OF EMR ON PATIENT CARE

EMRs have the potential to improve patient care. This observation was made upon reviewing different studies that have demonstrated that there is improvement in care delivery where an EMR is implemented (Blaya et al. 2010:248).

Impact studies of EMR have usually focused on the following key areas:

- Improving staff productivity
- Reducing patient wait times
- Improving staff satisfaction
- Providing higher quality of data to personnel
- Improving the care provided to patients

Impact can be measured by looking at patient treatment outcomes after introduction of an intervention. However this can overshadow the adherence to CPGs by health care providers in cases there was an adverse outcome regardless of the correct care processes being followed. Therefore impact can also be measured by assessing adherence to best or recommended clinical practice. The EMR is a tool that can be
used to measure adherence to CPGs (Piette, Lun, Moura, Fraser, Mechael, Powell & Khoja 2012:90).

CPGs can be presented actively during a health care provider and patient encounter using an EMR or while being pre-processed using an EMR and presenting them as reminders on paper-based forms.

A randomised control study where reminders were actively turned on in one EMR implementation and turned off in another implementation was carried out in order to observe the impact on outcomes for patients enrolled in a diabetes programme where an EMR was used. The study observed an increase in ordering of tests for patients that were seen with input from an active reminder system (Cebul 2008:73). This is therefore an example of an information resource having an impact on care processes.

2.5 CARE DELIVERY IN HIV/AIDS CLINICS

The World Health Organisation released best care practices for managing patients enrolled in HIV/AIDS programmes (World Health Organization, 2010). These best practices have been translated into clinical practice guidelines relevant to different settings by implementing countries.

Provider adherence to CPGs and recommended care practices has proven difficult in most care settings (Trafton, Martins, Michel, Wang, Tu, Clark, Elliott, Vucic, Balt, Clark, Sintek, Rosenberg, Daniels & Goldstein 2010:1). This is evidenced in low-resource settings in particular where adherence to best practices for patient care is often lagging despite adoption of CPGs (Rowe et al. 2005:1026). This lack of adherence usually results in preventable deaths. Opportunistic infections tend to affect PLWHA and are a cause of high levels of morbidity and mortality (Seddon & Bhagani 2011:19). CPT has been in use as an antimicrobial agent that reduces morbidity and mortality in developed countries for a long time with positive results (Seddon & Bhagani 2011:24). Consequently, the WHO/UNAIDS released provisional recommendations for the routine use of CPT in HIV-positive adults and children in Africa in the year 2000 (World Health Organization 2001) based on evidence that CPT can reduce mortality and morbidity.
Implementation in the developing world, particularly in Africa, was delayed because it required epidemiological research in order to ascertain the efficacy of CPT in PLWHA in this region (Hutchinson, Phiri, Gibb, Chishinga, Benson & Hoskins, 2011:2). This was due to some physiological conditions such as high resistance to CPT in some regions of the developing world. After further research and policy change in ART implementing programmes, CPT was first implemented as part of the routine ART program in the year 2005 in sub-Saharan African countries. Malawi, Zambia and Uganda were the countries that incorporated CPT in their standard ART protocol (Hutchinson et al. 2011:6).

2.5.1 Implementing CPT as part of the national ART guidelines

CPT reduced mortality in adult patients enrolled in the ART program by over 40 percent in Malawi (Lowrance et al. 2007:56). With these results the Malawi HIV/AIDS programme stepped up its efforts to roll out CPT beyond pilot districts that were administering CPT to patients enrolled in ART programmes. It thus included CPT as part of the Malawi national ART CPGs and rolled out its distribution in ART clinics nationally by 2007. The CPGs thus guide health care providers in providing care to patients. A study on implementing nurse-initiated and managed antiretroviral treatment (NIMART) in South Africa recommend that well-defined CPGs are necessary to improve management of patients in an environment where there is task shifting and high volumes of patients (Georgeu, Colvin, Lewis, Fairall, Bachmann, Zwarenstein, Benson & Bateman 2012:11).

In addition to implementing CPGs as a way of improving standard care, implementing countries are looking at ways of using technology to improve adherence to CPGs. The HIV/AIDS department in Malawi has been rolling out a point-of-care EMR in high-volume ART clinics to improve monitoring and evaluation as well as influencing standard care by embedding CPGs in the development of the EMR (Douglas et al. 2010:2).

2.6 ASSESSING AN INFORMATION RESOURCE ON CARE PRACTICES

Four major aspects can be assessed when evaluating an information resource. These areas are encompassed in (Friedman & Wyatt 2000:6) the following:
• **Need for the resource**

Evaluations study the clinical status quo absent from the resource: the nature of problems the resource is intended to address and how frequently these problems arise.

• *Development process:* Evaluators study the skills of the development team and methodologies they employed, to understand if the design is likely to be sound.

• *Resource’s intrinsic structure:* The focus of the evaluation includes specification, flow charts, programme code and other representations of the resource that can be inspected without actually running it.

• *Resource’s functions:* The focus is on how the resource performs when it is used.

• *Resource’s impact:* The focus switches from the resource itself to its impact on users, patients, and health care organisations.

This study focused on assessing the impact of an information resource on clinicians’ adherence to CPT prescription. Information on evaluation of EMR on patient care processes in resource constrained settings is scant (Blaya et al. 2010:244). This study therefore aimed at adding to the body of knowledge on impact of EMR on care processes in resource-constrained settings.

The studies cited above acknowledge that an information resource can influence care delivery. The literature however also acknowledges that there are gaps in analytical studies that have critically looked at the impact of information resources on care processes. Therefore this study was a necessary step in providing evidence on the impact of an information resource in low-resource settings.

2.7 **CONCLUSION**

The chapter presented the literature review in line with the research question and the research objectives. The literature review discussed implementation of EMR systems in health facilities and their impact on quality of care. This chapter also discussed the importance of CPT in HIV/AIDS treatment. The literature review exposed that there are gaps in analytical studies where the impact of EMR on care delivery is assessed. The next chapter will discuss the research design and methodology.
CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

*Research design* refers to the structured approach followed by researchers to answer a given research question (Joubert et al. 2007:77). Several aspects need to be addressed in a research design in order to increase plausibility of the research findings. This is achieved by specifying the study design, the target population, the selection criteria for the target population, size of the study population as well as specifying approaches that are required to uphold good research ethics. These aspects were tackled in this chapter.

3.2 RESEARCH DESIGN

This is the blueprint for conducting a study that maximises control over factors that could interfere with the validity of the findings (Burns & Grove 2005:211). Study designs can fall into two broad categories: quantitative study designs and qualitative study designs. This study was a quantitative study. Quantitative methods to evaluate an information resource can fall into descriptive evaluation, correlational evaluation and comparative evaluation (Friedman & Wyatt 2000:156). A comparative quantitative study paradigm, with a historically controlled (before and after) study design was used for this study (Friedman & Wyatt 2000:165).

3.3 QUANTITATIVE STUDY DESIGN

This is a formal, objective, systematic process in which numerical data are used to obtain information about the world. This approach is used to examine variables, relationships between variables or cause and effect between variables (Burns & Grove 2005:23). Quantitative research designs can be basic or applied, in which the former focuses on adding to the existing body of scientific knowledge whilst the latter focuses
on changing the current clinical practice (Burns & Grove 2005:23). This study fell under applied research since the results of the findings apply to an existing installed EMR.

3.4 POPULATION AND SAMPLING

*Population* refers to the entire set of individuals or elements that meet the sampling criteria (Burns & Grove 2005:342). Studies usually select only a subset of the population in order to answer a research question. This is called sampling. *Sampling* involves selecting a group of people, events, behaviours, or other elements with which to conduct a study (Burns & Grove 2005:341).

This study selected all the patient records that met the inclusion criteria as specified in section 3.5.4. All records that met these criteria were selected because they were in electronic format and the effort of selecting all these records was no greater than selecting a subset of the records.

3.4.1 Site sampling

This study took place in Malawi, Africa. ART clinics at Zomba Central Hospital and Dedza District Hospital were chosen. Two sites were selected in order to increase the representation of the results.

3.4.2 Site sampling frame

*Sampling frame* refers to the list or some representation of the study population (Joubert et al. 2007:95). All the ART clinics in Malawi constituted the site sampling frame.

3.4.3 Accessible sites

*Accessible population* refers to the proportion of the population which a researcher has reasonable access to (Burns & Grove 2005:342). Zomba Central Hospital and Dedza District Hospitals were the accessible clinics for this study.
3.4.4 Site sampling technique

*Sampling technique* is the method that is used in selecting a group of people, events, behaviours or other elements (Burns & Grove 2005:346). *Purposive sampling* was used to select Zomba and Dedza as the study sites. These health facilities were convenient for the following reasons:

1. Both facilities had a paper-based system before adopting the ART EMR.
2. All paper-based records have been migrated verbatim into an electronic database.
3. EMRs have been deployed at both Dedza and Zomba ART clinic and patient visits are now managed through the EMR.

3.5 DATA SOURCE SAMPLING

Electronic databases were used as the source of the data for this study. These were patient records at Zomba Central Hospital and Dedza District Hospital. For Zomba Central Hospital the period that was considered for data extraction was: August 2009 to July 2010 (pre-EMR) and August 2010 to July 2011 (post-EMR).

For Dedza District Hospital this period was: October 2006 to September 2007 (pre-EMR) and October 2007 to September 2008 (post-EMR). This data set was relevant for interpretation since the measurement of interest was the introduction of the EMR and its impact immediately after introducing the EMR on CPT prescribing.

3.5.1 Respondent/participant target population

All records of patient visits at Dedza and Zomba ART clinics were selected, based on the study period.
3.5.2 Respondent/participant sample frame

All records of patient visits during the study period formed the sampling frame.

3.5.3 Respondent/participant accessible population

All records of patient visits at Zomba and Dedza Hospitals that met the inclusion criteria within the study period formed the accessible population.

3.5.4 Respondent/participant sampling technique

Convenience sampling was used to select participants in this study. This was arrived at by considering the following selection criteria: (1) all pregnant women, (2) all adults with CD4 count less than 500, and (3) all patient visits with HIV disease in stages 2, 3 or 4. These formed the inclusion criteria. These inclusion criteria were influenced by the CPT guideline which isolates these patients as groups that should be given prescriptions for CPT (World Health Organization 2001).

3.6 RESPONDENT/PARTICIPANT SAMPLE SIZE

There were 136,375 patient records that met the prescription criteria for CPT within the study period. The 95 percent confidence level with 5 percent confidence interval resulted in a sample size of 383 patient records. Since the effort of selecting these 383 records was similar to selecting all records, the researcher decided to use all the patient visit records. Joubert et al. (2007:143) illustrate that a larger sample size minimises the sampling error. Since all records were selected, the researcher minimised the sampling error.

3.7 DATA COLLECTION

All paper-based records were routinely back entered into an electronic database verbatim before the EMR was deployed. After the system was commissioned, the data were directly entered by health care providers in the course of routine care delivery. Therefore the data for both before the EMR and after the EMR were in electronic format.
Database queries were used to extract the data on the CPT prescription in the different groups of patients before and after introduction of the EMR. Database queries look at different criteria for selecting patient records in tables (Beaulieu 2005:2). The database structure that the EMR uses is based on the Open MRS data model (www.openmrs.org) version 1.1 (Wolfe, Mamlin, Biondich, Fraser, Jazayeri, Allen, Miranda & Tierney 2006:1146).

3.8 DATA MANAGEMENT AND ANALYSIS

3.8.1 Descriptive statistics

Count statistics on characteristics of the population, such as age groups of patients that were prescribed with CPT, were assessed. This was done in order to assess homogeneity in the results within the demographic characteristics.

3.8.2 Inferential statistics.

Proportions of patients that fall within the identified guidelines pre-EMR and post-EMR implementation were compared, using chi-square test. A p-value < 0.05 was considered statistically significant.

An example of a two-by-two table, using mock data is shown below:

Table 3.1 Sample chi-squared test

<table>
<thead>
<tr>
<th>Patient count</th>
<th>Number of no CPT prescriptions</th>
<th>Number of CPT prescriptions</th>
<th>Total patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 months prior to EMR go-live</td>
<td>1,572 (59%)</td>
<td>1,991 (62%)</td>
<td>3,563</td>
</tr>
<tr>
<td>12 months post EMR go-live</td>
<td>1,085 (41%)</td>
<td>1,205 (38%)</td>
<td>2,290</td>
</tr>
<tr>
<td>Total number of patients</td>
<td>2,657</td>
<td>3,196</td>
<td>5,853</td>
</tr>
</tbody>
</table>

Pearson chi-square statistic = 5.9760  Pr = 0.015
3.8.3 Data analysis software

The data were analysed, using free and open source statistical software called R (R Development Core Team 2011).

3.9 DATA AND DESIGN QUALITY

3.9.1 Internal validity

This is the extent to which the effects detected in the study are a true reflection of reality rather than being extraneous variables. The main target of studies that deal with causality is internal validity (Burns & Grove 2005:215). A number of extraneous factors could have affected this research study based on the choice of the study design. In order to minimise the effect of these extraneous factors, the study took the following measures:

- Eliminated any interval before and after implementing the EMR. This reduced the chance that other factors surrounding CPT prescription could have affected CPT prescription.
- Standard ART guideline training offered by the MoH made sure that the health care providers working in the health facilities did not have an upper hand in the period preceding the deployment of the EMR and immediately after implementing the EMR.
- Ensured that all patients and their visits were entered verbatim into the EMR system in the period preceding the implementation of the EMR.

3.9.2 External validity

This refers to the extent to which the study designs are generalisable beyond the sample used in the population (Burns & Grove 2005:219). External validity can be affected by the size of the sample. Since this study measured adherence to CPT prescribing guidelines at two different health facilities, consistent findings across both facilities were generalisable to other clinics of the same type. The sample size of the
CPT prescriptions was also representative – hence the ability to generalise these findings.

3.10 DATA-GATHERING INSTRUMENT

3.10.1 Reliability

Reliability assesses the consistency of a data-gathering tool in terms of consistency in the event that repeated tests are performed with the same tool. Reliability of the data-collection tool will be ensured since standard definitions of the variables being assessed, will be used. These definitions are derived from the Malawi MoH ART guidelines.

3.10.2 Validity

Validity of a research instrument measures the extent to which the instrument measures what it said it would measure at the outset (Keele 2011:28). Since this research used data that were extracted from a national database, validity was achieved. This is achieved because the national database is defined in line with national guidelines and the data are verified by the MoH through routine quarterly supervision visits.

3.11 ETHICAL CONSIDERATIONS

3.11.1 Introduction

Joubert et al. (2007:31) define public health ethics as principles and values that help guide actions among public health system actors, which are designed to promote health and prevent injury and disease in a population. This study assessed ethics by looking at several aspects such as the participants in the study, the site where the study was conducted and the data sources. These aspects are discussed below.
3.11.2 Participants/human data sources

This study did not collect any data from human subjects, hence did not require any consent forms.

3.11.3 The study site/Institution

A letter of approval was provided by the Malawi Ministry of Health's Central Monitoring and Evaluation Division (depicted as annexe 3). This division is responsible for all medical records in the country.

3.11.4 Domain-specific ethical issues

The following ethical issues relating to the research methodology and design and the research topic in general as reflected in literature, were included:

- *Privacy and confidentiality of patient records:* This study directly accessed the records of HIV-positive patients. In an area where stigma issues are high for people who are HIV-positive, privacy and confidentiality were of prime importance. This was achieved by removing the identities from the records of patient visits selected in this study.

- *Privacy and confidentiality of clinicians’ performance:* This study measured adherence of clinicians to prescribing cotrimoxazole. The records that were accessed had identifiers that could be linked to clinician names, thus posing a possibility of being reprimanded if they did not adhere to prescribing cotrimoxazole. This study removed the clinician identifiers in order to uphold the privacy of the health care providers.

- Maintaining *privacy of the location where the research was conducted* was of prime importance since this could affect care delivery at the facilities. This study masked the sites in the research title by not directly referring to them.

This study was also approved by the UNISA ethical clearance committee. A letter of approval has been represented as annex 1.
3.12 CONCLUSION

The chapter addressed the study design and method. The design of this study was influenced by the research question and similar studies that have been done. Issues ranging from sample selection to ethics of the study were also addressed in order to adhere to best practices of scientific research. The next chapter will present the results of the study.
CHAPTER 4

ANALYSIS, PRESENTATION AND DESCRIPTION OF THE RESEARCH FINDINGS

4.1 INTRODUCTION

Chapter 3 presented the study design where the approach for collecting data and the data analysis plan was discussed. The aim of this study was to assess the impact of an EMR on prescription of CPT to patients enrolled in an ART clinic in two selected health facilities. This chapter thus presents the findings of this research with focus on the research objectives.

4.2 DATA MANAGEMENT AND ANALYSIS

Patient visit data were collected in order to answer the research question on the impact of an EMR on CPT prescription one year before and one year after implementation of the EMR at two selected health facilities. The patient and health care provider identifiers were removed from the data before being handed over to the researcher. The researcher designed and ran database queries to extract data required to answer the research question and meet the research objectives. The database queries were validated by the developers of the EMR in order to make sure that correct data were extracted. The database queries were executed using a database management system called MySQL. Spreadsheet package from Open Office foundation was used to view the extracted data. These data were then analysed using the R-Core statistical package (R Development Core Team 2011). The results of this study have thus been presented according to the data analysis plan.

4.3 RESEARCH RESULTS

The results of this study are presented below:
4.3.1 Sample characteristics

This study focused on prescription of CPT to patients who met stipulated WHO CPT prescription criteria. The total number of patients who visited the two health facilities during the period of the study was 50,538. These patients made a total of 136,375 visits to the health facilities. Of these visits, 65 percent were made by female patients and the remainder (35%), were made by male patients.

4.3.2 Visits of patients before and after implementation of the EMR

It is observed that CPT prescription before and after implementation of the EMR differed in the two health facilities. Whilst there was an increase in CPT prescription at Dedza District Hospital after implementation of the EMR, there was a decrease in the prescription of CPT at Zomba Central Hospital. Specifically Dedza District Hospital had an average CPT prescription of 14 percent before implementing the EMR and 64 percent after implementation of the EMR.

The prescription pattern at Dedza was further broken down by month in order to understand the prescription habits of CPT to eligible groups as depicted below:

![Figure 4.1 CPT prescribing at Dedza District Hospital](image)
The data show that there was an increase in CPT prescription after implementing the EMR at Dedza District Hospital. This increment is confirmed as significant after performing a chi-square test that indicates a p-value < 0.05. Although this is the case, it can be observed that the data in the period before were not complete, with gaps in two months before implementing the EMR. This then points to the fact that this significant difference could have been due to other extraneous factors.

In contrast to Dedza District Hospital, the data show that Zomba Central Hospital experienced a decrease in CPT prescription during the one-year period following the implementation of the EMR. This can be observed as presented below:

![Figure 4.2 CPT prescribing at Zomba Central Hospital](image)

Of eligible patients that visited Zomba Central Hospital during the one year before implementing the EMR, 95 percent had a CPT prescription, compared to 88 percent that had a CPT prescription during the one year following the implementation of the EMR. This indicates that there was a decline in CPT prescribing at Zomba Central Hospital after implementing the EMR.
4.3.3 Significance of differences in CPT prescription at the two health facilities

The research question of this study was to determine whether an EMR influenced prescription of CPT one year before its implementation and one year after its implementation. The CPT prescription for the two facilities was thus compared using the chi-squared test in order to assess the significance of the differences. The significance was measured at the 0.05 significance level. Studies that demonstrate the effect of an information resource on given care practices commonly use the chi-squared test to measure (Friedman & Wyatt 2000:227). The table below presents the discrete observations for Zomba Central Hospital.

Table 4.1 Comparison of the number of CPT prescriptions before and after EMR implementation at Zamba Central Hospital

<table>
<thead>
<tr>
<th></th>
<th>Number without CPT prescriptions</th>
<th>Number with CPT prescriptions</th>
<th>Chi-Square</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before EMR</td>
<td>1,745 (5%)</td>
<td>33,162 (95%)</td>
<td>1157.90</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>After EMR</td>
<td>4,495 (12%)</td>
<td>36,628 (88%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The chi-squared statistic resolves to P < 0.001 which is less than the significance level (P=0.05) which indicates that there was a significant difference in CPT prescribing before and after the introduction of the EMR at Zomba Central Hospital.

Table 4.2 Comparison of the number of CPT prescriptions before and after EMR implementation at Dedza District Hospital

<table>
<thead>
<tr>
<th></th>
<th>Number without CPT Prescriptions</th>
<th>Number with CPT Prescriptions</th>
<th>Chi-square</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before EMR</td>
<td>1,723 (86%)</td>
<td>281 (14%)</td>
<td>1585.062</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>After EMR</td>
<td>2,699 (36%)</td>
<td>4,797 (64%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

However the test statistic for Dedza District Hospital indicates that there was a significant increase in the prescription of CPT after implementation of the EMR. Exploratory data analysis of Dedza suggests that there were some gaps in the data on CPT prescription before implementation of the EMR. The gaps were there because CPT
prescription was not being consistently documented before the EMR was implemented even in cases where CPT was actually prescribed. This is a confounder to the prescription of CPT as it skews the results towards a significant difference when in fact the data was not complete.

4.4 SUMMARY

Implementation of an EMR at two selected health facilities resulted in different habits of prescribing CPT at the two health facilities. However, Zomba Central Hospital had more complete data than Dedza District Hospital. It was observed that the information resource at Zomba Central Hospital resulted in lower CPT prescription.

4.5 CONCLUSION

The EMR data showed a significant decrease in the prescription of CPT at Zomba Central Hospital. Although there was a significant increase in prescribing CPT at Dedza District Hospital after implementing the EMR system, this is probably due to incomplete data as observed in the month-by-month CPT prescription and hence cannot be attributed to the EMR.
CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

Chapter 4 described the research data analysis, presentation and description of the research findings. This chapter summarises the study, and provides the research overview, conclusions, and limitations. This chapter also presents things to consider for an effective EMR implementation.

5.2 RESEARCH DESIGN AND METHOD

A historically controlled study design (Friedman & Wyatt 2000:199) was conducted. This design was evaluated following a before-and-after setup in order to assess the impact of an information resource. This study was done by extracting data from a database management system which had its data entered verbatim in an electronic database. The data were extracted from two ART clinics during one year before implementation of an EMR and one year immediately after implementation of an EMR. Patient visits that individually had a CPT prescription based on WHO criteria for CPT prescription were included in this study.

Patients selected for this study numbered 50,538. These patients made a total 136,375 visits to the two selected ART clinics. These patients were extracted from an electronic database using database queries. The database queries were verified by the developers of the EMR, Baobab Health Trust (Douglas et al. 2010:2). The data were then entered into a spreadsheet package and later analysed by the researcher using R statistical package (R Development Core Team 2011).
5.3 SUMMARY AND INTERPRETATION OF THE RESEARCH FINDINGS

This study originally set out to find clinician habits of prescribing CPT to patients who met one or more of three WHO criteria as shown below:

(1) all pregnant women
(2) all adults with CD4 count less than 500
(3) all patient visits with HIV disease in stage 2, 3 or 4

However, it was noted during analysis of the data that there is no clear precedence of any of the above factors in determining that a patient started due to only a single factor. The realisation also arose that individual patients could have been initiated due to one condition and then later on developed another condition that would make them eligible for CPT prescription. In the light of this complexity, the researcher made the decision to isolate only single eligibility conditions for the patients and then to classify eligibility of CPT prescription based on this single criterion. This prevented double counting of patients. The resultant interpretation of research findings is presented below:

5.3.1 CPT prescription before and after implementation of an EMR at Dedza District Hospital and Zomba Central Hospital ART clinics

The percentage of patient visits where CPT was prescribed and CPT was not prescribed were compared one year before implementation of the EMR and one year immediately after implementing the EMR. The prescription was stratified by month to better understand the prescribing habits of CPT. The data indicate that CPT prescription percentage increased during the one year after implementing the EMR at Dedza District Hospital from an average of 14 percent to 64 percent after implementing the EMR. Further observation in the period before, indicates that CPT was not prescribed in 86 percent of the visits before the EMR. In fact, the 14 percent prescription rate in the preceding period indeed shows some months where CPT was not prescribed at all. The researcher attempted to find an explanation for this by contacting the facility and was informed that, in the period before the introduction of the EMR, the patient chart did not have a field for documenting CPT. This prompted clinicians to improvise
documenting CPT in a remarks field and this, again, was not consistently documented. The researcher thus sees this as potential for bias in testing the significance of this increased prescription of CPT after implementing the EMR.

On the other hand, the data indicate that CPT prescription at the Zomba Central Hospital ART clinic declined from 95 percent to 88 percent after introducing the EMR. The data for Zomba Central Hospital were complete and the patient chart had a CPT field that enabled documentation of CPT. This decrease was further analysed for significance using the Pearson Chi-squared test (Betty & Jonathan 2003:166) at 0.05 significance level. A p-value of <0.001 was observed and, since this is <0.05, the conclusion to be drawn is that there was a significant decline in CPT prescription one year after implementation of the EMR.

5.4 CONCLUSIONS OF THE STUDY

Despite an increase in implementation of the EMR in developing countries, there is still a need to assess the implementation of these systems in order to harness the benefits of the EMRs. The data obtained from this study indicates that there was a significant decline in prescription of CPT at Zomba Central Hospital which had more complete data as compared to Dedza District Hospital which had incomplete data. Based on this fact, the researcher concludes that there is insufficient evidence to support the findings of the study at Dedza.

The findings in this study require further interpretation particularly by mapping the care framework to the settings where this study took place. The care framework as stated in chapter 1, section 1.7 has three elements that can be mapped as below to the setting of this study:
Prescribing of CPT was the process that was supposed to be measured in this study. In order to adequately measure this, the structural inputs need to be in place. The EMR is a structural input that was introduced at the facility to help with monitoring and evaluation but also to improve patient outcomes. This study, however, shows that that implementation of an EMR will not automatically result in improved adherence to processes. In a resource-limited setting other structural processes seem to be required for an intervention to be available. One of the challenges of complying with clinical practice guidelines in low resource settings is the shortage of essential of commodities to be distributed once a criterion has been met. A report on Malaria prevention where insecticide-treated bed nets (ITN) were the intervention in Mozambique indicated that a key challenge to increasing adherence to prescription of ITNs was the availability of the commodity (Brentlinger et al., Dgedge, Correia, Rojas, Saúte, Gimbel-Sherr, Stubbs, Mercer & Gloyd 2007:876). This experience in Mozambique is not alien to Malawi where the country usually faces drug stock outs. In situations such as these clinicians usually do not actively prescribe drugs since they know that the drugs are out of stock.

In the light of the background that there are several other factors that influence the outcome of an intervention, the researcher proposes that, over and above the current
criteria which use the volume of patients at a facility, a process should be followed when implementing EMR. And, as proposed by Were & Meslin (2011:1503), these criteria can be an adaptation of the framework of points to consider when implementing and EMR.

5.5 RECOMMENDATIONS

For an EMR implementation to work effectively as an intervention, the documentation of the care process needs to be tightly coupled with the care process itself. The researcher thus makes the following recommendations mainly to the Malawi Ministry of Health, Department of HIV and AIDS. These recommendations will help the MoH to further understand the impact of the EMR on care processes and harness key outputs from the EMR.

- Isolate care processes into variables that should be collected as part of patient care in order to ably assess the impact of the EMR after its implementation.
- Ensure that drug commodities (e.g. cotrimoxazole) are available in order to ensure make sure that the care framework is realised. It seems that absence of commodities affects adherence to guidelines.
- Advise the developers of the EMR to give feedback to caregivers to include reporting of adherence to care protocols in routine reporting.
- Include monitoring of care indicators in routine supervision that should be driven by observations made during the patient and clinician encounters. The care indicators should inform mentorship programmes.

5.6 CONTRIBUTIONS OF THE STUDY

The results of this study have contributed to the body of evidence around the impact of an information resource on adherence to CPGs in prescribing of CPT in two selected health facilities in Malawi. This is important because it exposes the fact that implementation of an EMR does not necessarily improve adherence to CPGs. The mapping of the care framework to the setting on the ground provides an opportunity to design measurement of impact of information resources before they are implemented in various health facilities.
5.7 LIMITATIONS OF THE STUDY

This study has been conducted and concluded despite some limitations as stated below:

- Site population: This study sampled only two facilities that have the EMR. This was because these were the only sites that had their data entered verbatim before implementation of the EMR. Therefore it is not possible to generalise the results to all facilities that have an EMR. However, despite this limitation, the operation and design of the EMRs in other facilities is the same, hence the researcher believes that there will not be much variation in the other facilities.

- Incompleteness of data in the Dedza data set skewed the interpretation of this study. The researcher did not have any way of retrieving this data since it was not documented anywhere. In the light of this, the researcher has highlighted this as a challenge that makes it hard to measure adherence to CPGs even in situations where there are no EMRs. Thus, due to the information resource, researcher has not used the Dedza data set to arrive at a conclusion of a significant difference.

- Although historically controlled designs exemplify a study design commonly used in evaluating information, resources limited the researcher to the situation that was found in the results. A historically controlled study design also increases the potential of committing a type 2 error where we fail to reject the fact that there is no difference (Friedman & Wyatt 2000:200). In this study the null hypothesis was that there is no difference. However, the Dedza data set indicated that there was a significant difference. This was despite the fact that the data were incomplete.

5.8 CONCLUDING REMARKS

A national scale-up of EMR in Malawi continues to happen in high burden ART facilities. This indicates that the HIV/AIDS Department sees the benefits of reporting the EMR during its supervision visits. Despite the above-stated limitations, this study has exposed the fact that there is no evidence that EMR has a direct care benefit surrounding the prescription of CPT. This is a contribution to the body of knowledge in the country but also in the developing world where descriptions of systems are done
without any evaluation of their impact. The indication that the EMR did not influence prescription of CPT brings to light the need to implement the recommendations stated in section 5.5 above if the benefits of the EMR implementation work are to be realised.
LIST OF REFERENCES


________________________
ANNEXE 1: ETHICAL CLEARANCE CERTIFICATE

UNIVERSITY OF SOUTH AFRICA
Health Studies Higher Degrees Committee
College of Human Sciences
ETHICAL CLEARANCE CERTIFICATE

HSHDC/115/2012

Date: 12 December 2012

Student No: 4193-662-5

Project Title: Prescribing Co-trimoxazole Prophylactic Therapy before and after electronic medical record system implementation in two selected hospitals in Malawi

Researcher: Oliver Jinta Gadaba

Degree: Masters in Public Health

Code: D154653

Supervisor: Prof BL Dolamo

Qualification: D Cur

Joint Supervisor: Dr G Douglas

DECISION OF COMMITTEE

Approved [ ] Conditionally Approved [ ]

Prof L Roets
CHAIRPERSON: HEALTH STUDIES HIGHER DEGREES COMMITTEE

Dr MM Moleki
ACTING ACADEMIC CHAIRPERSON: DEPARTMENT OF HEALTH STUDIES

PLEASE QUOTE THE PROJECT NUMBER IN ALL ENQUIRIES
ANNEXE 2: CARE FRAMEWORK

(Adapted from Peabody et al. 2006: 194)
ANNEXE 3: LETTER OF APPROVAL

Dear Mr. Gadabu,

Re: Request for Data Access for the Research Proposal on “Prescribing Cotrimoxazole Prophylactic Therapy before and after electronic medical record system implementation in two selected hospitals in Malawi”

I would like to express support for the above study that you have shared with us.

This research proposal addresses an important question for the Ministry of Health on the prescribing CPT before and after implementation of an EMR in two selected health facilities. Prescription of CPT is important since it is a cheap prophylaxis for preventing bacterial infections in patients enrolled in the ART programme in Malawi.

As such we would like to grant permission for you to access the ART clinic databases of Zomba Central Hospital and Dedza District Hospital for the scope specified in your study.

I would like to encourage you to share the findings of your research with us once you have completed your research.

Yours faithfully,

[Signature]

Chris Moyo
For: SECRETARY FOR HEALTH