

UNIVERSITY OF KWAZULU-NATAL

THE RELATIONSHIP BETWEEN NURSE STAFFING AND
SELECTED PATIENT OUTCOMES IN CHUK
KIGALI – RWANDA

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UNIVERSITY OF KWAZULU NATAL

**THE RELATIONSHIP BETWEEN NURSE STAFFING AND
SELECTED PATIENT OUTCOMES**

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**PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
MASTERS IN NURSING MANAGEMENT**

BY

MBABAZI Perpetua

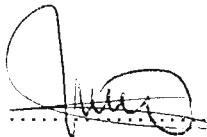
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November 2006

DECLARATION

I, MBABAZI Perpetua, declare that this dissertation titled "The relationships between nurse staffing and selected patient outcomes" is my original work. It has never been submitted for any other purpose, or at any other university. Sources of information utilized in this work have been acknowledged in the reference list.

Signature: 

Date: ...16/03/2007

DEDICATION

THIS DISSERTATION IS DEDICATED TO MY HUSBAND VIATEUR,
MOTHER- IN -LAW CHRISTIANA AND OUR CHILDREN BELYSE,
BLAISE, BENITHA, AND BELINE AND OTHER RELATIVES FOR ALL
THEIR LOVE, SUPPORT AND ENCOURAGEMENT

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ABSTRACT

This research study aimed at determining the relationships between nurse staffing and nurse sensitive outcomes (urinary tract infection, pressure ulcers, pneumonia, missed dose, wrong dose, and wrong drug) in the University Central Teaching Hospital of Kigali.

A retrospective, descriptive design guided the study. A purposive sampling method was used to select the unit of study. Patient files were selected ($n = 797$) and reviewed from the medical and surgical wards in February and March 2006. A checklist format was used to collect the data. The first instrument for data collection on staffing included the shifts, the categories of nurses, the total number of nurses and the patient census. The second instrument on adverse events included all events under study. Data collection was done by the researcher. A quantitative method was used to analyze data.

The results indicated a statistically significant relationship between pressure ulcers, pneumonia, and phlebitis and number of registered nurses. Risk of wound infection was statistically significant between both increased numbers of enrolled nurse and registered nurses as well as nurse: patient ratio. The findings also revealed a statistically significant protective relationship between pneumonia, missed dose, and phlebitis with increased nurse: patient ratio. The findings of this study revealed no statistically significant relationship were found between urinary tract infection, pneumonia, phlebitis, and missed medication dose and the mean number of enrolled nurses. There was no statistically significant relationship between urinary tract infection and missed medication dose and the mean number of registered nurses.

The result of this study suggests that there is an impact of nursing workload and expertise on patient outcomes.

LIST OF ABBREVIATIONS

CHUK	:	Central Hospital University Kigali
BTC	:	Belgian Technical Cooperation
SPSS	:	Statistical Package for Social Sciences
UKZN	:	University of KwaZulu Natal
WHO	:	World Health Organization
ICN	:	International Council of Nursing
UTI	:	Urinary Tract Infection
ANA	:	American Nurses Association
IOM	:	Institute Of Medicine
ADE	:	Adverse Drug Event
AHRQ	:	Agency for Healthcare Research and Quality.
AORN	:	Association of Perioperative Registered Nurses
JCAHO	:	Joint Commission on the Accreditation of Healthcare Organizations
NP	:	Nosocomial pneumonia
USA	:	Unites States of America
STT	:	Sigma Theta Tau
HAIs	:	Hospital Acquired Infections.

TABLE OF CONTENTS

DECLARATION.....	ii
DEDICATION.....	iii
ACKNOWLEDGEMENT.....	iv
ABSTRACT.....	vi
LIST OF ABBREVIATIONS.....	vii
LIST OF CONTENTS.....	ix
LIST OF GRAPHS.....	xii
LIST OF TABLES.....	xiii
LIST OF FIGURES.....	xiv
LIST OF APPENDICES.....	xv

CHAPTER ONE - INTRODUCTION

1.1 Background:	1
1.2 Setting	3
1.3 Problem statement	3
1.4 Research objectives.....	5
1.5 Research question	5
1.6 Significance of the study.....	6
1.7 Conceptual framework.....	7
1.7.1 Leadership.....	7
1.7.2 Staff expertise.....	7
1.7.3 Staff stability.....	7
1.7.4 Teamwork.....	8
1.7.5 Resources.....	8

1.7.6	Workload.....	8
1.7.7	Patient outcomes.....	9
1.8	Definition of terms.....	9
1.8.1	Medication errors.....	9
1.8.2	Pressure ulcers.....	9
1.8.3	Nurse sensitive outcomes.....	10
1.8.4	Wound infection.....	10
1.8.5	Nurse workload.....	10
1.8.6	Hospital Acquired Pneumonia.....	11
1.8.7	Phlebitis (inflammation of a vein).....	11
1.8.8	Nurse staffing.....	12
1.8.9	Urinary tract infection.....	12
1.8.10	Adverse events.....	12
1.8.11	Independent variables.....	12

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction	14
2.2 Nurse staffing and adverse patient outcomes.....	14
2.3 Nurse staffing and workload.....	21
2.4 Nurse expertise.....	22
2.5 Nurse staffing and medication errors.....	23
2.6 Nurse staffing and infection.....	26
2.7 Nurse staffing and surgical wound infection.....	29
2.8 Nurse staffing and pressure ulcers.....	29

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction	32
3.2 Study design	32
3.3 Study population.....	32
3.4 The sampling.....	33
3.5 The inclusion criteria.....	33
3.6 The exclusion criteria.....	33
3.7 The sample and sample size.....	34
3.8 Data collection instruments.....	34
3.9 Data collection process.....	35

3.10	Validity and reliability of instruments.....	35
3.11	Data analysis.....	36
3.12	Ethical Consideration.....	36
3.13	Limitation of the study.....	37

CHAPTER FOUR

DATA PRESENTATION AND FINDINGS

4.1	Introduction	38
4.2	Results.....	39
4.3	Indicators for documentation of an advent event.....	40
4.4	Population	41
4.5	Pilot study.....	41
4.5.1	Adverse events.....	42
4.5.2	Staffing data.....	42
4.5.3	Summary of the findings.....	43
4.6	Main study	43
4.6.1	Checklist instrument for adverse events.....	43
4.6.2	Hypothesis.....	43
4.6.4	Data analysis of adverse events.....	45
4.6.5	Analysis of adverse events on medical February.....	46
4.6.6	Analysis of adverse events on medical March.....	46
4.6.7	Analysis of adverse events on surgical February.....	47
4.6.8	Analysis of adverse events on surgical March.....	48

4.6.9 Instrument for staffing.....	48
4.6.10 Analysis of staffing data and patient census.....	48
4.6.11 Staffing data on medical unit March.....	49
4.6.12 Staffing data on surgical unit February.....	49
4.6.13 Staffing data on surgical March.....	50
4.7 Poisson regression.....	50
4.8 Mean nurse ratio and adverse events.....	69
4.8.1 Mean nurse patient ratio and adverse events.....	69
4.8.2 Mean nurse patient ratio and UTI.....	70
4.8.3 Mean nurse patient ratio and pressure ulces.....	70
4.8.4 Mean nurse patie ratio and wound infection.....	70
4.8.5 Mean nurse pateint ratio and pneumonia.....	70
4.8.6 Mean nurse patient ratio and missed dose.....	71
4.9 Summary of the findings.....	71

**CHAPTER FIVE
DISCUSSION**

5.1 Introduction	73
5.2 Mean number of nurses and adverse outcomes.....	73
5.3 Staff qualification and adverse patient outcomes.....	74
5.4 Nurse patient ratio and adverse outcomes.....	76
5.5 Recommendations.....	77
5.6 Conclusion.....	79

5.7 References	80
5.8 Appendices	

LIST OF GRAPH

4.2.1 Mean staffing for each unit on selected months.....	39
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LIST OF TABLES

4.6.3 Frequency and percentage of adverse event on medical and surgical.....	45
4.6.5 Adverse event on medical unit February 2006.....	46
4.6.6 Adverse events on medical unit March	46
4.6.7 Adverse event on surgical unit February.....	47
4.6.8 Adverse event on surgical unit March.....	48
4.6.10 staffing data on medical unit February.....	48
4.6.11 Staffing data on medical unit March.....	49
4.6.12 Staffing data on surgical unit February.....	49
4.6.13 Staffing data on surgical unit March.....	50

LIST OF FIGURES

4.7.1 Relationship between UTI and staffing data in medical and surgical	52
4.7.2 Relationship between pressure ulcers and staffing on medical surgical.....	53
4.7.3 Relationship between wound infection and staffing on medical surgical.....	54

4.7.4 Relationship between pneumonia and staffing on medical surgical.....	55
4.7.5 Relationship between phlebitis and staffing on medical and surgical	56
4.7.6 Aggregated data of missed dose with the staffing data on medical and surgical unit February and March.....	57
4.7.8 Relationship between UTI and RNs on medical and surgical units February and March.....	58
4.7.9 Staffing and adverse events of pressure ulcers and RNs on medical surgical	59
4.7.10 Relationship between wound infection and RNs on medical and surgical units February and March.....	60
4.7.11 Relationship between pneumonia and RNs on medical and surgical units February and March.....	61
4.7.12 Relationship between phlebitis and RNs on medical and surgical units February and March.....	61
4.7.13 Relationship between missed dose and RNs on medical and surgical units February and March.....	63
4.7.15 Relationship between UTI and ENs on medical and surgical units February and March.....	64
4.7.16 Relationship between pressure ulcers and ENs on medical and surgical units February and March.....	64
4.7.17 Relationship between wound infection and ENs on medical and surgical units February and March.....	66

4.7.18 Relationship between pneumonia and ENs on medical and surgical units February and March.....	67
4.7.19 Relationship between phlebitis and ENs on medical and surgical units February and March.....	68
4.7.20 Relationship between missed dose and ENs on medical and surgical unit February and March.....	69

LIST OF APPENDICES

Appendix A Data collection instrument.....	.i
Appendix B Nurse staffing instrument.....	.ii
Appendix C Information form.....	.iii
Appendix D Application for permission to conduct a research.....	.iv
Appendix E UKZN Ethical approval	
Appendix F a letter of hospital Director to allow me to reviews the patient documents	

Chapter one

Background

1.1 Introduction

Historically the nursing profession has experienced many cycles during which demand for nurses exceeded the supply (Hodge, Romano, Harvey, Olson, Sauve & Kravitz, 2004). The current shortage, however; is the product of a set of issues different from those that have caused previous shortages (Hodge et. al., 2004). The availability of other professional opportunities and adverse public perception of nursing salaries, working conditions, and career development have resulted in fewer individuals choosing nursing as a career. Widespread job dissatisfaction, as a consequence of work place stress and poor working conditions with inadequate staffing, have resulted in decline in numbers of working nurses and resulted in poor patient outcomes (Hodge et. al., 2004).

There is a growing concern about the decrease in number of qualified staff in government hospitals, the growing concern about the adequacy of nurse staffing has led to an increased emphasis on researcher exploring the relationships between nurse staffing and patient outcomes (Burnes, Aydin, Storer, Nelson & Harms, 2003). In University Central Hospital of Kigali (CHUK) a government hospital, nurse: patient ratios are high at approximately 1 nurse to 11 to 12 patients (e-mail from Director of nurses CHUK, April 2006), compared to the WHO standard for nurse: patient ratios in a general ward, which is 1 nurse to 4 to 5 patients (who.int/searo/2002). In addition, hospital care

may be compromised by forces such as increased patient acuity and reduced patient nurse ratio (Lang, Hodge, Olson, Romano & Kravitz, 2004).

Prior studies have shown a relationship between positive registered nurse's (RN) perceptions of their practice, working environment and patient outcomes such as pressure ulcers, wound infections, urinary tract infection and pneumonia (Sales, Sochalski, Sharp, Lowy, Cournoyer & Greiner, 2005).

A number of hospital level studies have demonstrated that lower staffing levels are associated with higher adverse patient outcomes (Whitman, Yookyung, Landy, Davidson, Wolf & Shiaw- Ling, 2002). However, there are insufficient studies about the relationship between unit level staffing and patient outcomes. Furthermore, unit level inquiry is necessary to fully explicate the relationship between staffing and outcomes and to provide assistance to nurse administrators to develop blueprints for staffing and plans that are linked to quality outcomes. Results from the study by (Whitman et. al., 2002) suggest that the impact of staffing on patient outcomes is highly variable across specialty units; however, when present, the relationships are inversely related with lower staffing levels, resulting in higher rates of all outcomes such as pressure ulcers, wound infection, medication errors, urinary tract infections, and pneumonia (Whitman et. al., 2002).

Numerous studies have examined cross-sectional data to determine the relationship between nurse staffing and patient outcomes (Seago, Williamson & Atwood, 2006). Nurse staffing levels are an important working condition issue for nurses and are

believed to be one of the determinants of quality of nursing and patient outcomes (Ketefian, Cho, Barkaukas & Smith, 2003).

Adverse patient occurrence data have traditionally been a major indicator of quality care in hospitals; few studies have examined the relationship among these indicators or the usefulness of the indicators for assessing the quality of nursing care (Reed, Blegen & Goode, 1998).

Health care systems are struggling to control costs and improve the quality and safety of patient care. In some parts of the world greater investment in qualified nurses is part of a strategy to improve quality care (Lankshear, Sheldon & Maynard, 2005).

1.2 Setting

The study will be conducted at CHUK, situated in the center of the city Kigali, Rwanda where the researcher is employed. Kigali is the Capital city of Rwanda with a population of 1 million people and 1,927 inhabitants per km². There are three tertiary hospitals, three district hospitals, health centers, dispensaries and health clinics within Kigali city.

1.3 Problem statement

The problem of low nurse staffing is serious at many hospitals, and its consequences for patients can be severe. Patient outcomes like hospital-acquired wound infection, pressure ulcers, medication errors, pneumonia, sepsis, and associated risk of death, should be reduced to zero (Needleman, Beurhaus, Mattke, Stewart & Zelevinsky, 2002).

The overall low number of nurses in Rwanda has been exaggerated by the war and

genocide of 1994 during which many nurses were killed and others migrated to other countries, leaving a big gap to be covered. However, most qualified staff are not committed to a career in the public health system where salaries are low, choosing to migrate to the private sector or go abroad (Rwanda's Health Sector Policy, 2005).

Research objective is now stated

THE MAP OF RWANDA



The nursing shortage is a well-documented phenomenon that has impacted health care settings worldwide (Heinz, 2004). Health care organizations struggle to meet professional nurse staffing, safety and quality requirements. The acute care hospital setting in South Florida in the USA is one of the hardest hit by the bedside nurse shortage. Nurse staffing presents as a cost accounting challenge that demands the application of management control systems by creative, energetic, and financially savvy nursing system administrators. Future-oriented planning is critical if repercussions of a foreseeable progressive worsening of this condition are to be avoided and control of future patient outcomes achieved (Heinz, 2004).

Studies suggest that nurse-staffing changes affect patient and organizational outcomes, but the impact of nurse staffing on patient outcomes has not been documented sufficiently (Sasichay–Akkadechanunt, Saclzi & Jawad, 2003). The occurrence of each adverse event was associated with a significant prolonged length of stay, increased medical cost and greater probability of death during hospitalization (Heinz, 2004). However, there are no published studies on the impact of nurse staffing on patient outcomes that have been examined in CHUK where the proposed study was conducted.

1.4 Research Objective

The purpose of the study is to determine the relationship between nurse staffing and selected patient outcomes in selected units (medication error, wound infection, and pressure ulcers, urinary tract infection, sepsis, pneumonia, phlebitis) in CHUK.

1.5 Research question

The following questions have been developed to guide the researcher.

- 1) What is the relationship between nurse staffing and selected nurse sensitive patient outcomes?
- 2) What is the relationship between nurse educational preparation and selected nurse sensitive outcomes?
- 3) What is the relationship between nurse workloads and selected nurse sensitive outcomes?

1.6 Significance of the study

Inquiry into the relationship between nurse staffing and patient outcomes is necessary to fully explicate the relationship and to provide information for hospital and nursing administrators. The information can be used when restructuring the clinical workforce, revising hospital policies, or making contractual decisions of nursing and public beneficiaries, (Sasichay-Akkadechanunt et. al, 2003) and provide assistance to nurse administrators to develop blueprints for staffing plans that are linked to quality patient outcomes (Whitman et. al., 2002). The findings of this study will enhance understanding of the importance of nurse staffing and its relation to patient outcomes such as, wound infection, pressure ulcers, pneumonia, phlebitis, medication error and sepsis. There was currently no research available of this type from CHUK, and such a study will be a starting point for future research by qualified nurses as well as student

nurses working in this setting, should patient outcomes be related to staffing, recommendations will be made to nurse administrators to consider adequate staffing as a priority.

1.7 Conceptual Framework

According to Polit and Hungler, (1999) a conceptual framework is a combination of interrelated concepts that are assembled together in some rational scheme by virtue of their relevance to a common theme. The conceptual framework selected for this study attempts to explain patient outcomes using several issues of interest to nursing included in my study. The following section describes each element of the framework and their relevance for this study in which only staff expertise and workload elements will be explored as they relate to adverse patient outcomes.

1.7.1. Leadership

According to Houser (2003) leadership is a key aspect affecting nurse job satisfaction and is related to many other factors that influence nurse recruitment and retention as intervening variables.

1.7.2 Staff expertise

Nurse expertise influences patient outcomes by improvement in care when cared for by nurses who have greater expertise. Expertise will be measured by recording the level of qualification of the nurses on selected units on all shifts in which staffing will be measured (Houser, 2003).

1.7.3. Staff stability

Turnover is an endemic problem on nursing units. The nursing shortage makes it difficult to fill positions quickly resulting in the use of temporary and traveling nurses. It takes time to recruit and train replacements and the remaining nurses lose their motivation, resulting in adverse patient outcomes (Houser, 2003).

1.7.4. Teamwork

Teamwork is when nurses work in a team, share experiences and work together to achieve the unit goals. Teamwork is seen as critical for unit functioning, it is directly identified as a condition that could enhance or reduce the efficiency and thereby reduce demand on staff (Houser, 2003).

1.7.5. Resources

Resources affect efficiency and the quality of care. When the resources are inadequate or received late on the unit, the efficiency and the quality of care is affected (Houser, 2003)

1.7.6. Workload

Care delivery is a dynamic process, requiring flexibility and adaptability. This is particularly difficult on the patient care units where the nurse patient ratio is very low. Nurse patient ratio often indicates the workload as when the number of patients is high compared to number of nurses, the quality of care becomes affected with increased

adverse outcomes (Houser, 2003). Therefore, nurse patient ratios will serve as a proxy for measurement of workload.

1.7.7. Patient outcomes

Patient outcomes in this study refer to outcomes, which focus on how patients and their healthcare problems are affected by nursing interventions. They are anticipated results. Conceptual framework suggests that the factors described above in the framework influences patient outcomes. Certain types of leadership, e.g., transformational, democratic or laissez faire may enhance nurse's retention and increase staff expertise. Staff expertise, teamwork, staff stability and resources positively influence patient outcomes.

1.8. DEFINITION OF TERMS

1.8.1 Medication errors

Are errors in the process of ordering, dispensing, monitoring or administering a medication regardless of whether an injury occurred or whether the potential for injury was present. The Council for Medication Error Reporting and Preventing define the medication error as: any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient or consumer (Osborne, Blais & Hayes, 1999). The medication error will be measured by use of incidence report and medical records.

1.8.2 Pressure ulcers

Pressure ulcers are defined as new incidences of skin breakdown secondary to pressure or exposure to urine or feces (Reed et al 1998). Pressure ulcers was measured by using medical and nurses' records indicating presence of new incidence of skin breakdown.

1.8.3 Nurse sensitive outcomes

Nurse sensitive outcomes refer to outcomes for which individual nurses are held accountable and represent the consequences as effects of intervention delivered by nurses (Hall, 2002).

Other adverse outcomes e.g., hospital acquired pneumonia, UTI, phlebitis, and wound infection was measured through review of medical and nursing notes, and laboratory tests. Medication error was measured by use of the incidence report and nurses care plan.

1.8.4 Wound infections

Are infections around surgical site and is one of the most common (Hospital Acquired Infection) HAIs and are an important cause of morbidity and mortality. They delay in recovery and subsequent increase length of hospital stay and was measured through review of medical notes and laboratory tests.

1.8.5 Nurse workload

Nursing workload measurement is the determination of the total amount of nursing time, this includes direct and indirect nursing services, required for clients and the number of nurses required providing this service. A nursing workload measurement system is a complex, dynamic process designed to aid in determining and allocating nursing resources by assisting in staff allocation and budget planning decisions (Nurses Association of New Brunswick 2003). In this study the nurse workload was measured by use of nurse duty plan and patient daily census to determine the number of nurses per shift for each selected unit and the number of patients on that shift.

1.8.6 Hospital Acquired Pneumonia

Hospital acquired pneumonia is an infection of the lungs and is a very common illness. It is caused by many different germs and can range in seriousness from mild to life threatening. Hospital acquired pneumonia tends to be more serious, because a patient's defense mechanisms against infection are often always impaired during hospital stay. In addition, the types of germs present in a hospital are frequently dangerous than those encountered in the community. It was measured through review of medical records and laboratory results.

1.8.7 Phlebitis (Inflammation of a vein)

With phlebitis, there is infiltration of the walls of the vein and usually, the formation of a clot (thrombus) in the vein (thrombophlebitis). Phlebitis in a leg, for example, will cause the leg to swell with edema fluid and feel stiff and painful. It was measured through review the medical records and nurses notes

1.8.8 Nurse staffing

Nurse staffing mean the appropriate number of staff, with suitable mix of skill levels, is available at all times to ensure that patient care needs are met and that hazard- free working condition are maintained (ICN 2006).

1.8.9 Urinary tract infection (UTI)

An infection in the urinary system that begins when microorganisms cling to the opening of the urethra (the canal from the bladder) and begin to multiply. Most UTIs are due to one type of bacteria, (Escherichia coli) a normal denizen of the colon. An infection in the urethra leads to inflammation called urethritis. It was measured by use of medical records and laboratory results

1.8.10. Adverse events.

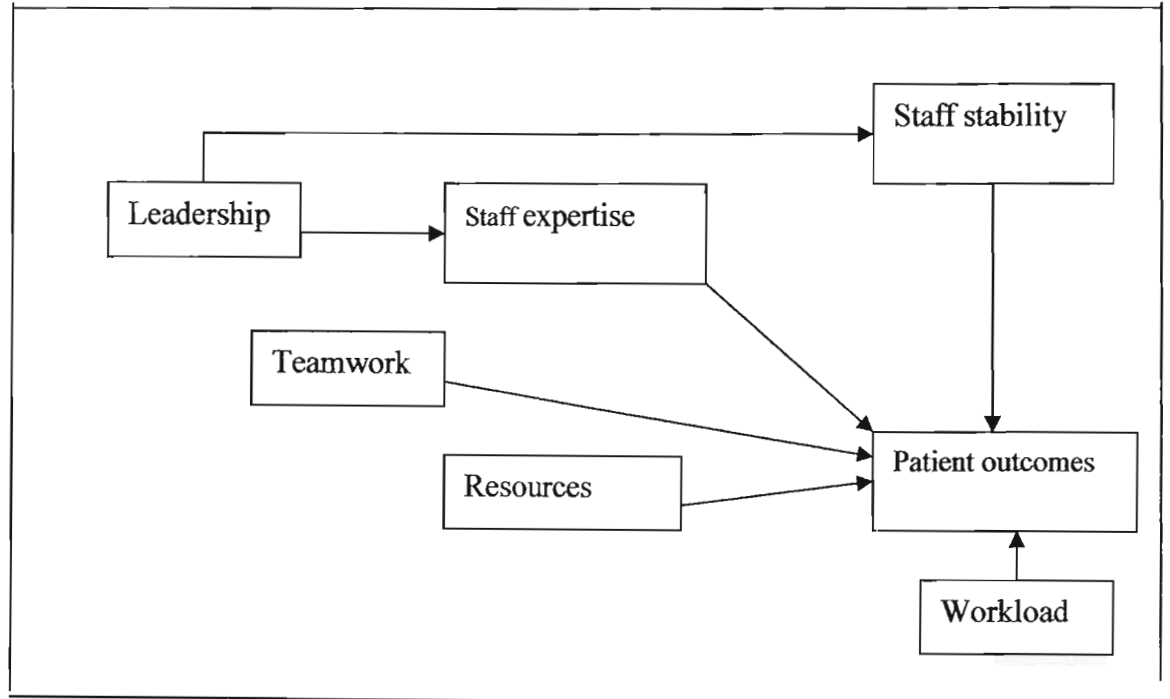
An adverse event is defined as an injury caused by patient care management, as distinct from any underlying disease process, which either prolonged hospital stay or caused disability at discharge.

1.8.11. Independent variables

Only two independent variables was extracted for this study. If the selected variables are significantly related to patient outcomes the remaining conceptual framework concepts will be explored during PhD level research. The independent variables are workload (indicated by nurse: patient ratio) and expertise (indicated by the level of qualification of the nurse).

Conceptual framework

Figure 1: Conceptual framework (According to Houser 2003).



Chapter two

Literature Review

2.1 Introduction

A literature review refers to the activities involved in identifying and searching for information on a topic and developing an understanding of the state of knowledge on a topic (Polit & Hungler, 1999, p.79). This chapter deals with the reviewed literature concerning studies undertaken on staffing and nurse sensitive patient outcomes.

2.2 Nurse staffing and adverse patient outcomes

Nurse staffing is a process that affects both patient and staff outcomes. It involves determining, allocating, and delivering nursing resources necessary to provide quality care to patients and dynamically incorporates how care is organized and delivered. Nurse staffing is driven by informed decision making regarding resource allocation and patient needs, reflecting on structural characteristics within the facility, e.g., policies, standards of care and mandated staff regulations (Reilly, Mueller & Zimmerman, 2006).

Widespread reports of declining levels of quality of care and patient safety in hospitals, an escalation in calls for legislation mandating minimum nurse staffing ratios, growing levels of nurse burnout and a looming nursing shortage have focused attention on the working conditions that nurses face and their implications for patient outcomes. Surveys of staff nurses working in acute care hospitals in Pennsylvania, USA, reveal that one out of every five staff nurses reported the quality of care on their unit as fair or poor. Workload played a role in these quality assessments, but it was the

consequences of workload, such as the reports of unfinished nursing at the end of the last shift and the frequency of adverse events among patients, that played a much more prominent role (Sochalski, 2001).

Hospital nurse staffing is a major concern because of the effects it can have on patient safety and quality of care. Nurse sensitive outcomes are an indicator of quality and may be defined as variables with patient and family care giver state, conditions or perception responsive to nursing intervention, and include specific outcomes. The adverse patient outcomes potentially sensitive to nursing care are urinary tract infections (UTIs) pneumonia, pressure ulcers and wound infection (Stanton, 2004)

When nurses say that low overall staffing numbers and low proportions of RNs adversely influence patient outcomes, the basis for that claim is stronger than individual impression and opinion as there is research evidence supporting it. A recent study (Brown, 2001) commissioned by the American Nurses Association (ANA) confirmed the relationship between low staffing and poor patient outcomes. These results add to the evidence of prior studies in which a strong inverse relationship between nurse staffing and adverse patient events: pneumonia, pressure ulcers, wound infections and urinary tract infection has been found (Brown, 2001).

The Institutes of Medicine in their recent outcome studies, (Deutschendorf, 2003), have definitively linked registered nurse staffing to patient outcomes, however, these studies indicate that a key to positive patient outcomes is critical thinking and decision making

of the nurse administrators. The ability to maintain nurse staffing to meet the objectives of the direct patient care delivery model that ensures direction and support to novice staff, expert resources to validate the critical decision and competency, and the infrastructure that provides the necessary resources and processes to support professional nursing practice thus reducing negative nurse sensitive outcomes such as medication errors, pressure ulcers and wound infections (Deutschendorf, 2003).

Various groups, including the American Hospital Association and the Joint Commission on the Accreditation of Health Care Organizations and the Institute of Medicine (IOM), have expressed their concerns about the evolving nursing crisis. The IOM issued a report in 1996 by (Stanton, 2004) that recognized the importance of determining appropriate nurse patient ratios and distribution of skills ensuring that patients receive quality healthcare. The report highlighted the fact that research on the relationship between the level of staffing by nurses in hospitals and patient outcomes has been inconclusive. The IOM's analysis of staffing and quality care in hospital concluded by calling for a "systematic effort to revise nurse staffing and reduce the number of hospital complications such as pressure ulcers and wound infections" (Stanton, 2004).

A comprehensive overview of nursing workforce studies (Buerhaus & Needleman, 2000) examined current efforts to investigate the relationship between hospital nurse staffing and patient outcomes that are sensitive to nursing care. Although the impact of hospital restructuring on nurses is generally well known, public policy making in this area has not resulted in significant changes. The lack of substantial policy is attributed

to insufficient empirical evidence linking changes in hospital nurse staffing to adverse patient outcomes. The authors suggest that readers use caution when using these findings to support mandated hospital nurse staffing levels.

Developing a clear, precise prescription for care delivery systems that can provide high quality cost effective patient outcomes is a primary goal for all nurse administrators. Essential to development of these optimal staffing patterns one needs a clear understanding of the impact of staffing on patient outcomes. Seminal work of the American Nurses Association considered nurse-sensitive outcomes including nosocomial infections, wound infection, pressure ulcers, patient falls, and medication errors. Investigators as linked to lower staffing levels have identified these outcomes and low staff level mix (Whitman et. al., 2002).

A study conducted in the USA by Needleman and Beurhaus (29th May 2003) reported results of a government funded study to determine whether there is scientific evidence for a relationship between patient outcomes that are potentially sensitive to nurse staffing. A strong and consistent relationship was found between nurse staffing variables and outcomes in medical patients (pressure ulcers, pneumonia, wound infections, etc) in patients who underwent major surgery. The strong and consistent relationship was between nurse staffing and failure to rescue. For outcomes associated with nurse staffing, higher RN staffing was associated with a 3% to 12% reduction in complication rates. "Nurses are the glue that holds the health care system together, and

it is time that we invest more resources in the nursing profession" (Jackson, Chiarello, Gaynes & Gerberding, 2002).

Hospitals with low nurse staffing levels tend to have higher rates of poor patient outcomes such as wound infections, medication errors, pressure ulcers and prolonged hospitalization, according to the research by the Agency for Health Care Research and Quality (AHRQ). However, increasing staffing levels is not an easy task. Major factors contributing to lower staffing levels include the needs of today's higher acuity patient for more care (Stanton, 2004).

Needleman and Beurhaus, (2003) conducted a study in 11 states in the USA to explore the relationship between the amount of care provided by nurses and patient's outcomes. The researchers studied adverse outcomes for medical and surgical patients. The results indicated that higher registered nurse staffing levels were associated with lower adverse outcomes. Needleman and Beurhaus, (2003) concluded that a higher proportion of total hours of nursing care provided by registered nurses were more frequently associated with lower rates of adverse outcomes. These researchers recommended that systems should be developed for routine monitoring, in a large number of hospitals, for outcomes that are sensitive to the levels of staffing by nurses. An adequate nurse staffing level must be available to protect patients and to improve the quality of care (Huber 2006, p. 307).

Researchers have found an association between lower staffing levels and higher rates of some adverse patient outcomes. An evidence report entitled; the effect of health care workers on patient safety produced by the (AHRQ), studied the relationship between nurse staffing levels and measures of patient safety. Most of the studies examined nurse staffing levels and adverse occurrences in the hospital setting, including in hospital death, nosocomial infections, medication errors, and patient falls. Lower nurse to patient ratios were associated with higher rates of adverse outcomes at both hospital level and the nursing unit level (Stanton, 2004). The study to be conducted in CHUK explore whether adverse patient outcomes are related to low staffing and nurses qualifications.

Few studies have emerged since the report that adds considerable knowledge about nursing sensitive patient outcomes. Four studies of relevance were found, three of which were conducted at the unit level and one at the institutional level of analysis. Institutional level analysis is criticized for an inability to identify specific aspects of the context of care, such as unit level structures and processes that may affect outcomes. This level of understanding is necessary for administrators to effect practical, targeted change in the practice setting (Whitman, et al 2002). Although unit-level analysis has occurred in the past, the cluster of unit-level studies in this monitoring report may signal a growing awareness that work environment conditions, including but not limited to staffing, are relevant to patient outcomes (Williams 2004).

Sovie and Jawad, (2001) conducted a study about hospital restructuring and its impact on outcomes in twenty-nine university teaching hospitals in the USA. The results of the study indicated that the reduction in number of nurses on patient care units and the impact of these reductions were increased adverse patient outcomes. Registered nurses were vocal about their heavy workloads and the resulting inability to provide all the needed nursing care to patients resulting in poor nurse sensitive outcomes.

Inappropriate staffing is the number one concern of nurses today; this increases the stress and challenges on the job. Nurses must care for greater numbers of patients and patients in hospital are more acutely ill than in the past. Adequate staffing is critical to the delivery of quality patient care because it allows nurses time for appropriate assessment of patients and their needs and initiation of suitable interventions. Low staffing levels hinder nurses to do all the interventions needed and thus results in negative patient outcomes (Blakeney, 2002).

Blegen, Goode and Reed (1998) reviewed the literature on nurse staffing and healthcare associated infections. Multiple factors influence the development of healthcare associated infections, including patient variables (severity of illness, extent of debilitation), care variables (antibiotic use, use of central venous catheters), and organizational variables (staffing). Research has addressed nurse staffing as a variable that affects patient outcomes. Regardless of the type of study, the results are generally consistent in showing a relationship between nurse staffing and health care associated infections. There is also evidence of association between a higher registered nurse workforce and fewer infections. Healthcare associated infections result from a multitude

of factors, one organizational factor with a consistent effect is the level of RN staffing on patient outcomes (Jackson et. al., 2002).

When the morale among employees is high, they tend to work enthusiastically, courageously, confidentially and in a disciplined manner. When morale is low, employees are timid, rebellious and display an indifferent attitude towards their job, with the result that their productivity is low (Booyens, 1998 p.206). The nurse manager/leader should find out what the values are which the person would regard as “caring for the worker” in order to promote motivation among nurses thus improving the quality of care given and good patient outcomes.

2.3 Nurse staffing and workload

The workload of nurses may be essential in the drive to recruit and retain sufficient nursing staff. A study by Lewis (2005) concludes that increasing the workload of nurses by one patient can subsequently increase the likelihood of job burnout by 23 percent and dissatisfaction by 15 percent. Furthermore, 23 percent of the same nurses who report burnout and job dissatisfaction report an intention to leave their job within the next year, compared with only 11 percent of nurses who are satisfied (Lewis, 2005).

Evans (2006) state the California law was motivated by a growing number of studies documenting higher adverse event rates in hospitals with lower nurse/patient ratios. For example, a 1999 report by the Institute for Health and Socio-economic Policy examined 4 years worth of hospital discharge data from California and found that over the time

period analyzed, inpatient outcomes were declining and so were hospital staff levels. Studies by Aiken, Clarke, Sloane, Sochalski, Silber, (2002). Found higher adverse event rates in hospitals with lower staffing ratios. Finally,(Bell, and Redelmeier, 2001) found higher mortality rates among patients admitted over the weekend, a period when hospital staffs are typically lower, compared to admissions during the week, when the hospital staff levels are greatest. The call for higher nurse/patient ratios is coming at a time when some hospitals are having a difficult time filling positions.

Since its 1999 report, the IOM's Committee on the Adequacy of Nurse Staffing in Hospitals and Nursing Homes has begun to illustrate the relationship between nurse staffing, patient outcomes, and cost of care. This report acknowledges that patient care provided by a registered nurse does affect patient outcomes and has a positive impact on cost of care (AORN, 2006).

2.4 Nursing expertise

Sigma Theta Tau International Honor Society in Nursing (STT) (2004) defined evidence-based practice by identifying nursing expertise as one of the components of effective nursing practice, (Bunkers, 2004).

The study conducted in California (Dunton 2005) on science of the relationship between nurse staffing and patient outcomes is still very young. Much remains to be learned about models of the provision of nursing care. The implementation of mandatory staffing policies, especially those that regulate only one aspect of nurse staffing, could have

unintended negative consequences on patient health and safety. Until the science has reached a more mature stage, the most prudent policy is to monitor a variety of nurse staffing and nursing-sensitive patient outcome indicators to promote improvement in the quality of patient care. Medical surgical units that had no pressure ulcers had nurse-to-patient staffing ratios that ranged from approximately 1:7 to 1:1. Appropriate, effective, and efficient nursing care involves more than minimum staffing ratios. Nursing is a complex process involving patient assessment, monitoring, nursing interventions, provision of patient comfort, and patient education. The science and art of deploying appropriate nurse staffing on a unit begins with an assessment of patient acuity. Based on acuity, nurse managers must have an appropriate mix of RNs, LVNs(licensed vocational nurses), and unlicensed nursing assistants designed to deliver patient care in an efficient and a cost-effective manner. They must have an appropriate level of nursing expertise, as indicated by education, certification, and experience (Dunton and Schumann, 2005).

2.5 Nurse staffing and medication errors

Medication errors occur commonly in the hospital. While most such errors are minor, small proportions result in an injury or adverse drug event (ADE). About 1-in 100 medication errors actually results in an adverse drug event, although about 7 per 100 have the potential to do so. Although most medication errors have little potential for harm, they are undesirable and do cause substantial extra work. Some adverse drug events are serious and a few even result in death. These events are also costly. Two studies conducted in the US estimated the cost of medication errors to be more than

\$2,000 per event. Nationally, the cost of ADEs occurring in hospital has been estimated at \$2 billion annually (Bates, Cullen & Laird, 1999).

A study conducted at the University of Toronto, Ontario; revealed that the lower the proportion of professionals nursing staff employed on the unit the higher the number of medication errors and wound infections and the lesser experienced the nurse, the higher the number of wound infections. The result of this study suggest that a higher proportion of professional in the staff mix (RN/EN) on medical and surgical units in Ontario teaching hospitals are associated with a lower level of medication errors and wound infections (Hall, Doran & Pink, 2004). The impact of medication errors can be devastating to the confidence and self-esteem of nurses. Nurses involved in committing a medication error may be reluctant to report it unless there is obvious harm to the patient. The reluctance comes from fear of punishment, which could include corrective action, termination from work, or report to the State Board of Nursing for disciplinary action (Osborne et. al., 1999).

Measuring nurse sensitive patient outcomes using publicly available data provides exciting opportunities for the nursing profession to quantify the patient care impact of staffing changes at individual hospitals and to make comparisons among hospitals with differing staffing patterns. Using data from California and New York, the study tested the feasibility of measuring such outcomes in acute care hospitals and examining relationships between these outcomes and nurse staffing. Both higher nurse staffing and a higher proportion of RNs were significantly related to shorter lengths of stay and

lower medication errors. Lower adverse outcome rates were more consistently related to a higher proportion of RNs (Lichtig, Knauf & Milholland, 1999).

Nurses administer many medications to many patients, increasing the chance of error. Nurses are the final checkpoint before medications are administered; thus, the burden of medication errors falls more heavily on nurses than any other member of the health care team (Osborne et. al., 1999).

A recent Institute of Medicine report estimated that 44, 000 to 98, 000 people die each year in the United States as a result, at least in part, of medication error (Harrington, 2000). In a Harvard Medical Practice Study, investigators reported that many adverse events experienced by patients in New York State in 1984 were complications of medication use (Harrington, 2000). Shortly thereafter; the ADEs Prevention Study 2000 confirmed that adverse drug events (ADEs) were common, costly, and often severe, subsequent studies have further substantiated these findings (Harrington, 2000).

Osborne et. al. (1999) conducted a study to determine the frequency of medication administration errors to identify classes of errors and to identify patient characteristics and staffing situations that may serve as predictors of medication errors in intensive care units. The results suggested that there was a low medication error rate of 2.2% in intensive care unit, compared with the 13% to 18% reported in other units. The most important type of medication error was the wrong time.

Osborne et. al. (1999) reviewed situations leading to medication errors and identified several situations that preceded medication errors: in transcribing doctors orders, distraction of institutional environment, failure to absorb or act on information on drug packing labels, confusion over similar packing labels and container sizes, use of defective equipment, and selection of wrong medication container. Other factors include poor handwriting, selecting medication from memory without checking the medication as given before it was administered, leaving medication at the bedside, and scheduling medication during change of shift report.

A study conducted by Reed et. al. (1998) found evidence that units with higher average patient acuity had lower rates of medication errors and patient falls, but higher rates of the other adverse outcomes. With average patient acuity on the unit controlled, the proportion of hours of care delivered by RNs was inversely related to the unit rates of medication errors, pressure ulcers, and patient complaints. Total hours of care from all nursing personnel were associated directly with the rates of pressure ulcers, complaints, and mortality. When the RN proportion increased, rates of adverse outcomes decreased up to 87.5%.

2.6 Nurse staffing and infections

A new study has found a strong, consistent relationship between nurse staffing and patient outcomes, according to an April 20, 2001, news release from the Health Resources and Services Administration of the US Department of Health and Human Services. The study was based on 1997 data of more than five million patient discharges collected from 799 hospitals in 11 states. The study found this relationship

between levels of nurse staffing and five outcomes in medical patients' urinary tract infection, pneumonia, shock, upper gastrointestinal bleeding, and wound infection. Results showed a higher number of RNs were associated with a 3% to 12% reduction in adverse outcomes, and higher staffing levels of all types of nurses were associated with a 2% to 25% decrease in adverse outcomes. Reductions in the rates of adverse outcomes can decrease hospital costs and significantly lower financial and psychological costs to patients and their family members. It is hoped that these findings will compel hospital administrators to improve quality and performance measures to ensure better nursing care for all patients Association of Perioperative Registered Nurses (AORN 2002).

Cho, Ketefian, Berkeuskas and Smith (2003) found three statistically significant relationships between nurse staffing and adverse events. An increase of one hour worked by a registered nurse per patient day was associated with an 8.9% decrease in wound infection and odds of pneumonia. The occurrence of each adverse event was associated with a significantly prolonged length of stay and increased medical costs. Patients who had wound infection, pneumonia, or sepsis had a greater probability of death during hospitalization (Cho et. al., 2003). Care systems to reduce adverse events and their consequences are needed. Having appropriate nurse staffing is a significant consideration in some cases.

Hall, Doran and Pink (2004) state: “the lower the proportion of professional nursing staff employed on a unit, the higher the number of wound infections. The less experienced the nurse, the higher the number of wound infections” (Hall et. al., 2004)

Duffy (2002) states “Clinical and cost burdens related to nosocomial infections continue to plague the US healthcare system (Duffy, 2002, p 358). Vulnerable populations, such as the elderly and the immuno compromised are especially at risk. Current evidence suggests that although hospital stays are shorter, nosocomial infection rates per 1000 patients have actually increased. Nurse staffing and practices recently have been linked to the incidence of nosocomial infections, such as wound infections. Advanced practice nurses are key to ensuring that evidence-based practice environments, in which data drive decision-making, can flourish so that nurses can identify and implement practices that can reduce the rates of nosocomial infections, as urinary tract infection and wound infection.

The study conducted in the US (Feb 2003) by Nevada RN Formation looked at hospital and Medicare data in nine states in five categories of adverse outcomes: length of hospital stay, hospital acquired pneumonia, postoperative infection, pressure ulcers, and hospital-acquired urinary tract infections. All five measures were markedly lower with higher levels of RN involvement in patient care. Two other studies published this year, one in the New England Journal of Medicine and one by the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO), also found direct links between nurse staffing levels and better patient outcomes (Nevada RN Formation, 2003).

Nosocomial pneumonia (NP) is well documented as the second most common nosocomial infection. It is now more common in surgical patients than surgical-site or wound infection. Healthcare implications of NP include not only increased patient morbidity and mortality, but also increased use of healthcare resources. The advanced practice nurse plays an integral role in the prevention and minimization of NP across healthcare settings. The article by Brooks (2001) about nosocomial pneumonia focuses on postoperative NP after abdominal, cardiac, or thoracic surgery in the non-mechanically ventilated patient and discusses the diagnostic assessment, risk factors, and potential nurse-sensitive interventions to prevent or minimize this complication. Ideas for potential nursing research related to these risk factors are described (Brooks, 2001).

2.7 Surgical wound infections

A study conducted in Australia, (2002) found that surgical wound infections occur in up to 10% of patients undergoing clean surgery, with the incidence varying with complexity of surgery, intrinsic patient risk and surgical skills. Most surgical wound infections result from contamination of the surgical wound with the patient's own flora or that of operating-room personnel or environment at the time of the surgery. Postoperative haematogenous seeding of the wound site is uncommon. Infection may present clinically during hospitalization. However, the current trend to shorter postoperative stays and day surgery result in more than 50% of surgical wound infections becoming apparent after discharge from hospital. Clinical infection may occur up to four weeks

after deep surgery and up to 12 months after surgery involving an implanted prosthesis (e.g., joint replacement) (Spelman 2002).

2.8 Nurse staffing and pressure ulcers

Pressure ulcers were defined as new incidences of skin breakdown secondary to pressure or exposure to urine or feces (Reed et. al., 1998). Approximately one million people in the US are affected by pressure ulcers, which cost close to \$1.6 billion annually. The estimated cost per hospital stay associated with each pressure ulcer increases with the stage of the pressure ulcer. This cost ranges from \$2,000 to \$30,000 for stage 1, 2, and 3 ulcers to \$70,000 for complex full thickness stage 4 ulcers (Young, Amy & Davis, 2003). Pressure ulcers are costly for hospitals, resulting in increased lengths of stay and related costs, and have significant effects on patients who must endure the suffering and pain associated with a pressure ulcer. Increased lengths of stay in hospital may cause individuals, especially the elderly, to lose their independence, delay rehabilitation, and weaken normal social networks of support, making independence at discharge more difficult (Reed et. al., 1998).

Fewer registered nurse hours and nursing assistant hours were associated with total deficiencies and quality of care deficiencies, when other variables were controlled. Facilities that had more depressed and demented residents, that were smaller, and that were non profit or government owned, had fewer deficiencies. Facilities with more residents with urinary incontinence and pressure ulcers and with higher percentages of Medicaid residents had more deficiencies, when staffing and resident characteristics were controlled (Hopf & Donaldson, 2003).

Pressure ulcers have serious consequences on the quality of life of patients and a big impact on the cost of care. Sixty percent of the patients who develop pressure ulcers do so while in the hospital; they have stays as much as five times longer than average and cost \$8.5 billion on a national level (Reed et. al., 1998). Pressure ulcers heal slowly and result in pain and impaired quality of life. Strategies to enhance healing of pressure ulcers are critical to the treatment regime. (Reed et. al., 1998) explores the possibility that patients with pressure ulcers may experience low tissue oxygen and impaired hydration. Results presented, suggest that some proportion of patients with pressure ulcers experience low subcutaneous oxygen and that fluid administration increases the low tissue oxygen (Hopf & Donaldson, 2003).

Nursing personnel have primary responsibility for skin care of patients and implementing pressure ulcer prevention programs. Pressure ulcer prevention, early intervention, and treatment programs are essential strategies to decrease the prevalence of pressure ulcers. Effective pressure ulcer prevention programs enhance the quality of care by decreasing the incidence of pressure ulcers and, therefore, pain associated with pressure ulcers while controlling costs. All these can be possible only with adequate nurse staffing (Young et. al., 2003). More nurses were associated with fewer pressure ulcers. Nursing contributes to the prevention of pressure ulcers, but many other factors such as the acuity of the patient also contribute to the eventual occurrence of these adverse events (Reed et. al., 1998).

Chapter three

Research Methodology

3.1 Introduction

Data was collected using two instruments: the first instrument for adverse events and the second instrument for nurse staffing

3.2 The study design

The study was quantitative in nature. The research design is the set of logical steps taken by the researcher to answer the research question. "A retrospective, cross-sectional, correlation study was planned. In correlational descriptive design, the researcher attempted to determine and describe the relationships existing between variables" (Brink, 2006, p. 105)

3.3 The target population

The population was the entire group of persons or objects that was of interest to the researcher (Brink, 2006, p.123). Two units' medical and surgical units were included. The population were the records of all patients admitted in CHUK for the months of January to June 2006. The nurse staffing duty plans at CHUK from January to June 2006, form the second population from which a sample was drawn.

3.4 Sampling

Sampling is a process of selecting a portion of the population to represent the entire population (Polit, 2004, p.291). The researcher used a purposive sampling method, which is non-probability in nature. This sample was adequate for the unit level because it represented the population of nurse staffing and patients (Polit & Hungler, 1999, p. 284). The sampling method was based on the belief that a researcher's knowledge about the population was used to hand pick the cases which was included in a sample. All patient files that meet the inclusion and exclusion criteria below were included in the sample.

3.5 The inclusion criteria

According to Polit (1999, p.284) the criteria that define who are included must be specified along with the characteristics that people must or must not possess. There were both unit level criteria and patient record level criteria. With regard to unit level, only records from hospital units at CHUK with more than 60 beds were included in the study

3.6 The exclusion criteria

Exclusion criteria are those characteristics that are specified should not be included in the sample group. In this study, one-unit level criteria were the pediatric ward it was not included in the study because the adverse events to be studied are rare in pediatric patients. With regard to patient level, patient files in which the patient was admitted with adverse patient outcomes to be studied was excluded. There are not results of the

quality of nursing care provided but rather associated with the health status of the patient pre-admission. The adverse condition that were typically associated with the primary diagnosis were restricted for example, the sample excluded patients in the major diagnostic category of 'kidney and urinary tract' diagnoses from the urinary tract infection rates since these patients were considered to be at high risk for developing the complication as a result of their functional health status. The sample also excluded patients with diabetes and AIDS because there are at high risk of developing complications under study.

3.7 Sample and sample size

A sample of two months from the six months (January-June 2006) was selected from the two populations patient records and staffing plan. A recent review of the number of admissions on the surgical and medical units selected at CHUK was found to have a total of 797 admissions during a two months period. Therefore, all records were reviewed from February to March 2006. Adverse events data were collected from all patient case files of the units which met inclusion/exclusion criteria for the months of February and March 2006. Nurse staffing data was collected from all units that have met the inclusion criteria for the period of two months February and March 2006.

3.8 Data collection instruments

The instrument that was used for data collection on adverse outcomes (Appendix A) was a checklist format and has been developed through adaptation of the instrument used by Schmidt (2004) but no data on validity and reliability were available. The

instrument for data collection on staffing (Appendix B) has been developed by the researcher. The instrument for staffing, which was developed by researcher, was pilot tested along with the adapted adverse events instrument to determine validity and reliability. Pilot testing was done immediately following approval to conduct the study. Pilot testing was done on ten (10) patient records from one unit not selected for the study sample.

3.9 Data collection Process

All patient files from February and March 2006 of the units which met the inclusion criteria were included in the study and data was collected using the checklists in Appendix A and B. The researcher conducted data collection over a two week period immediately following UKZN and hospital research committee approval. The researcher presented herself to the in charge of the hospital documentation department with the authorizing letter to conduct a study. . There was no patient file and nurse staffing plan which was taken out of the consultation room for any reason by the researcher

3.10 Validity and reliability of instruments.

The instrument for data collection on adverse events has been used and the results were reliable. The instrument for staffing which was developed by researcher a pilot study was done to test its reliability. The instrument was changed after pilot testing; adverse event due to out of stock was removed because it was not a nurse sensitive patient outcomes. Instrument for medical ward a change was made, an adverse event for surgical wound infection was removed because it was not applicable. The instrument

was valid and reliable. The removal of adverse events which was not applicable on the instruments made it reliable and valid during data collection process. It produced almost similar results of pilot study and main study though pilot study was done on different unit setting with the main study.

3.11 Data analysis

Each item of the checklist was coded (assigned a number). Data was analyzed using SPSS (Statistical Package for Social Science) Version.13.0 for Windows. Frequency distributions and percentages were used to describe the sample. It was planned that Pearson correlations would be used to calculate and determine relationships among variables followed by multiple regressions; however, because of the structure and type of data it was not logical to use the Pearson correlation statistic to test the hypotheses. Therefore, after consultation with a statistician, it was decided that Poisson regressions was the most useful statistic to answer research questions and test hypotheses. This statistic was used to determine what strength and direction of relationship was between staffing and nurse sensitive patient outcomes.

3.12 Ethical consideration

The research proposal was submitted and presented to the UKZN School of Nursing Research Committee. It was reviewed and monitored for ethical approval from the University of KwaZulu Natal Medical School Ethics Committee. A letter for a permission to conduct a study was submitted to the CHUK hospital authority. The permission was granted to conduct the study, the researcher proceed with the study immediately. The

hospital Superintendent gave a permission to access the patient files because after discharge the files remain the hospital property.

3.13 Limitations of the study

The following were limitations to this study:

- ❖ The adverse outcomes to be studied were not properly documented thus providing limited clinical information.
- ❖ The generalizability of the findings were limited due to the nature of non probability sample.
- ❖ The results of this study were analyzed at unit level, thus they cannot be inferred to other levels of analysis such as hospital level, and national level.
- ❖ The study included only medical and surgical units and excluded other units such as intensive care units, emergency, pediatric and obstetric settings.
- ❖ Most medical files were written in French so there was a language barrier to the researcher.

Chapter 4

Data Analysis and Findings

4.1 Introduction

This was a retrospective quantitative descriptive study. Data were analyzed using SPSS (Statistical Package for Social Science) Version 13.0 for windows. Frequency distributions were used to describe the sample. Poisson regression was computed on the aggregated data to determine if a relationship existed between qualification of staff, staffing levels and adverse patient events. Because adverse events occur gradually over a period of time one cannot tell whether it occurred on a particular day or date therefore, the data were aggregated and analyzed on a monthly basis. This also made it possible to use the Poisson regression statistic.

Data were collected using the two instruments developed by the researcher. The first instrument was used to record staffing for two months (February and March 2006) for each unit. Codes were assigned to each ward (medical and surgical) for each month.

The adverse events under study were urinary tract infection, pressure ulcers, and systemic sepsis, pneumonia, phlebitis, and medication errors.

According to the Director of Nursing at CHUK (personal communication 2006), the nurse patient ratio was 1:12 for the medical nursing unit on day shift and 1:18 on night shift, and 1:11 for the surgical unit day shift and 1:15 on night shift. The data, however, indicated that the mean number of nursing staff on the medical unit was 13.2 in February and 10.8 in March 2006 and was 14.6 for the surgical ward in March and 11.5

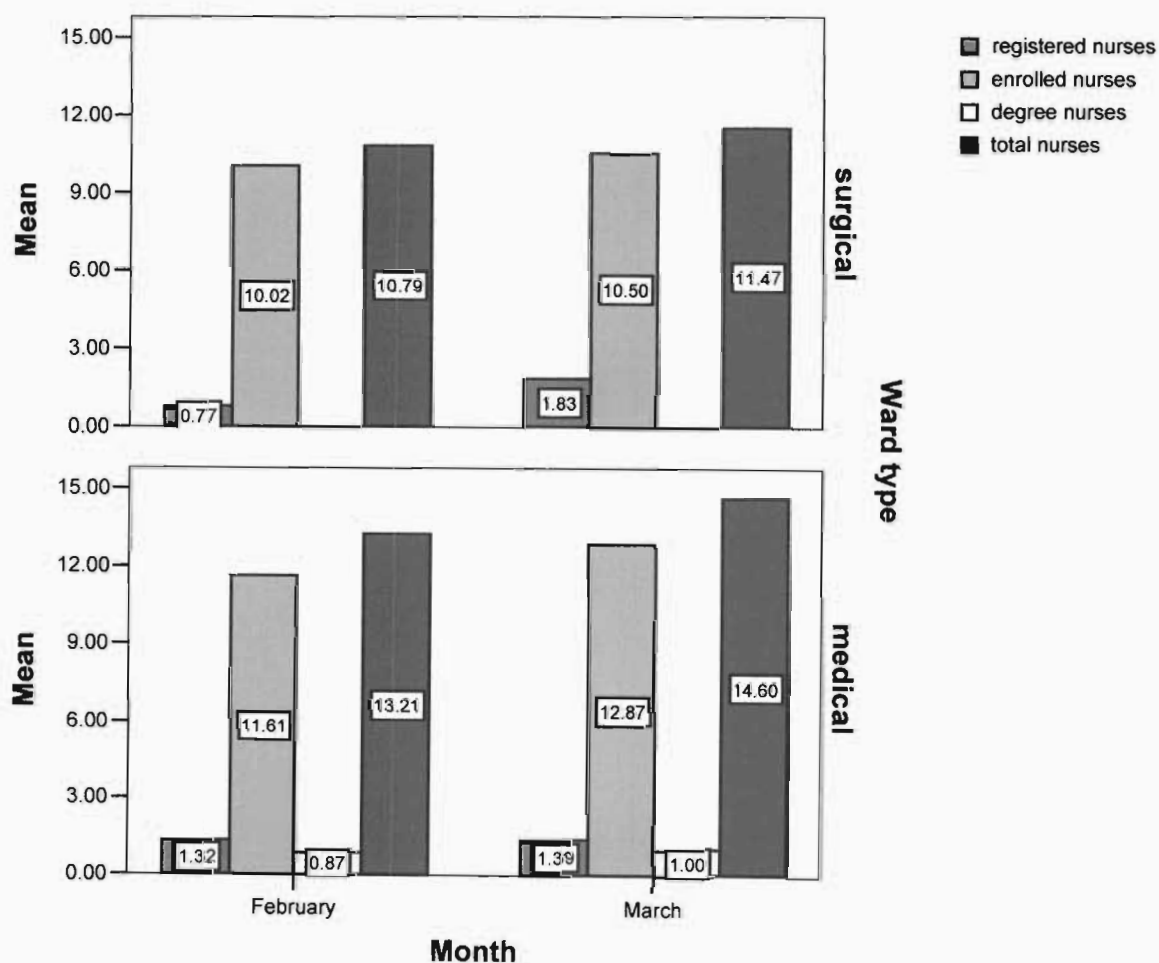
in February 2006. The medical unit had one nurse with an Honors degree and surgical had only diploma nurses as the highest qualification.

4.2 Results

The results were presented in tables, bar graph and figures and the number of adverse events were interpreted into percentages and frequencies.

Graph 4.2.1 shows the mean staffing and their qualification on medical and surgical ward in February and March 2006.

Graph 4.2.1 Mean staffing for each unit on selected months



The second instrument used for data collection was an adverse events checklist. For each of the units selected (one medical and one surgical) medical records for each patient who were admitted on medical and surgical unit for the period of February and March 2006 were reviewed. The checklist consisted of the adverse events (nurse sensitive) that were of interest to the researcher, the patients' file were reviewed looking for any of the adverse events under study. The patient file in which one or more of the adverse events were found were recorded on the checklist. If the patient file had evidence of more than one adverse event they were all recorded. Each indication of one of the selected adverse events were recorded. For each of the adverse events the following indicators were used as evidence of the adverse event, unless the condition were present on admission, in that case the event were not recorded. The hospital uses two official languages English and French therefore, both indicators will be provided.

4.3 Indicators for documentation of an adverse event:

Urinary tract infection: Those who use French they write "infection urinaire" English write urinary tract infection in any patient file where I found those words was recorded as an adverse event acquired from the hospital.

Pressure ulcers: the files written in French where I found words like "escarre" and those in English where I found bed sores or pressure ulcers were all recorded.

Wound infection: the files where I found infection of surgical site, infected wound, or "infection de la plaie" were recorded.

Phlebitis: the files where I found IV infection, phlebitis, swelling on intravenous site or "phlebite" were recorded.

Pneumonia: the files where I found pneumonia or "pneumonie" were recorded.

Missed doses: When the drug were given it was signed for or a tick is put in front of the time the drug were administered. In the files where i found no signature or tick on the treatment sheet I recorded it as a missed dose. Because adverse events occur over a number of days and are not likely to be related to the staffing on one particular day, data were aggregated and mean for each adverse event per month on each unit were calculated.

4.4 Population and Sample description

The population for the study were all patient files admitted to a selected medical and surgical ward for the months of January to June 2006. A sample of two months from this six-month period were selected from the two populations; the patient files and staffing duty plan for these months formed the samples. Surgical and medical units selected at CHUK were found to have a total of 797 admissions during the selected two-month period. Therefore, all records were reviewed from 1st February to 31st March 2006. There were 241 records from medical ward in February 2006 and 261 records in March 2006. A total of 502 records were reviewed from the medical ward for the two-selected month. There were 140 records from the surgical ward in February 2006 and 155 in March 2006 with a total of 295 records reviewed for the selected two months.

4.5 Pilot Study

To test the reliability of the instruments a pilot study were conducted. The pilot study were conducted in a private ward with a capacity of 32 patients; the medical side of the unit has 16 patients and the surgical side 16 patients. The private ward is a different setting from the actual wards where the main study were conducted. For example, the private ward has rooms that accommodate two patients while the medical and surgical

wards for the main study have only ward type rooms with 53 beds and 37 beds per room, respectively.

4.5.1 Adverse event data

Ten records were randomly selected from patients' files, five from the medical and five from the surgical side. Findings related to adverse events revealed that, two patients missed their drugs because it was out of stock, and three patients from the medical side missed medication doses, instead of receiving the drugs three times a day they were given only two times a day.

The files were reviewed in comparison with the checklist instrument for adverse events. Any file where adverse events under study were found were recorded on the checklist. Using the indicators indicated in figure 4.1 it was easy to tell which adverse events were present in the file.

Missed-dose errors were errors in which doses of medications were not available to nursing personnel at the time they were needed for administration; or the nurse were doing other care at the time other than administration of the drug .

4.5.2 Staffing data

There were 21 nurses, two registered nurses (diploma) and 19 enrolled nurses (certificate) on the private ward. Furthermore, the private ward has two shifts per day with five nurses on night shift and 11 nurses on day shift.

4.5.3 Summary of the pilot study

From such a small sample size it was difficult to determine if there is any relationship between staffing on the private ward and adverse events since only two adverse events (only one a nurse sensitive event) occurred in the pilot study. However, the pilot study did highlight one anomaly in the adverse events instrument. As a result, a change was made on the instrument. The researcher found that the instrument for adverse events for the medical ward included the adverse event of wound infection. This item was removed from the medical ward and remained on the instrument for the surgical ward. The medication error due to drugs out of stock is not a nurse sensitive outcome but is an administration error; this adverse event was removed on the checklist.

4.6 Main study

4.6.1 Checklist instrument for adverse events

The checklist instrument were used to record the adverse events that appeared in each patient file. On discharge the nurses' notes and doctors' notes were put together as one patient file therefore, the information was obtained from both nurses and doctors notes.

4.6.2 Hypothesis Testing

In this section the test results of H_1 and H_2 are provided.

Hypothesis One: There is a negative relationship between nurse staffing and selected nurse sensitive outcomes

Hypothesis Two: There is a negative relationship between nurse educational preparation and selected nurse sensitive outcomes

Of the adverse events studied, four outcomes were found to have statistically significant relationships with nurse staffing, phlebitis, wound infection, pneumonia, and pressure ulcers. As expected RN staffing were found to be inversely related to the occurrence of pneumonia, pressure ulcers, and phlebitis. Wound infection were positively related with the RNs and ENs.

The data indicated that pressure ulcers on the medical ward in February 2006 were higher 51 % ($n = 60$) than in March 2006 (34.9%; $n = 36$). On the surgical ward pressure ulcers were higher for March 13.4 % ($n = 15$) than in February 5.8 % ($n = 6$). Missed medication doses also had a higher percentage 42.5 % ($n = 50$) on the medical ward in February than in March 29.1 % ($n = 30$). The surgical ward had a higher rate of missed medication doses in February 29.2 % ($n = 30$) than in March 17.9 % ($n = 20$). The adverse event of phlebitis were high on the medical ward for both months with 24.3 % ($n = 29$) in February and 24.7 % ($n = 25$) in March. The adverse event of phlebitis had a rate of 6.3 % ($n = 7$) in March and a rate of 3.9 % ($n = 4$) in February. The adverse event of wound infection was 14.6 % ($n = 15$) in February and 22.4 % ($n = 25$) in March on the surgical ward. There was no evidence of systemic infection, wrong drug, and wrong dose on either medical or surgical wards in February and March 2006. There was no evidence of pneumonia on the surgical ward in February and March 2006. Table 4.6.3 indicates the percentages and frequency of adverse events found in the medical and surgical wards in February and March 2006.

Table 4.6.3 frequency and percentage of adverse events on medical and surgical ward for February and March 2006.

Events	%	Med ical February Frequency	%	Med ical March Frequency	%	Surgical February Frequency	%	Surgical March Frequency
Urinary tract infection	4.3%	5	5.8%	6	3.9%	4	2.7%	3
Pressure ulcer	51%	60	34.9%	36	5.8%	6	13.4%	15
Pneumonia	6.8%	8	5.8%	6	0	0	0	0
Phlebitis	24.7%	29	24.3%	25	3.9%	4	6.3%	7
Medication errors	0	0	0	0	0	0	0	0
-Missed dose	42.5%	50	29.1%	30	29.2%	30	17.9%	20
Wound infection					14.6%	15	22.4%	25

Adverse events were analyzed using the Poisson regression with the mean total number of nurses, mean RNs and mean ENs (degree nurse were not considered because there was only one BN nurse on either of these wards).

4.6.4 Analysis of adverse events

In this section the data on adverse events on the medical and surgical wards for February and March 2006 are provided. There were no cases of sepsis, wrong drug and wrong dosage of medication. In general the adverse events of pressure ulcers were high in both the medical and the surgical units, whereas urinary tract infections were low on both units.

4.6.5 Analysis of adverse events in medical unit February 2006

In this section the percentages were calculated by dividing the number of adverse events by the total number of documents reviewed times one hundred. There were 241

patient files on the medical ward in February all were reviewed. Forty percent ($n = 81.6$) had no evidence of adverse events while 5.8% ($n = 51$) of patients had adverse events with underlying diseases like HIV/AIDS and diabetes. Only 4.3% of patients had evidence of urinary tract infection during their stay in hospital. From the remaining number, 51% ($n = 60$) of patients developed pressure ulcers, 24.7% ($n = 29$) patients had phlebitis 6.8% ($n = 8$) patients acquired pneumonias, 42.5% ($n = 50$) patients missed a dose of medication; instead of three times daily the medication was given two times and instead of two times daily they received the medication only once.

Table 4.6.5 adverse events on the medical unit for February 2006.

Month	UTI	Pressure ulcers	Phlebitis	Pneumonia	Missed dose
February	5	60	29	8	50

4.6.6 Analysis of adverse events in medical unit March 2006

Files for 261 patients were reviewed with 20.3% ($n = 53$) files indicating no adverse events. 3.7% ($n = 37$) files had underlying diseases and were excluded, 5.8% ($n = 6$) patients had evidence of urinary tract infection, 34.9% ($n = 36$) patients developed pressure ulcers, 5.8% ($n = 6$) patients acquired hospital pneumonia, 3.9 %($n = 25$) patients had evidence of phlebitis, and 29.2% ($n = 25$) missed a dose of medication. Table 4.6.6 displays findings of medical unit for the month of March 2006. The total numbers of each adverse event were calculated by dividing the event by total number of files reviewed times a hundred to get the number in percentages.

Table 4.6.6 adverse events on the medical unit for February 2006.

Month	UTI	Pressure ulcers	Phlebitis	Pneumonia	Missed dose
March	6	36	25	6	30

4.6.7 Analysis of adverse events in surgical unit February 2006

Files for 140 patients were reviewed with 53.6% ($n = 75$) files having no evidence of the adverse event under study, 1.7% ($n = 2$) files had evidence of adverse events with underlying diseases and were excluded, 3.9% ($n = 4$) files had an evidence of urinary tract infection, 5.8% ($n = 6$) files had evidence of pressure ulcers, 3.9% ($n = 4$) files showed evidence of phlebitis, 29.2% ($n = 30$) missed a dose of medication and 14.6% ($n = 15$) had evidence of wound infection. The total numbers of each adverse event were calculated by dividing the event by total number of files reviewed times a hundred to get the number in percentages. Table 4.6.7 shows the frequency of the adverse events for March 2006 on the surgical ward. Among the files reviewed from the medical and surgical wards in February and March 2006 there were no evidence of systematic sepsis.

Table 4.6.7 adverse events on surgical unit for February 2006

Month	UTI	Pressure sores	Wound infection	Phlebitis	Missed dose
February	4	6	15	4	20

4.6.8 Analysis of adverse event in surgical unit March 2006

Files for 155 patients were reviewed on surgical ward for March 2006, 67.2% ($n = 75$) files had no evidence of the adverse event under study, 0.7% ($n = 1$) file had adverse events with underlying disease and were excluded, 2.7% ($n = 3$) files had urinary tract infection, 34.9% ($n = 15$) files indicated that patients developed pressure ulcers, 22.4% ($n = 25$) files showed evidence of wound infection, 6.3% ($n = 7$) files had evidence of phlebitis, 17.9% ($n = 20$) missed a dose of medication.

Table 4.6.8 adverse events on surgical unit March 2006

Month	UTI	Pressure sores	Wound infection	Phlebitis	Missed dose
March	3	15	25	7	30

4.6.9 Instrument for staffing

The instrument for staffing was used to record the number of nurses and their qualifications, which were on duty in the months of February and March 2006 in both the medical and surgical wards. A high nurse patient ratio was indicated by the data comparing mean number of nurses with mean patient census.

4.6.10 Analysis of staffing data and patient census

There are three categories of nurses in the hospital where the study was conducted. The categories were degree nurses (Honors or Bachelors), Registered nurse (diploma) and Enrolled nurses (certificated). The units under study were medical and surgical units. In the following sections analysis of the total nurses per ward per month, patient census and nurse- patient- ratio are provided.

The mean total number of nurses in all categories who were on duty on medical ward February 2006 was 13.2. There was a mean of nine nurses, 1.3 registered nurses, and 11.6 enrolled nurses and a mean patient census of 117.6. The mean nurse patient ratio for February was one nurse per 11 patients. Table 4.6.10 displays the mean number of nurses on the medical ward February 2006. Patient census and nurse: patient ratio for this period.

4.6.10 Staffing data on medical unit February 2006

Month	RN mean	EN mean	Degree mean	Total mean	Patient census mean	Nurse:Patient Ratio
Feb	1.32	11.61	.87	13.21	117.57	1:11

4.6.11 Staffing data on medical unit March 2006

The mean number of nurses on medical March 2006 was 10.8, with a mean of 1.00 degree nurse, .8 registered nurses and 10 enrolled nurses with a mean patient's census of 103 for March 2006. The mean nurse patient ratio for March was 1:3 Table 4.6.11 indicates the number of nurses who were on duty in March, patient census and nurse: patient ratio.

Table 4.6.11 Staffing data on medical unit March 2006

Month	RN mean	EN mean	Degree mean	Total mean	Patient census mean	Nurse:Patient Ratio
March	.77	10.02	1.00	10.79	103.04	1:13

4.6.12 Staffing data on surgical unit February 2006

The surgical ward had a mean of 11.5 nurses with a mean of 1.8 registered nurses, and 10.5 enrolled nurses and total mean census of 102.8 patients. The mean nurse patient ratio for February was 1:11. Table 4.6.12 displays the number of nurses and their qualifications on duty on both day and night shifts on surgical ward in February 2006.

Table 4.6.12 Staffing data on surgical unit February 2006

Month	RN mean	EN mean	Total mean	Patient census mean	Nurse: patient ratio
Feb	1.83	10.50	11.47	102.84	1:11

4.6.13 Staffing data on surgical unit March 2006

The surgical ward had a mean patient census of 111.6 and a mean of 14.6 nurses with 1.4 registered nurses and 12.9 enrolled nurses. The mean nurse patient ratio for March was 1:11 Table 4.6.13 indicates the staffing data and patient census.

Table 4.6.13 Staffing data on surgical unit March 2006

Month	RN mean	EN mean	Total mean	Patient census mean	Nurse: patient ratio
March	1.39	12.87	14.60	111.55	1:11

4.7 Poisson regression analysis

Poisson regression is often used to analyze count data. It can be used to model the number of occurrences of an event of interest or the rate of occurrence of an event of interest, as a function of some independent variables. The Poisson regression test states, if the incidence rate ratios (IRR) is greater than >1 it is a risk and when it is less than <1 it is protective of the event of interest (dependent variable), in this case patient adverse events.

Because it was necessary to aggregate data to meaningfully establish strength and direction of relationships, Poisson regressions were calculated. This statistic determines the strength and direction of relationships between the independent variables (staffing and staff qualifications) and the dependent variables (adverse events) for each ward and the month on aggregated data.

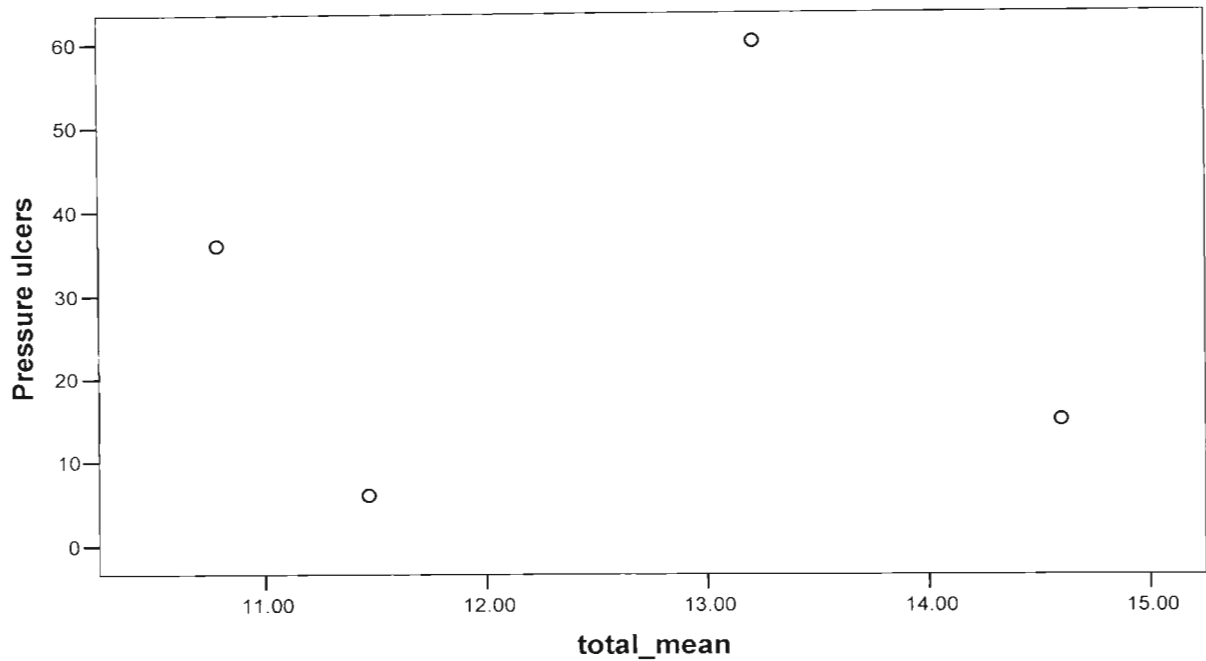
Initially, the staff data and adverse events were merged together to make it possible to calculate the Poisson regression. The mean number of nurses, according to their qualifications, and the mean patient census and mean adverse event, were calculated per unit and month in order to use the Poisson regression.

The adverse events which were under study are UTI, was protective and not statistically significant with the mean number of nurses. Other events like pneumonia, phlebitis, and missed dose were slightly protective and not statistically significant with the mean number of nurses. Pressure ulcers and wound infection were risk and not statistically significant.

4.7.1 Urinary tract infection

The relationship between urinary tract infection and total mean number of nurses of all qualifications (degree, registered and enrolled nurses) for the medical and surgical ward in February and March 2006. The rate of UTI on the medical in March was 5.8% ($n = 6$) slightly greater than 4.6% ($n = 5$) found in February 2006. The UTI rate in March for major surgical procedure is 2.7% ($n = 4$) slightly decreased from February 2006 (3.9%; $n = 4$). There was a protective not significant trend between the mean number of nurse and the urinary tract infection. Figure 4.7.1 Displays relationship between urinary tract infection and staffing data on both medical and surgical units, February, March 2006

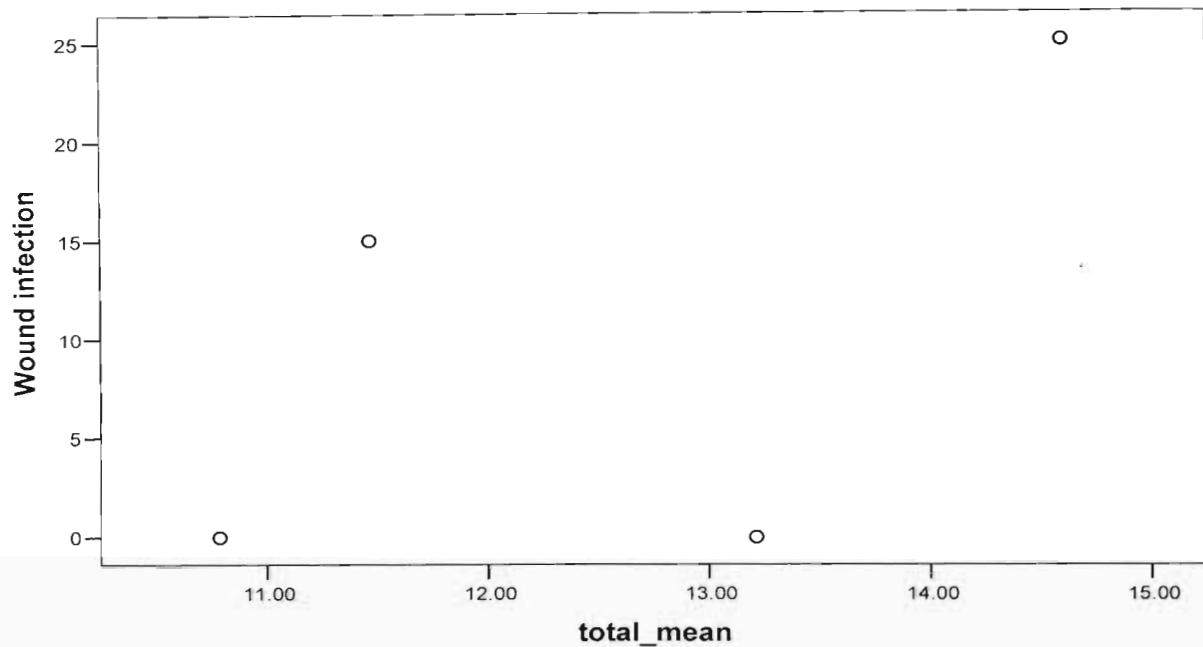
Figure 4.7.2 Relationship between pressure ulcers and staffing data on both medical and surgical units, February and March 2006



4.7.3 Wound infection

The rate of wound infection in March 2006 for major surgical procedures is 22.4% ($n = 25$), which were considerably greater than the 14.6% ($n = 15$) rate of February 2006. The Poisson regression indicated a significant risk relationship ($IRR = 1.52$; $p = .000$) between the mean number of nurses and wound infection. Figure 4.7.3 displays the relationship between nurse staffing and wound infection.

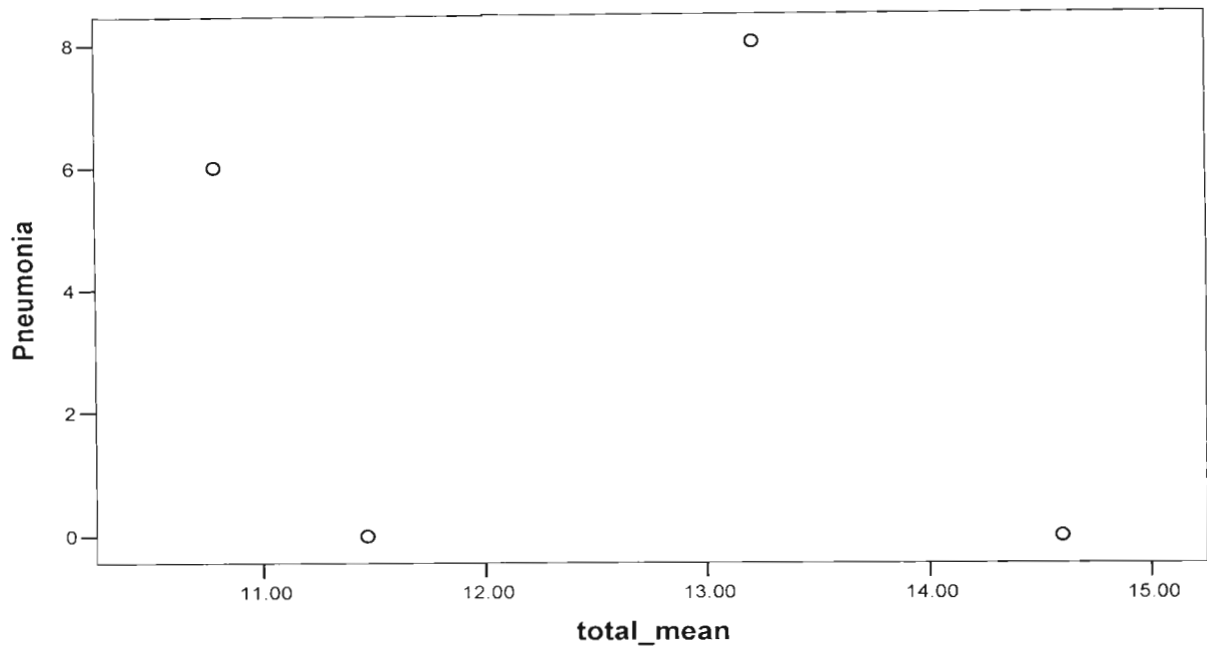
Figure 4.7.3 Relationship between wound infection and staffing on the surgical ward in February and March 2006.



4.7.4 Pneumonia

The incidence rate of pneumonia on the medical unit in February and March 2006 was 5.8% ($n = 6$), there was a slight decrease of 1% from February 2006 (6.8%; $n = 8$). There was a slight protective trend (IRR = .85; $p = 0.39$) not significant between the mean number of nurses and pneumonia. Figure 4.7.4 visually displays the relationship between pneumonia and aggregated staffing data.

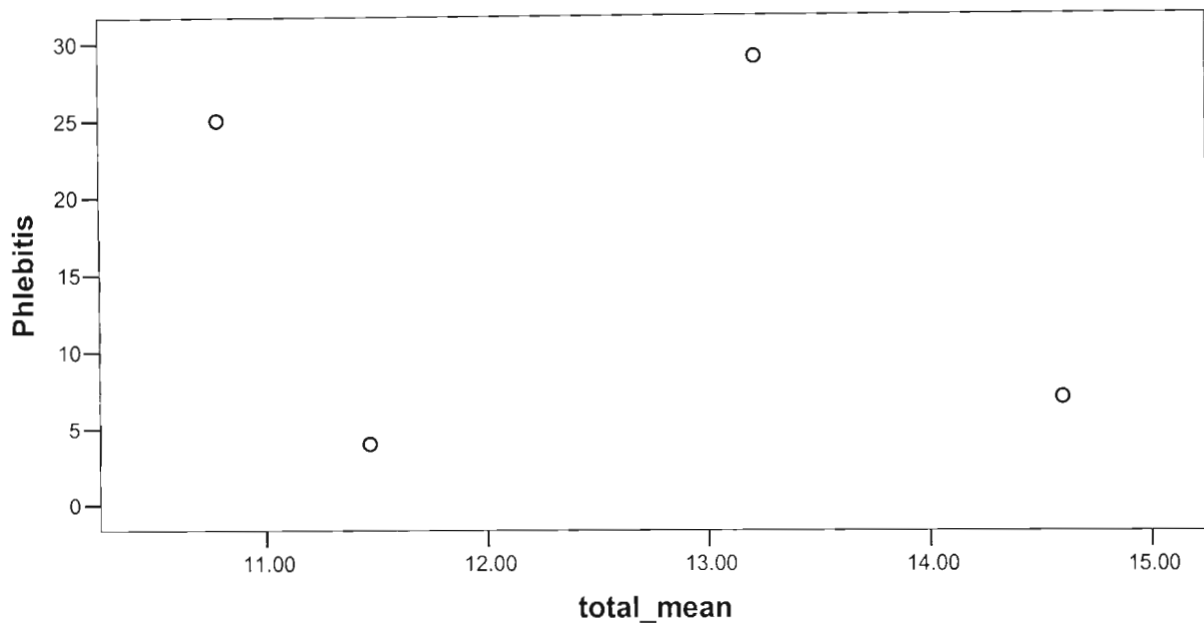
Figure 4.7.4 Relationship between pneumonia and staffing on the medical unit in February and March 2006.



4.7.5 Phlebitis

The incidence rate of phlebitis on the medical ward in March 2006 was 24.3% ($n = 25$), there was a slight decrease of .4% from the population in February, which was 24.7% ($n = 29$). Major surgical patients in March 2006 had a 6.3% ($n = 7$) rate of phlebitis, which is considerably greater than the 3.9% ($n = 4$) rate in February 2006. From the IRR (.91) There was a slightly protective, though not significant ($p = 0.30$) relationship between the mean number of nurses and phlebitis. Figure 4.7.5 visually displays the relationship between phlebitis and aggregated staffing data.

Figure 4.7.5 the relationship between phlebitis and staffing on medical and surgical units in February and March 2006.



Medication errors

The following describes the findings related to missed dose of medication, i.e., less than was prescribed.

4.7.6 Missed doses

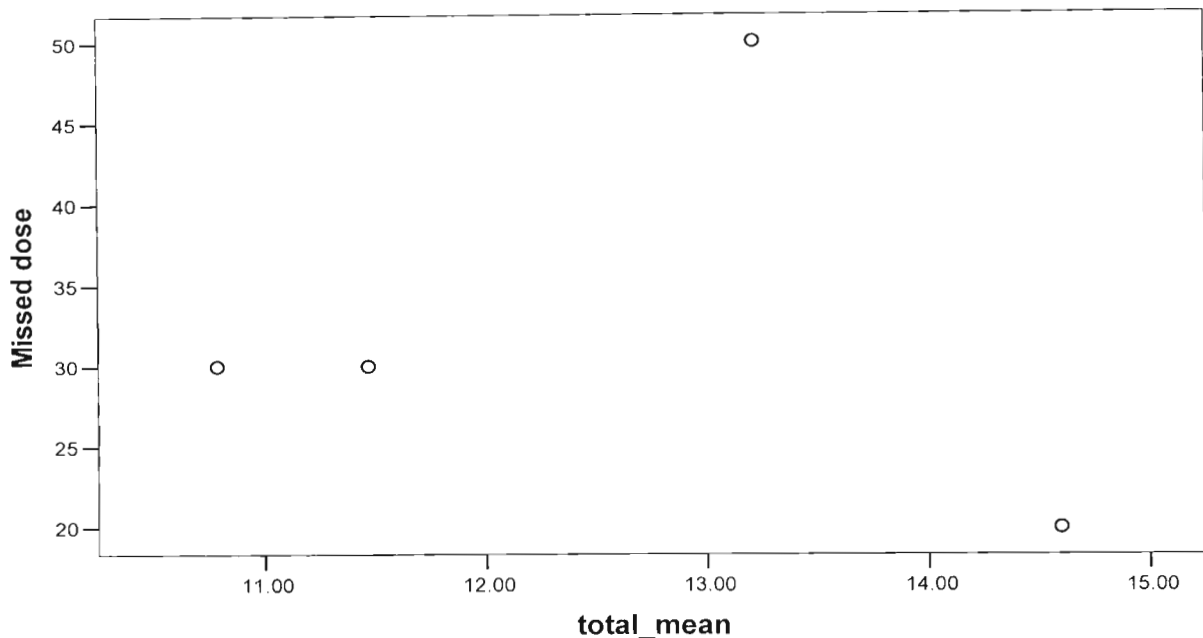
The medical ward population who missed the dose of medication in March 2006 were 29.1% ($n = 30$) with a decrease from those of February 2006, 42.5 % ($n = 50$).

The number of patients who missed a dose of medication in March on the surgical ward were 17.9% ($n = 20$) with a decrease from February 2006, which were 29.2% ($n = 30$).

There was a slightly protective and not significant relationship ($IRR = .98$; $p = 0.69$) between the mean number of nurses and missed dose of medication.

Figure 4.7.6 indicates the relationship between mean number of nurses and missed dose of medication on medical and surgical ward February and March 2006.

Figure 4.7.6 the aggregated data of missed dose with the staffing data on medical & surgical units February & March 2006.



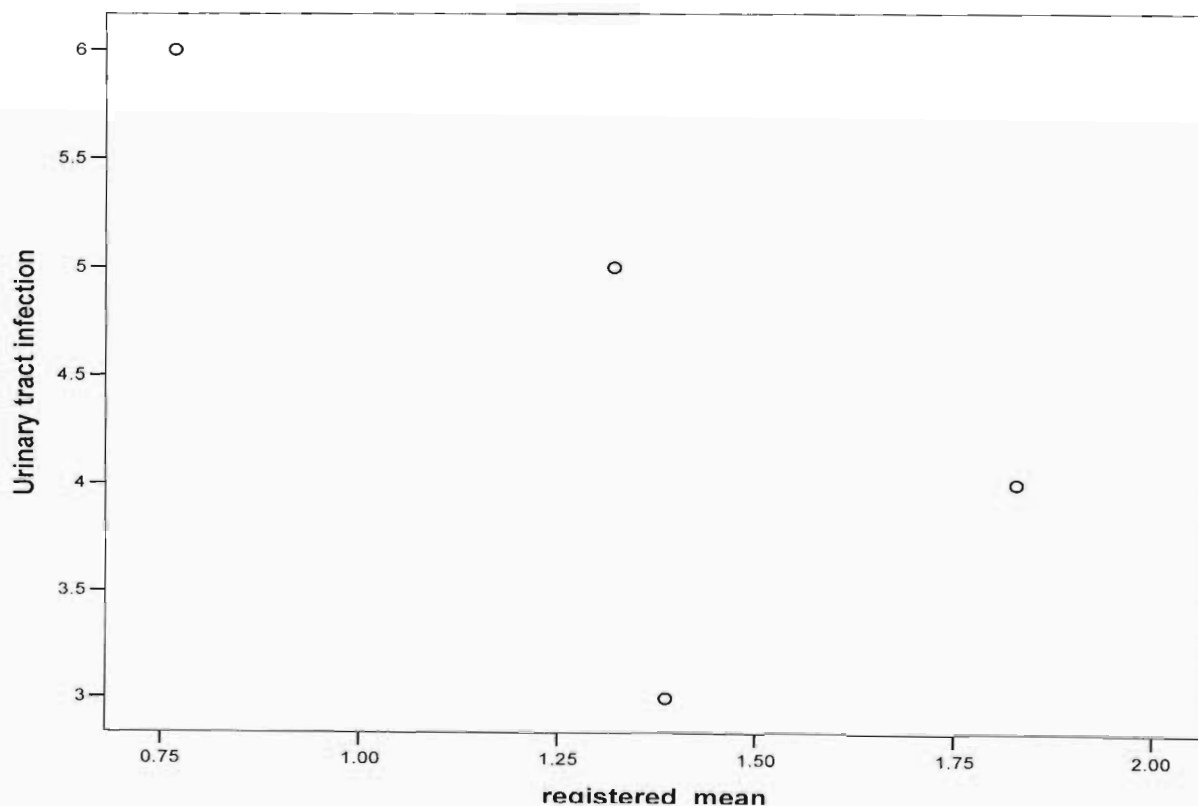
4.7.7 Mean registered nurses

The following section describes the findings of the Poisson regressions that examined the relationship between the adverse events and mean number of registered nurses on the medical and surgical wards for February and March 2006. The adverse events such as pressure ulcers, pneumonia, and phlebitis were very protective and statistically significant for every 1% increase of RNs at 63%, 82%, and 71%, respectively. Whereas UTI was protective and not statistically significant and wound infection was highly risky with the increased number of RNs. The adverse events of missed dose were low protective and not statistically significant with the RNs.

4.7.8 Urinary tract infection

The following percentage of patients developed urinary tract infection on the medical ward in March 2006; 5.8% ($n = 6$), which was slightly higher than those in February 2006 (4.6%; $n = 5$). The rate of UTI in March 2006 for major surgical procedures was 2.7% ($n = 3$), a slight decrease from February 2006 which was 3.9% ($n = 4$). There was a somewhat protective but non significant relationship ($IRR = .63$; $p = 0.46$) between mean number of registered nurses and urinary tract infection. Figure 4.7.8 indicates the relationship between RNs and urinary tract infection on medical and surgical ward 2006.

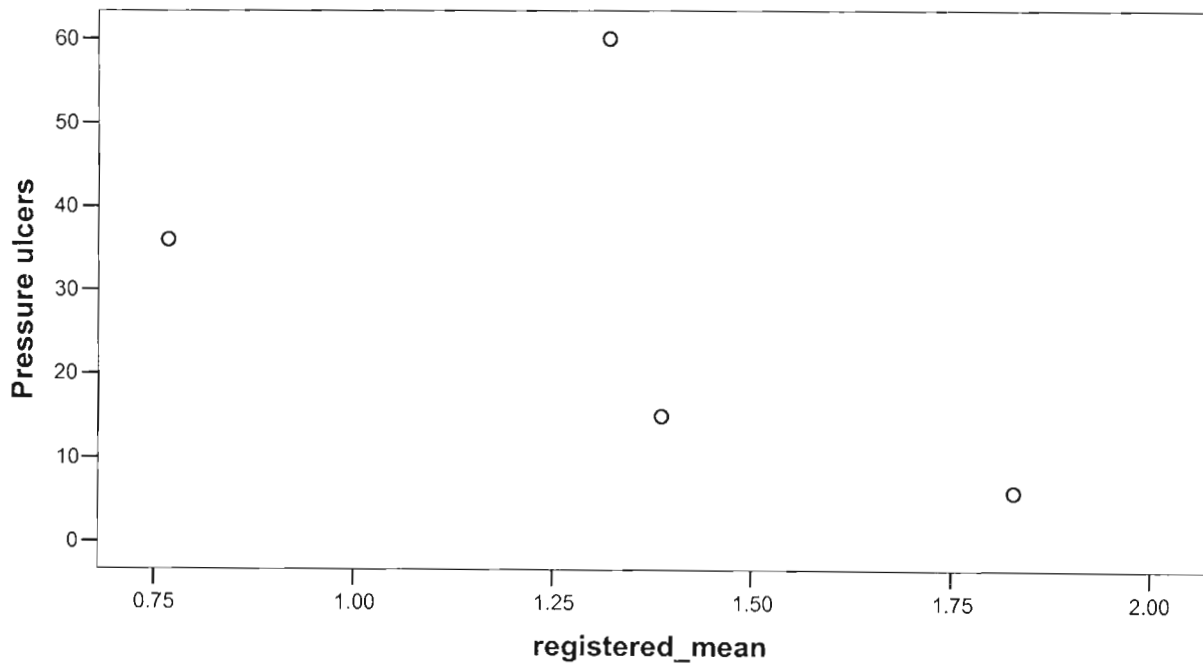
Figure 4.7.8 relationship between urinary tract infection and RNs on the medical and surgical units in February and March 2006



4.7.9 Pressure ulcers

The rate of pressure ulcers on the medical ward in March 2006 was 34.9% ($n = 36$) with a decrease from February 2006 51% ($n = 60$). Pressure ulcers were found to occur in 13.4% ($n = 15$) of major surgical cases in March 2006 with an increase from February 2006 5.8% ($n = 6$). An increase in registered nurses was significantly protective (IRR = .38; $p = 0.000$) meaning that for every 1% increase in RNs there is an increase in protection of 63%. Figure 4.7.9 displays the relationship between mean RNs and pressure ulcers on medical and surgical wards in 2006.

Figure 4.7.9 staffing and adverse events of pressure ulcers.

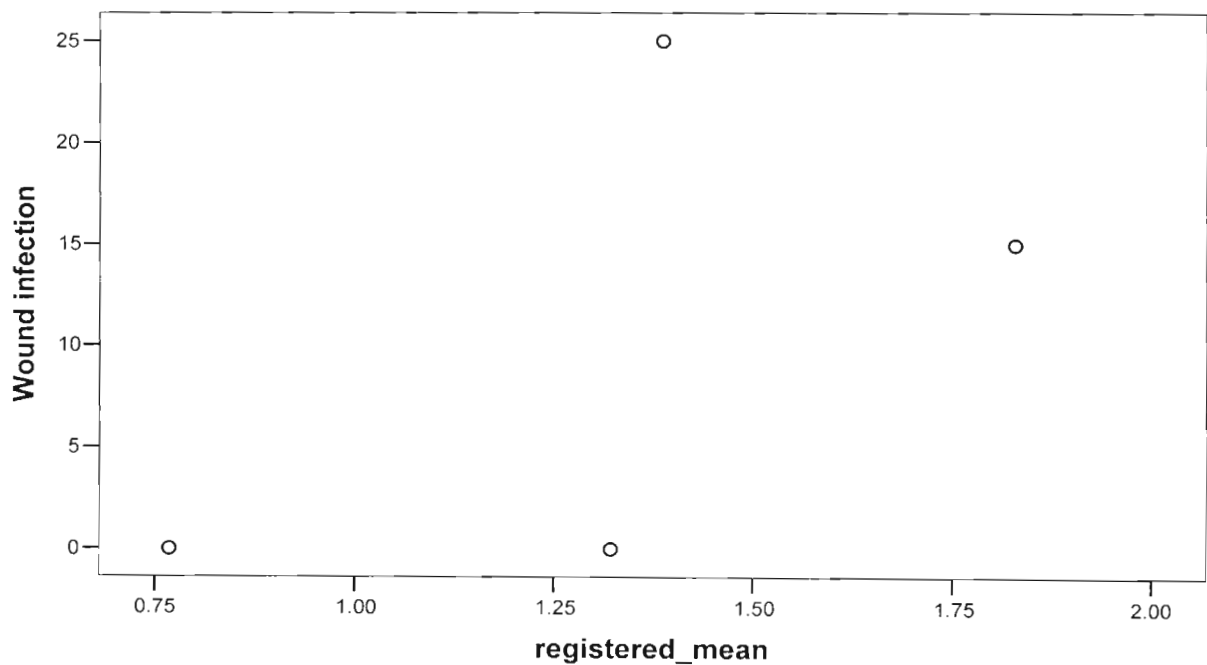


4.7.10 Wound infection

On the surgical ward in February 2006 the data indicated that there was a mean number of 1.8 RNs with the incidence rate for wound infection of 22.4% ($n = 25$), and March 2006 there was a mean number of 1.4 RNs on duty with an incidence rate of

14.6% ($n = 15$) . The data indicated a highly risky and statistically significant relationship ($IRR = 6.30$; $p = 0.000$) between wound infection and mean number of RNs. Figure 4.7.10 displays the relationship between RNs and wound infection on surgical ward in February and March 2006.

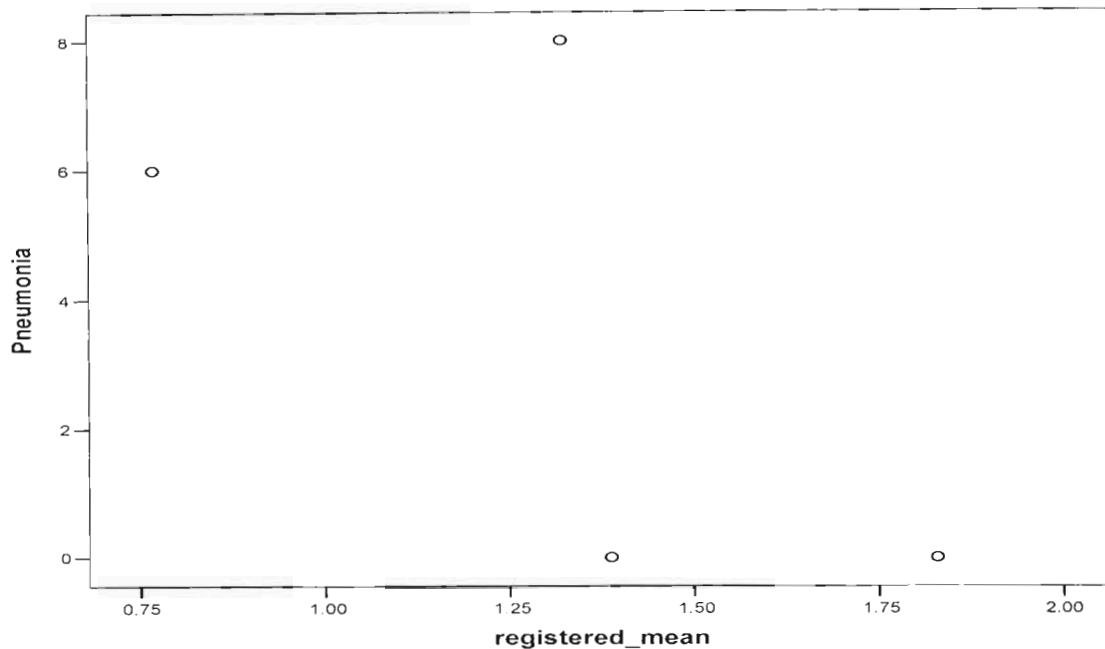
Figure 4.7.10 the relationship between wound infection and registered nurse on surgical ward February and March 2006.



4.7.11 Pneumonia

The incidence rate of pneumonia on medical in March 2006 occurred in 5.8 % ($n = 6$) with a slight decrease from February 2006, which was 6.8 % ($n = 8$). It was very protective and statistically significant at 82% protective with every 1% increase of RN. Figure 4.7.11 displays the relationship between RNs and pneumonia on the medical ward in February and March 2006.

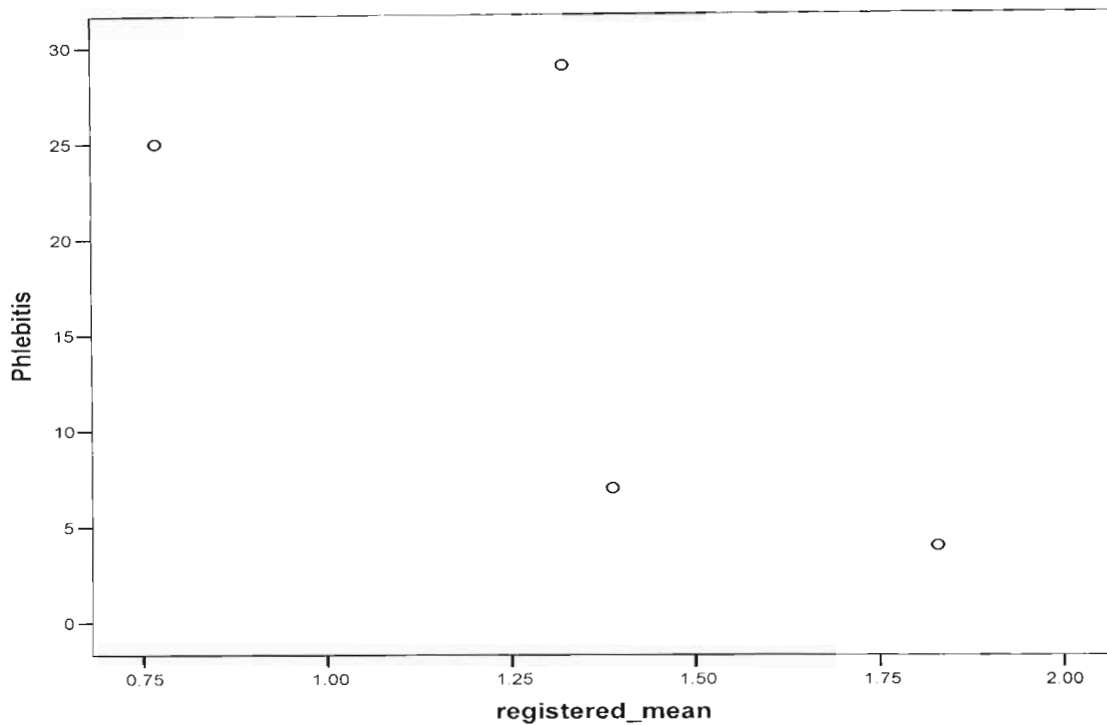
Figure 4.7.11 Relationship between pneumonia and RN on medical unit in February and March 2006



4.7.12 Phlebitis

On the medical ward the event of phlebitis was slightly higher 24.7% ($n = 29$) in February and 24.3% ($n = 25$) in March 2006. On the surgical ward in March 2006 there was an increased number of patients, phlebitis incidence was 6.3% ($n = 7$) compared to those in February 2006, which were 3.9% ($n = 4$). Registered nurses were protective and significant (IRR = .29; $p = 0.000$) every 1% increase in RNs giving a 71% in protection from phlebitis. Figure 4.7.12 indicates the relationship between mean number of RNs and phlebitis.

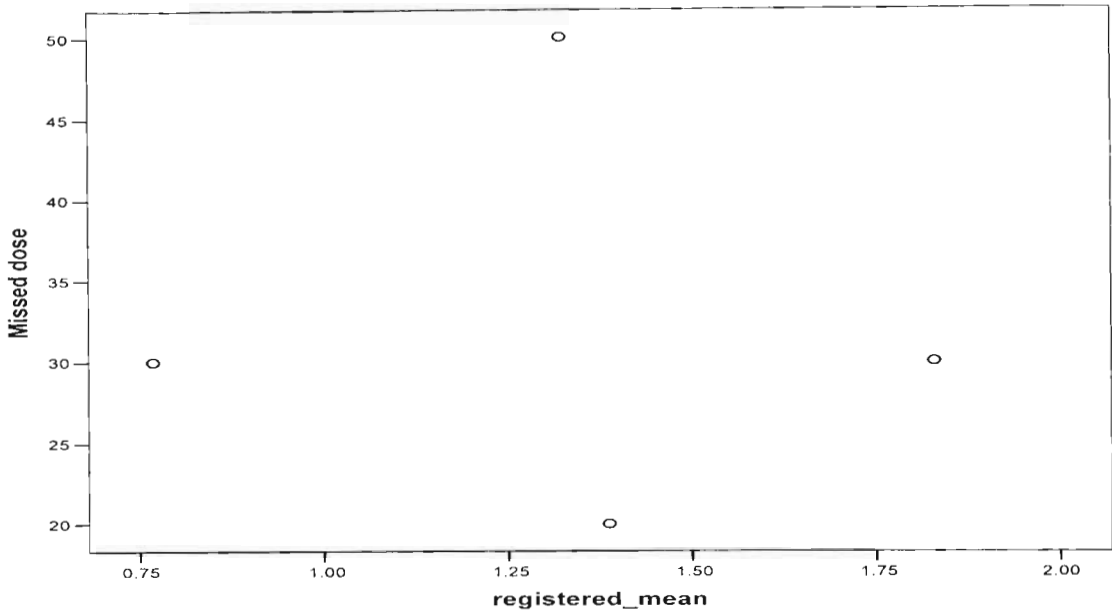
Figure 4.7.12 Relationship between phlebitis and RN on medical and surgical units February and March 2006.



4.7.13 Missed doses

On the medical and surgical wards the data indicated that an increased mean number of RNs was associated with an increased number of missed doses and the lower the mean number of RNs the lower the incidence of missed dose of medication. There was a low protective but not significant relationship ($IRR = .96$; $p = 0.87$). Figure 4.7.13 displays the relationship between mean RNs and missed medication dose.

Figure 4.7.13 Relationship between missed dose with the mean RN on medical and surgical units February and March 2006.



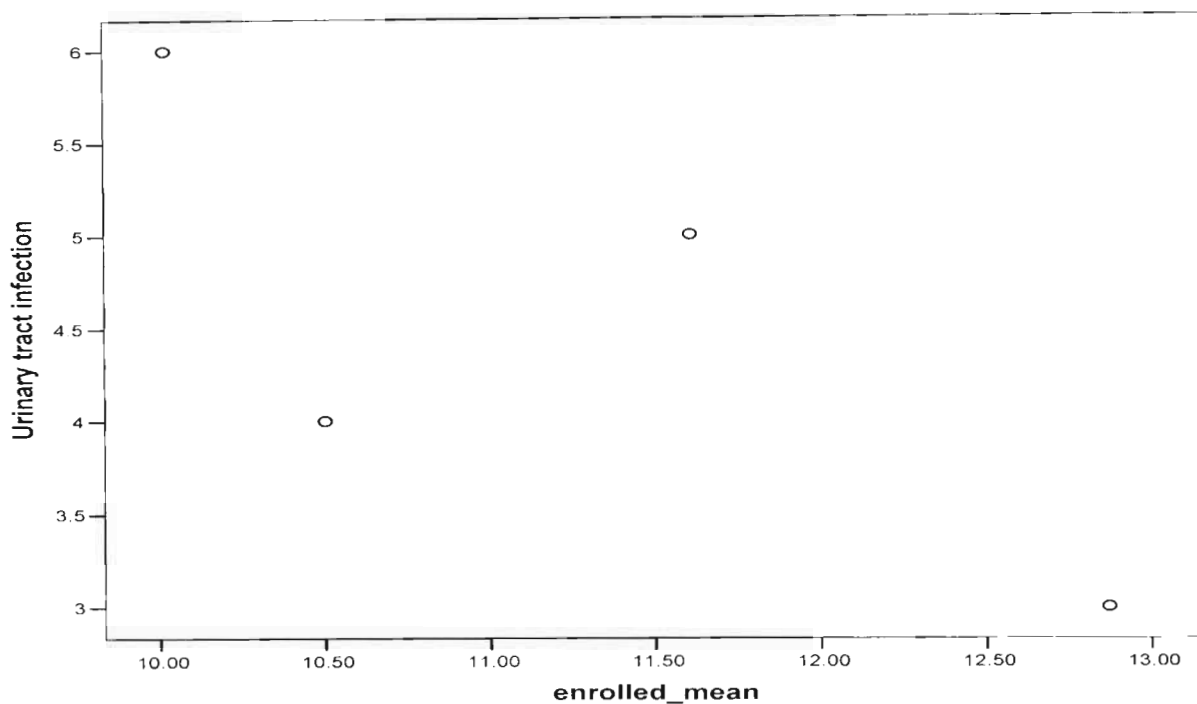
4.7.14 Enrolled Nurse (EN) mean

The adverse events which were low protective and not statistically significant with the ENs were UTI, missed dose, pressure ulcers, and those adverse events which were protective and not statistically significant were UTI, pneumonia, and phlebitis whereas wound infection was highly risky and significant with the ENs.

4.7.15 Urinary tract infection

The Poisson regression analysis demonstrated a trend that the higher the mean numbers of ENs on the medical and surgical wards the lower the incidence of urinary tract infection and the lower the number of ENs the higher the urinary tract infection (IRR = .84). Although this trend is not significant ($p= 0.43$) it indicated a potentially protective relationship between ENs and urinary tract infection. Figure 4.7.15 displays the relationship between urinary tract infection and mean number of ENs on the medical and surgical ward for February and March 2006

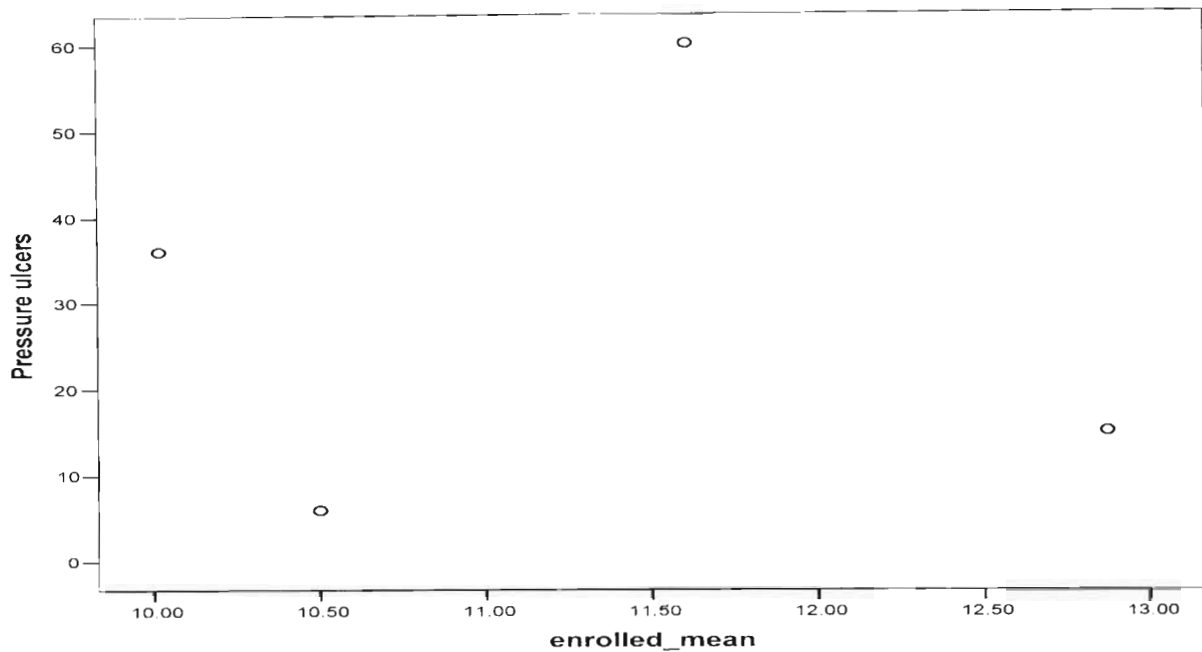
Figure 4.7.15 Relationship between urinary tract infection and the EN on the medical and surgical units in February and March 2006.



4.7.16 Pressure ulcers

The rate of pressure ulcers on the medical ward was high at 24.9% ($n = 36$) in February 2006 with increased mean number of ENs. In March the rate of pressure ulcers was lower when the mean number of ENs was lower, at 13.3% ($n = 60$). Pressure ulcers were found to occur in 4.2% ($n = 6$) of major surgical cases in February and 9.7% ($n = 15$) in March 2006. The data indicated a low protective and not significant trend (IRR = .98; $p = 0.80$) between ENs and pressure ulcers. Figure 4.7.16 displays the relationships between ENs and pressure ulcers on the medical and surgical units in February and March 2006.

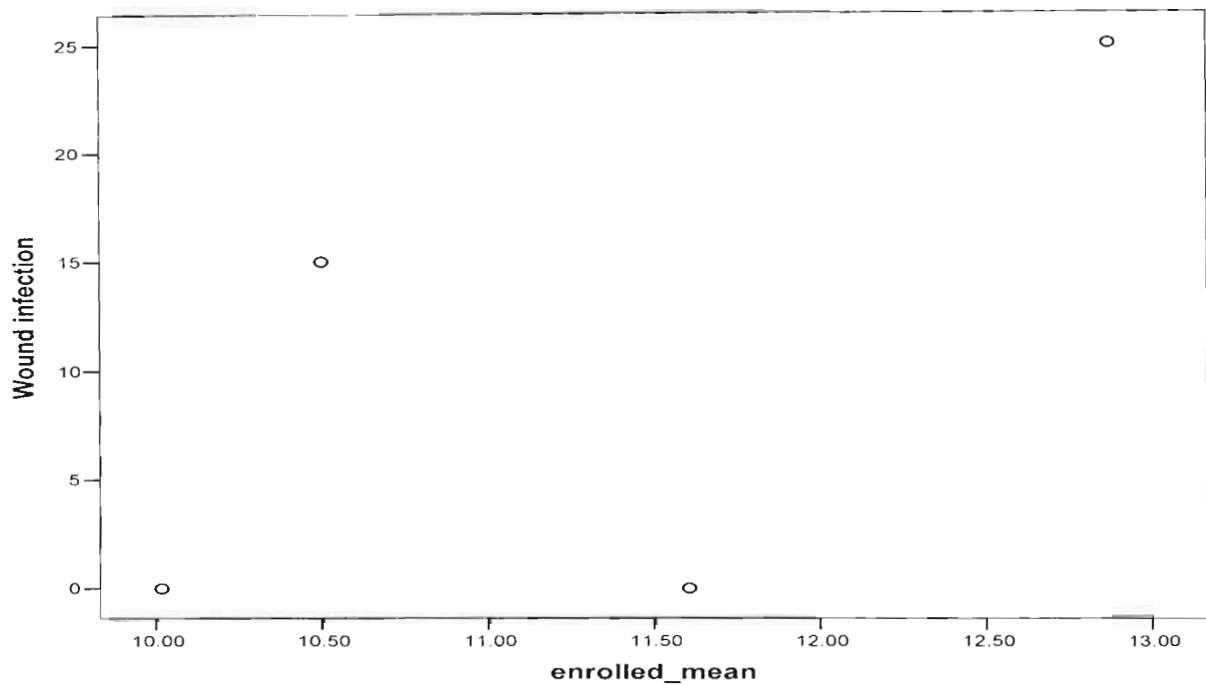
Figure 4.7.16 Relationship between ENs and pressure ulcers on the medical and surgical units in February and March 2006.



4.7.17 Wound infection

On the surgical ward in February 2006 the data indicated that the higher the mean number of ENs the higher the incidence of wound infection and the lower the mean number of ENs the lower the incidence rate of wound infection. Based on this data having more ENs is a risky and significant trend (IRR = 1.82; p = 0.000) between ENs and wound infection. Figure 4.7.18 indicates the relationship between ENs and wound infection on the surgical units in February and March 2006.

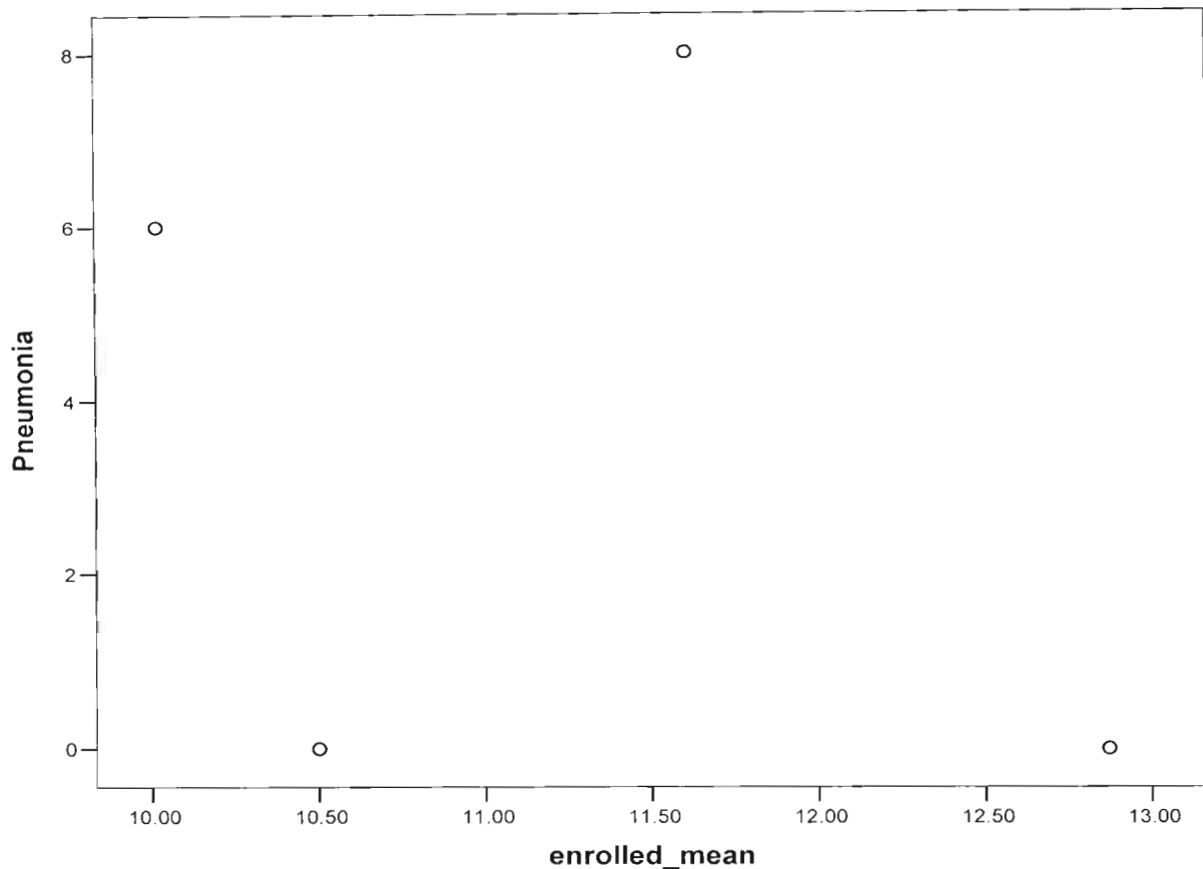
Figure 4.7.17 Relationship between ENs and wound infection on the surgical unit in February and March 2006.



4.7.18 Pneumonia

On the medical ward in February 2006 the higher the mean number of ENs the higher the incidence rate of pneumonia, in March 2006 the incidence of pneumonia decreased as the mean number of ENs decreased. There was a protective no significant trend (IRR = .75; $p = 0.28$) between mean number of ENs and the incidence of pneumonia. Figure 4.7.18 displays the relationship between ENs and pneumonia on the medical ward in February and March 2006.

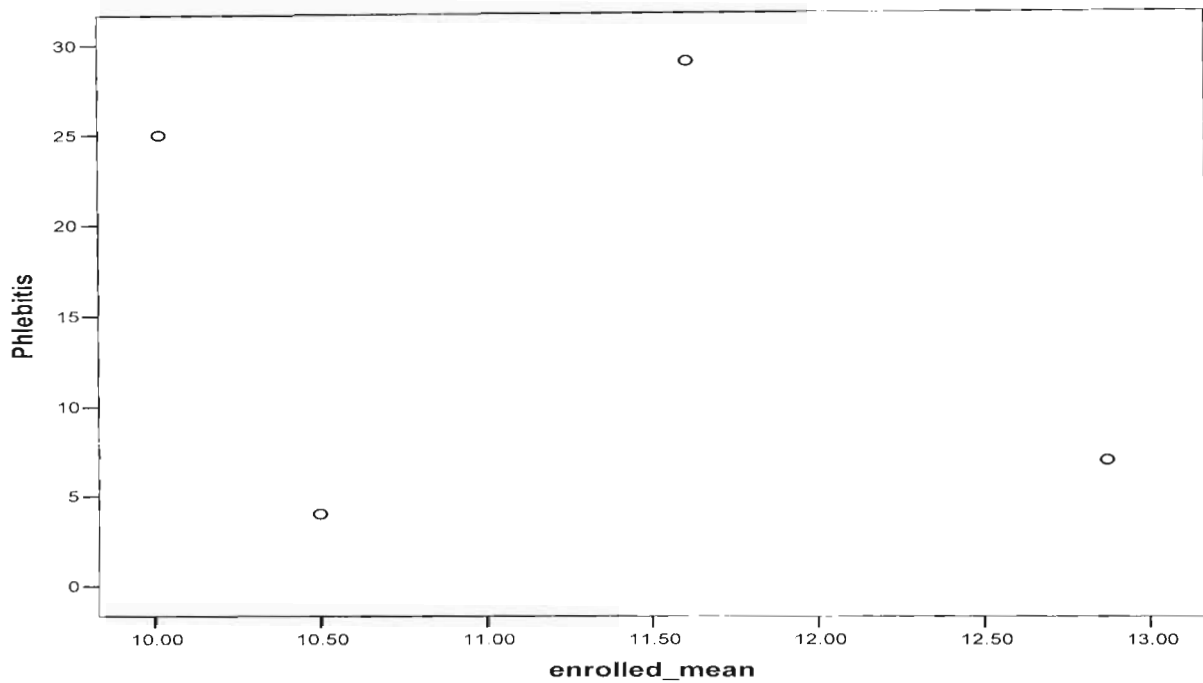
Figure 4.7.18 Relationship between ENs and pneumonia in the medical unit in February and March 2006



4.7.19 Phlebitis

On the medical and surgical ward the data indicated that the higher the mean number of ENs the higher number of patients with phlebitis and a decreased mean number of ENs was related to lower incidence of phlebitis. There was a protective trend, not significant ($IRR = .85$; $p = 0.18$), between ENs and phlebitis. Figure 4.7.19 indicates the relationship between mean ENs and the incidence of phlebitis.

Figure 4.7.19 Relationship between the ENs and phlebitis on the medical and surgical unit in February and March 2006.

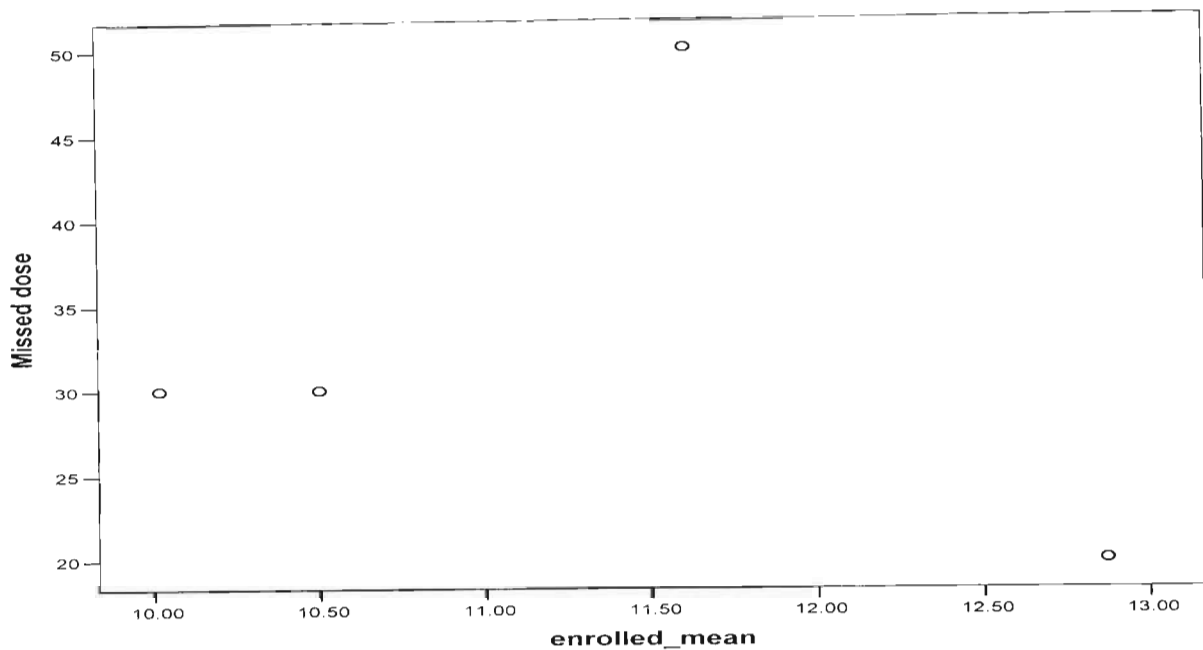


4.7.20 Missed doses

On the medical ward the data indicated that an increased mean number of ENs was associated with increased number of missed doses and the lower the mean number of ENs was related to lower incidence of missed dose of medication. There was a low protective trend, not significant (IRR = .94; $p = 0.47$), between ENs and missed dose.

Figure 4.7.20 displays the relationships between ENs and missed dose.

Figure 4.7.20 relationship between ENs and missed doses on medical and surgical units in February and March 2006.



Hypothesis Three: There is a positive relationship between nurse’s workloads and selected nurse sensitive outcomes.

4.8 Mean Nurse Patient Ratio and Adverse Events

Mean percent nurse patient ratios were calculate for each ward for February and March 2006. Although the nurse: patient ratio does not necessarily always an indicator of workload other research has used this ratio as a proxy for nurse workloads (Williams 2004). The mean percent represented staff of all categories of nurses for each day and night shift and daily patient census in these two months times 100. A Poisson regression was calculated for each ratio and each adverse event. The following section outlines the results of these Poisson regression analyses.

4.8.1 Mean nurse patient ratio and urinary tract infections

The Poisson regression analysis for mean percent nurse patient ratio with UTI resulted in an IRR = .78, indicating a protective but not significant relationship ($p = 0.35$).

4.8.2 Mean nurse patient ratio and pressure ulcers

The Poisson regression analysis for mean percent nurse patient ratio with pressure ulcers resulted in an IRR = .75, indicating a significant protective relationship ($p = 0.007$). This indicated that with each 1% increase nurse patient ratio (more nurses, fewer patients) there is a 25% increase in protection from pressure ulcers.

4.8.3 Mean nurse patient ratio and wound infection

The Poisson regression analysis for mean percent nurse patient ratio with wound infection resulted in an IRR = 2.18, indicating a significant ($p = 0.000$) increased risk in wound infection with an increased mean nurse patient ratio. This indicated that as the nurse-patient ratio was increased by 1% the risk of wound infection was increased by 1.87 times.

4.8.4 Mean nurse patient ratio and pneumonia

The Poisson regression analysis for mean percent nurse patient ratio with pneumonia resulted in an IRR = .39, indicating a significant protective relationship ($p = 0.04$). This indicated that with each 1% increase nurse patient ratio (more nurses, fewer patients) there was a 61% increase in protection from pneumonia.

4.8.5 Mean nurse patient ratio and phlebitis

The Poisson regression analysis for mean percent nurse patient ratio with phlebitis resulted in an IRR = .65, indicating a significant protective relationship ($p = 0.005$). This

indicated that with each 1% increase nurse patient ratio (more nurses, fewer patients) there was a 35% increase in protection from phlebitis.

4.8.6 Mean nurse patient ratio and missed dose

The Poisson regression analysis for mean percent nurse patient ratio with missed dose resulted in an IRR =.84, indicating a no significant protective relationship ($p = 0.06$).

Table 4.8 Relationship between Nurses: Patient Ratio and Adverse Events

Adverse Event	IRR	SD	z	p
UTI	.78	.21	-0.93	0.35
Pressure ulcers	.75	.79	-2.71	0.01
Wound infection	2.18	.33	5.10	0.00
Pneumonia	.39	.18	-2.03	0.04
Phlebitis	.65	.10	-2.79	0.01
Missed dose	.84	.79	-1.86	0.06

4.9 Summary of Findings

This was a retrospective, descriptive study conducted in Rwanda, central Africa. The study revealed significant relationships between a number of the independent variables (workload and expertise) and the dependent variable, adverse patient outcomes. Total staff means was related to UTI. Total RN staff means was related to the pressure ulcers, pneumonia and phlebitis were very protective and statistically significant at 63%, 82% and 71% respectively, were protective for every 1% increase in RN. EN staff means were related to missed dose, UTI, and pressure ulcers. Percent mean nurse: patient ratio was related to pressure ulcers, with each 1% increase nurse patient ratio

(more nurses, fewer patients) there was a 25% increase in protection from pressure ulcers, indicating a significant protective relationship ($p = 0.04$). With each 1% increase nurse patient ratio (more nurses, fewer patients) there was a 61% increase in protection from pneumonia, a significant protective relationship ($p = 0.005$), indicates that with each 1% increase nurse patient ratio (more nurses, fewer patients) there was a 35% increase in protection from phlebitis.

The fact that fewer outcomes among surgical patients than medical patients were found to be associated with the level of staffing by registered nurses. Surgical patient may be healthier than the medical patients and therefore have a lower risk of adverse event. There is a consistent evidence of association between high levels of staffing by registered nurses and lower rates of adverse outcomes, but no similar evidence related to Enrolled nurses. My findings may reflect the actual contribution of these different members of the nursing staff to patients' outcomes in general, or they may be specific to the outcomes examined in the study. It is possible that the outcomes for which I found significant association may be more sensitive to the contribution that the skills and education of registered nurses, in particular make to patient care.

Chapter Five

Discussion

5.1 Introduction

A discussion of the findings, limitations of the study and the recommendations will be presented in this chapter. By using a unit level study the discussion on findings would be applicable only on the units under study and may not be generalized to other units.

Because there were no studies of the relationship between nurse staffing and patient outcomes in Rwanda, this discussion of each research question compares findings from primarily the United States. The staffing variables related to adverse events under study were the workload and the staff expertise. In this study the researcher used nurse: patient ratio as an indicator of workload and level of qualification (degree, diploma or certificate) as staff expertise.

5.2 Mean number of nurses and adverse patient outcomes

The adverse events that were under study such as UTI, was protective but not statistically significant with the mean number of nurses. Other events like pneumonia, phlebitis, and missed medication dose were slightly protective but not statistically significant with the mean number of nurses. Pressure ulcers and wound infection were a risk but also not statistically significant.

The total nursing staff to patients was inversely related to the occurrence of many adverse events in the hospital. Table 4.4.1 in chapter four reflects the frequency and percentage of adverse events (nursing sensitive patient outcomes) found on the

medical and surgical ward in February and March 2006. These findings were consistent with Williams' study (2004) that looked at occurrence of adverse patient events

5.3 Staff qualifications and adverse patient outcomes

Patients were protected from pressure ulcers, pneumonia, and phlebitis, for every 1% increase of RNs at 63%, 82%, and 71%, respectively. The data indicated a highly risky and statistically significant relationship between wound infection and mean number of RNs, findings also noted by Blegen, Goode, and Reed (1998). These findings were similar to those in the study by Hall, et. al. (2004, p.44) conducted in Canada on nurse staffing models and patient outcomes in which the researchers found that higher professional nursing staff contributed to improved patient safety outcomes, specifically in medication error rates, wound infections, urinary tract infections, pressure ulcers and pneumonia.

It was possible that the high rate of pressure ulcers on medical ward was related to the increased number of patients where the total bed occupancy is twice the expected number of patients (frequently there are two patients to a bed). There are also nursing shortages and the bulk of the nurses on the wards are of lower qualification level who may not detect the complication before it occurs, or may not have enough time to assess the patient thoroughly because of their busy schedule

The unexpected findings of an inverse relationship between wound infection and both mean number of nurses and nurse: patient ratio would be due to any, or all, of the following.

- Incomplete risk assessment that would identify surgical patients at risk of wound infections (that is immobility and malnutrition).
- Poor hand washing by nurses who attend surgical patient may also be a factor to increase wound infection, especially since wound infections increased with increased numbers of nurses.
- Many surgical patients in a small area with the beds close together create a risk of cross infection from one patient to another.
- Possibly many nurses on the ward have excessive movements and increase exposure to infectious agents in these already congested wards.

Similar to the results of this study was a study by Needleman et, al (2003) conducted in 11 States in the USA to explore the relationship between the amount of care provided by nurses and patient outcomes. The researchers studied adverse outcomes for medical and surgical patients. The results indicated that higher registered nurse staffing levels were associated with lower adverse outcomes. Another study conducted in the UK by Rafferty (2006, p.5) found that the hospitals in which nurses cared for the fewest patients had a significantly lower surgical mortality rate compared to those in which nurses cared for a high number of patients. These findings suggested that an increase in number of RNs has differing effects on positive patient outcomes. A study by Jackson et. al. (2002) found that there was also evidence of association between a higher registered nurse workforce and fewer infections.

One might also conclude that there was insufficient RNs (Diploma or BN) on the wards where this study was conducted. Sasichay- Akkadechanut (2003 p.483) found similar

results in Thailand in a study conducted examining relationships between nurse staffing and in hospital mortality. This study revealed that the staffing variable significantly related to in-hospital mortality was the ratio of total nursing staff to patients.

5.4 Nurse: patient ratios and adverse patient outcomes

The findings of this study revealed an inverse significant relationship between nurse: patient ratio and pressure ulcer rates. A statistically significant protective relationship 1% increase of nurse: patient ratio resulted in a protective effect of 25%, against pressure ulcers. Nurses are the only professional caregivers at the bedside of an increasingly acute in-patient population, because they are there 24 hours per day they can intervene promptly at the first sign of trouble. On the medical ward there was a high incidence rate of pressure ulcers, possibly due to large number of patients and the preponderance of nurses who are qualified at the level of ENs. The insufficient number of RNs (Diploma and BN) on the wards where the study was conducted are consistent with Dunton (2005) who found that units that had no pressure ulcers had registered nurse: patient staffing ratios that ranged from approximately 1:7 to 1:1 and concluded that appropriate, effective and efficient nursing care involves more than minimum staffing ratios.

Nurse: patient ratio and pneumonia was significantly related with each 1% increase nurse patient ratio (more nurses, fewer patients) there was a 61% increase in protection from pneumonia. These results are consistent with what Brown (2001) found in a study conducted in the USA. This study found a relationship between low staffing and poor patient outcomes. There was a significant protective relationship ($p = 0.005$) between

nurse: patient and phlebitis with each 1% increase nurse patient ratio (more nurses, fewer patients) there was a 35% increase in protection from phlebitis.

Inadequate staffing was considered to be one of the working conditions that precipitate errors. Understaffing results in high workloads and time pressures. Increased fatigue and stress caused by workloads and excessive overtime may predispose the nurse to errors and prevent nurses from adhering to quality standards of care (Cho, 2001, p.80). Inadequate nurse staffing may also cause miscommunication between nursing staff and other health care providers and force new nursing personnel to conduct unfamiliar tasks without sufficient knowledge and experience.

The findings in this study with regard to infection are similar to a study conducted in the US by Nevada RN Formation (2003), which looked at hospital and Medicare data in nine states in five categories of adverse outcomes: length of hospital stay, hospital acquired pneumonia, postoperative infection, pressure ulcers, and hospital-acquired

This study was conducted in a setting of few registered nurses to enrolled nurses. With one registered nurse to eighteen enrolled nurses on medical ward and one registered nurse to twenty enrolled nurses on the surgical ward, it was surprising that the effect of RNs on patient outcomes were significant in this study.

5.6 Recommendations

The following recommendations are made as a result of the study findings.

- The hospital management needs to consider recruiting more nurses, preferably registered nurses and degree nurses, to improved quality of care and patient outcomes.

- The problem of staffing at CHUK should be addressed; the problem of nurse: patient ratio was high, for example 1:10 and 1:13 in medical surgical wards, and the ratio by WHO is not to exceed 1:6 / 1:7 in the same setting, and ICN suggests that 1:5 / 1:6 should not be exceeded if quality care is to be provided. The results of the study indicated that there was a relationship between staffing and adverse patient outcomes and has an impact on quality care.
- The wards need to accommodate the capacity of the patient it is intended to accommodate and avoid overcrowding, which is a risk factor for nosocomial infection.
- The hospital needs to clarify the policy, especially in the areas of identifying what constitutes a medication error, when a medication error should be reported to physician, and when an incidence report should be completed. It would also be beneficial to specify whose role it is to complete the incidence report.
- Increasing the number of RNs or the proportion of RNs relative to ENs on a hospital unit can be expected to reduce the number of negative outcomes experienced by patients.
- Hospitals require adequate RN staffing to ensure patient safety and improve quality of care. Adequate numbers of registered nurses that plan, coordinate, deliver and evaluate nursing care to patients is beneficial to both the hospital and the patients it serves.
- Strategies are needed to recruit and retain RNs in the hospital workforce for quality care, quality maintenance and quality improvement

- Nurse administrators should consider adequate staffing as a priority issue to ensure quality care
- Appropriate number of staff with suitable mix of skill levels at all times to ensure that patient care needs are met and that hazard-free working conditions are maintained.
- The nurse administrators should consider the nurse workload for positive patient outcomes.

5.7 Conclusion

This study indicated that there was a relationship between staffing, qualification, workload, and experience related to the occurrence of the adverse events that were under study. These findings were consistent with those that have been found in developed countries. Factors that may be responsible include the ward environment, nutritional status and patient condition. In this study the researcher controlled for some of the variance that may occur in patients with chronic health problems or pre-existing conditions by excluding these patients and still found that staffing was inversely related, in all but one adverse patient outcome (wound infection), to adverse patient outcomes. This study was conducted in Rwanda, one of the low-income developing countries in central Africa. Therefore, this research adds to the body of knowledge on adverse outcomes and staffing, workload and nurses' experience or qualifications.

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APPENDIX A

DATA COLLECTION INSTRUMENT

Adverse events

Events	Descriptor used in this study	Frequency Unit		Frequency Unit	
		No UD		UD	
Urinary tract infection	Infection in the bladder/kidneys				
Pressure ulcers	Skin pressure ulcer/bed sores				
Systemic Sepsis	Life- threatening infection				
Wound infection	Infection around surgical site				
Pneumonia	Pneumonia/ lung infection				
Phlebitis	IV infection				

APPENDIX B

Nurse staffing

Unit.....

Date	Shifts	Registered nurses	Enrolled nurses	Degree nurses	Total	Patient Census
	Day					
	Night					
	Day					
	Night					
	Day					
	Night					
	Day					
	Night					
	Day					
	Night					
	Day					
	Night					
	Day					
	Night					
	Day					
	Night					
	Day					
	Night					
	Day					
	Night					

APPENDIX C

INFORMATION SHEET

INFORMATION TO THE DIRECTOR OF UNIVERSITY CENTRAL HOSPITAL OF KIGALI (CHUK) ON A RESEARCH PROJECT CONDUCTED IN PARTIAL FULFILMENT OF A MASTERS DEGREE COURSEWORK IN NURSING MANAGEMENT.

INTRODUCTION

My name is Mbabazi Perpetua I am a postgraduate student at University of KwaZulu-Natal, studying for Master's degree Course work in Nursing Management academic year 2006. My thesis is being undertaken as partial fulfillment of the requirements for this degree.

TOPIC:THE RELATIONSHIP BETWEEN NURSE STAFFING AND SELECTED PATIENT OUTCOMES

I would like to conduct my research in University Central Hospital of Kigali (CHUK) in all units that has more than 60 beds. This study aims to determine the relationship between nurse staffing and patient outcomes. The outcomes to be studied are: hospital acquired pneumonia, pressure sores, wound infection, phlebitis, sepsis and urinary tract infection. This is necessary as it will provide information for hospital and nursing administrators about nurse staffing and patient outcomes and provide assistance to nurse administrators to develop blueprints for staffing plans that are linked to quality patient outcomes. The adverse events will be collected from all discharge patient case files and

incidence report for the months of February and March 2006; nurse staffing will be collected from the same units for the period of February and March 2006. No patients files will be removed from the hospital Document Department, all consultation will be done in the hospital.

In this study there will be no hospital personnel involvement, instead the researcher will use all the discharge patient files and nurses' duty plan of February and March 2006 of the units that will meet the inclusion criteria, and the instrument to be used is a checklist where the information will be recorded.

To ensure anonymity the selected units will be coded no name of the unit will appear in any of instruments used. In case of publication another request for permission will be made to the Director of CHUK.

If more information about this study is needed please contact Mrs. Mbabazi Perpetua at 08 83 57 37 / +27 07 81 75 74 79 e-mail mbabazi_perpetua@yahoo.fr the benefits to CHUK would be primarily in terms of the results obtained, and how could be applied by the nurse administrators to improve on nurse staffing and reduce the adverse events. The findings of the study whether or not the patient outcomes are related to nurse staffing will be communicated to the hospital authority if required.

MBABAZI Perpetua (Master student)

Signature.

University of KwaZulu-Natal faculty of Health Sciences

APPENDIX D

To: The Director University Central Hospital of Kigali

P.o, Box, 655

Kigali Rwanda

Mrs. Mbabazi Perpetua

Masters Student in Nursing Management

University of Kwa-Zulu Natal Howard College

P.o, Box, 4041 Durban, South Africa

E-mail: mbabazi_perpetua@yahoo.fr

Dear Sir,

APPLICATION FOR A PERMISSION TO CONDUCT A RESEARCH PROJECT IN UNIVERSITY CENTRAL HOSPITAL OF KIGALI IN JULY 2006

I am a student at UKZN Durban, South Africa taking Masters Course work in Nursing Management for health professionals for academic year 2006. As a requirement for the degree, I have to conduct a research project; the Topic is "The relationship between nurse staffing and selected patient outcomes" I therefore request your permission to allow me collect the data from the hospital patient case files and nurses duty plan in July 2006.

I hope my application will meet your favorable consideration as information obtained will be of relevance to the nursing department and the institution at large.

Cc: The Research Committee CHUK

Yours faithfully,

Mbabazi Perpetua.

Supervisor:
Prof Marilyn Lee.



APPENDIX E

To: The Director University Central Hospital of Kigali
P.o, Box. 655
Kigali Rwanda

From: Mrs. Mbabazi Perpetua
Masters Student in Nursing Management
University of Kwa-Zulu Natal
School of nursing
P.o, Box, 4041 Durban, South Africa
E-mail: mbabazi_perpetua@yahoo.fr

Dear Sir,

**APPLICATION FOR A PERMISSION TO CONDUCT A RESEARCH
PROJECT IN UNIVERSITY CENTRAL HOSPITAL OF KIGALI IN JULY
2006**

I am a student at UKZN Durban, South Africa taking Masters Course work in Nursing Management for health professionals for academic year 2006. As a requirement for the degree, I have to conduct a research project; the Topic is "The relationship between nurse staffing and selected patient outcomes" I therefore request your permission to allow me collect the data from the hospital patient case files and nurses duty plan in July 2006.

I hope my application will meet your favorable consideration as information obtained will be of relevance to the nursing department and the institution at large.

Cc: The Research Committee CHUK

Yours faithfully,

Mbabazi Perpetua

Supervisor

Prof. Marilyn Lee

Date 01/06/06

2:

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Postal Address: Durban, 4041, South Africa

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Email:

Website: www.ukzn.ac.za

Founding Campuses:

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Howard College

Medical School

Pietermaritzburg

Westville

APPENDIX F



CENTRE HOSPITALIER UNIVERSITAIRE
UNIVERSITY TEACHING HOSPITAL

CENTRE HOSPITALIER UNIVERSITAIRE
DE KIGALI (CHUK)

Kigali, le 01/08/2006
N° CHUK/MP/Nurs/06

Protocol Authorization

Research Title : THE RELATIONSHIP BETWEEN NURSE STAFFING AND
SELECTED PATIENT OUTCOMES

Principal Investigator Address

Name : University or High School UNIVERSITY OF KWAZULU-NATAL

Tel: +27 (03) (0) 31 260 2499

E-mail :

Acceptance of Responsibility and Ethics considerations.

If this application is accepted, I (we) declare that I (We) shall be actively engaged in, and shall be in day – to – day control of the project and I grant to supply in the CHUK a copy of my work after publication of my research. The researcher conducted will conform to the international principles guide lines for bid medical research involving patients files.

Signatures (s) of principal investigator (c)

date : 01/08/2006

MEABAZI PERPETUA

Authorization

We have the pleasure to announce to you that the research unit and the Director of CHUK analysed and considered relevant your entitled project and authorise you to conduct your study in CHUK.

Signature of chair person of CHUK research unit,

Dr. MUGANGA Narcisse

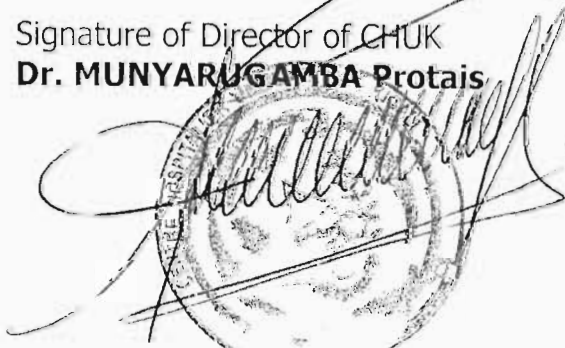
Pedestre
CHK

date : 01/08/06

Signature of Director of CHUK

Dr. MUNYARUGAMBA Protais

date : 01/08/2006





Research Office
BIOMEDICAL RESEARCH ETHICS ADMINISTRATION
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Website: www.ukzn.ac.za

26 July 2006

Ms P Mbabazi
Faculty of Health Sciences
School of Nursing
P O Box 4041
DURBAN 4000

EXPEDITED REVIEW

Dear Ms Mbabazi

PROTOCOL: The relationship between nurse staffing and selected patient outcomes. Mbabazi Perpetua. Faculty of Health Sciences, School of Nursing.
Ref: EXP014/06

A sub-committee of the Biomedical Research Ethics Committee has considered and noted your response to queries raised on 26 July 2006.
The study is given full ethics approval and may begin as at today's date: **28 August 2006**.

This approval is valid for one year from **28 August 2006**. To ensure continuous approval, an application for recertification should be submitted a couple of months before the expiry date. In addition, when consent is a requirement, the consent process will need to be repeated annually.

I take this opportunity to wish you everything of the best with your study. Please send the Biomedical Research Ethics Committee a copy of your report once completed.

The sub-committee's decision will be ratified at a full sitting of the Biomedical Research Ethics Committee meeting to be held on **12 September 2006**.

Yours sincerely


PROFESSOR J MOODLEY
Chair: Biomedical Research Ethics Committee

APPENDIX H



**CENTRE HOSPITALIER UNIVERSITAIRE
UNIVERSITY TEACHING HOSPITAL**

**CENTRE HOSPITALIER UNIVERSITAIRE
DE KIGALI (CHUK)
*Bureau de Nursing***

Kigali, le 26/07/2006
N° CHUK/PM/Nurs/06

TO WHOM IT MAY CONCERN.

DECLARATION

The undersigned Dr. MUNYARUGAMBA Protais Director of University Central Hospital of Kigali, declare that the patient files after discharge remain a Hospital property. The Director of the Hospital is the only person who gives permission to anyone who want to access patients files for any reasons.

Dr. MUNYARUGAMBA Protais

Director of CHUK