

**Triage Code:**  
**A Predictor of Nursing Care Time**  
**in the**  
**Emergency Department**

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### **Attestation of Authorship**

“I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the qualification of another degree or diploma of a university or other institution of higher learning, except where due acknowledgement is made in the acknowledgements.”

**Brian Gabolinscy**

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*He aha te mea nui i tenei ao?*

*Maku e kii: He tangata! He tangata! He tangata!*

What is the greatest treasure in the world?

I say: The people! The people! The people!

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## **Abstract**

This thesis explores triage code as a predictor of direct nursing care time, thus its potential usefulness in a model for calculating and allocating nurse requirements in emergency departments.

A framework for nursing work is proposed. This framework is based on the works of O'Brien-Pallas, Irvine, Peereboom, and Murray (1997) and Houser (2003). It suggests that the structures of environmental complexity, nursing characteristics, patient nursing complexity, and patient medical condition and severity, impact on the processes of direct and indirect nursing care to affect patient outcomes.

A prospective, non-experimental study was undertaken to examine the relationship between direct nursing care time and triage code. Six potential confounding variables were selected for this study: length of stay, age, ethnicity, sex, complaint type, and discharge category.

Data were collected for 261 visits over a three day period in one New Zealand emergency department. Patient visits averaged 200 minutes. The mean direct nursing care time per visit was 49 minutes. On average, patients with more urgent triage codes, longer length of stay, or who were not discharged, received more direct nursing care. The model developed predicted 49% of variation in direct nursing care time ( $p < .05$ ) related to triage code (16%), length of stay (31%) and disposition category (2%).

Further exploration of the proposed framework has potential to develop a model allowing managers to identify nurse staffing required for optimal nursing care in emergency departments.

# **Chapter One**

## **Introduction**

*He rimu pae noa.*

Seaweed drifting about.

During my nursing career I have worked in a number of health care organisations and emergency departments (EDs) as a staff nurse, nurse consultant, nurse specialist, charge nurse, and nurse manager. During this time, the difficulty in matching nurse staffing levels to the ever changing patient needs in the emergency setting became evident. I recall times when six nurses were looking after six patients while at other times one nurse was trying to meet the needs of 15 patients of much higher acuity. My goal as a nurse manager was to provide for quality patient care. In campaigning for nurse resources I realised that, although experience and tradition gave me some clues as to what adequate staffing might be, I did not have the tools necessary to quantify how many nurses were needed to provide quality patient care. The aim of this thesis was to develop a tool that would help identify the number of nurses needed in an ED. Chapter one describes the background that has led to me asking this question. Chapter two examines what is already known about emergency nursing workload. The research questions and study design are outlined in chapter three while chapters four and five present and discuss the findings and limitations of this research including its practical and theoretical implications.

## **Quality Patient Care**

Provision of quality patient care is the goal of health care professionals and the organisations within which they work. Donabedian (1988; 1990) suggests that seven ‘pillars’ of quality can be used as a framework to define the structures, processes, and outcomes of healthcare. Table 1 (p. 3) lists the seven pillars: efficacy, effectiveness, efficiency, acceptability, optimality, legitimacy, and equity. It provides an example of how Donabedian’s framework can be used to examine the impact of triage staffing on timely thrombolysis for patients with cardiac chest pain in the emergency setting.

Registered nurse (RN) staffing is a structural component of quality. The expectation that EDs are staffed by RNs is clearly articulated in the “Guidelines for Staffing and Skill Mix in New Zealand Emergency Departments” (Emergency Department Clinical Advisory Group, 2002). Equity of service is recognised by the need for “people to get the right care, at the right time, in the right place, from the right person” (Ministry of Health, 1999, p. 4). RN efficacy and effectiveness in providing quality health care is adequately demonstrated in the literature (Aiken, Havens, & Sloane, 2000; Aiken, Smith, & Lake, 1994; Blegen, Goode, & Reed, 1999; Blegen & Vaughn, 1998; International Council of Nurses, 2001; Jackson, Chiarello, Gaynes, & Gerberding, 2002; Lichtig, Knauf, & Milholland, 1999). The staffing dilemma described earlier directed the investigation for this thesis into developing a tool that would aid in predicting the optimal nurse staffing for an emergency department.

Table 1

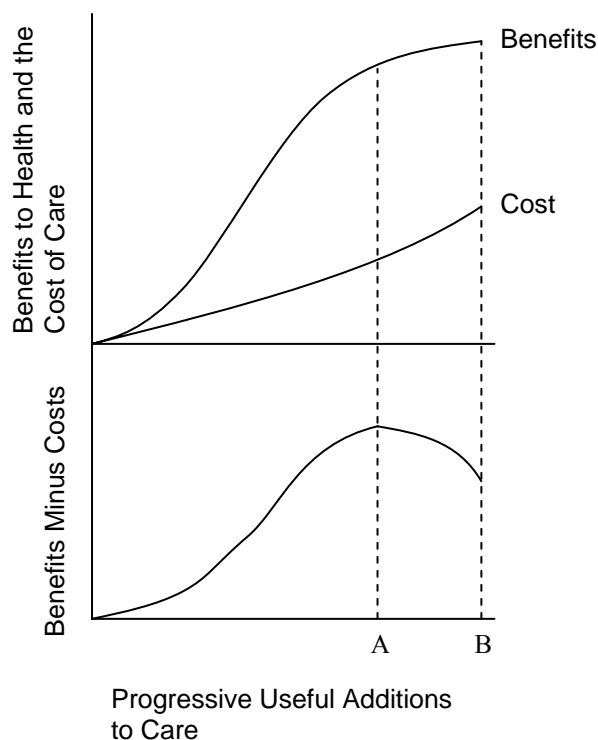
*Emergency Nursing Examples for the Seven Pillars of Quality*

Aspect	Definition	Emergency Nurse Example
Efficacy	The best that health care can achieve (Theoretical).	People presenting with cardiac chest pain are triaged by an RN on arrival and receive immediate thrombolysis (Theoretical).
Effectiveness	The improvement that is / can be achieved in normal practice (Actual).	People presenting with cardiac chest pain are triaged by an RN soon after arrival and receive early thrombolysis (Actual).
Efficiency	Improvement in Healthcare achieved (Theoretical or actual) divided by the cost of intervention.	The benefit of early thrombolysis (Actual or Theoretical) divided by the cost of staffing triage with a registered nurse.
Acceptability	The acceptability to patients / family / whanau of the service they receive.	How long would a patient with chest pain feel it is acceptable to wait for access to a triage nurse when they arrive in an emergency department?
Optimality	The benefits less the cost as additions to care are added.	The benefit of timely thrombolysis less the cost of RNs at triage as nurse coverage increases e.g. from 16 hours/day to 24 hours/day to two triage nurses 24 hours/day.
Legitimacy	The acceptability to the community or society of the service.	How long does society think it is acceptable to wait for a triage nurse when a patient with cardiac chest pain arrives at triage?
Equity	The fairness of distribution of care and its benefits.	Is it fair that a patient in a rural setting may wait for triage while a patient in an urban setting may be triaged immediately?

*Note.* Adapted from “The Seven Pillars of Quality,” by A. Donabedian, 1990, *Archives of Pathology and Laboratory Medicine*, 114, p. 1115-1118.

## Optimality

Donabedian (1988; 1990) uses the terms maximally effective and optimally effective to delineate the cost-benefit differences when additional resources or processes are added to care as indicated in Figure 1. In terms of this thesis, maximally effective care would be the best possible care with unlimited additional nurses, indicated by the vertical line labelled 'B' in Figure 1, while optimally effective care recognises that after a certain point, labelled 'A', the cost of additional nursing staff would outweigh the value of improvements in patient outcome. In considering optimality it is therefore necessary to consider the relationship between the three components graphed: costs, benefits, and useful additions to care.



*Figure 1.* The concept of optimality. From “The Seven Pillars of Quality,” by A. Donabedian, 1990, *Archives of Pathology and Laboratory Medicine*, 114, p. 1117.

In this thesis the useful additions to care focused on are RN resources. The American Nurses Association (ANA) (1999), New Zealand Ministry of Health (2001a), and World Health Assembly (1992, as cited in Thompson, 2002) have all argued the need to recognise the value of nursing in terms of patient outcomes. Blegen and Vaughn (1998) recognised that beyond an adequate level of staffing further increases in RN numbers will not improve quality of care. The cost of additional RNs must be weighed against the health benefits achieved through using these additional resources.

### **Benefits of Nursing to Patient Health**

Hodge, Asch, Olson, Kravitz, and Sauve (2002) used literature review and a modified Delphi technique to identify indicators of nursing quality for evaluation of nurse-patient ratios. In developing these the group of nurse experts evaluated 69 potential indicators for validity, feasibility, and overall suitability. Validity was defined as the sensitivity and specificity of the measure to nursing care. Feasibility related to the ease of collecting the indicator data, while overall suitability was a subjective decision by the group on whether the indicator should be used. Patient outcomes identified as sensitive or potentially sensitive to nurse-patient ratios included risk adjusted mortality, failure to rescue, patient satisfaction, patient satisfaction with pain management, nosocomial infections and hospital length of stay. The main limitations for indicators were the difficulty in separating the contribution of nursing from that of other disciplines and the feasibility of



data collection. Despite these limitations articles demonstrating nursing effectiveness have become prominent in the last decade. Nursing provides effective delivery of quality patient care (Aiken et al., 1994; American Nurses Association House of Delegates, 2000).

Studies that look at nursing care and outcomes can be divided into two main categories: those studies that look at nurse-patient ratios and those that consider nursing skill mix. Nurse-patient ratios relate RN numbers or total nursing numbers (including auxiliary nurses) to patient numbers while nursing skill mix relates proportion of RNs to that of other non-registered nursing providers such as enrolled nurses and nurse assistants. Statistically significant associations have been demonstrated between patient outcomes and both RN proportion (skill mix) and nurse-patient ratios (Blegen et al., 1999; Blegen & Vaughn, 1998; Flood & Diers, 1988; Kovner & Gergen, 1998; Lichtig et al., 1999; Needleman, Buerhaus, Mattke, Stewart, & Zelevinski, 2001; Tutarima, de Haan, & Limburg, 1993). Kovner and Gergen (1998) demonstrated that an increase of 0.5 RN hours per patient day decreased the risk of urinary tract infection by 4.5% as well as decreasing the risk of developing pneumonia (4.2%), thrombosis (2.6%) and pulmonary compromise (1.8%). A higher RN ratio was associated with reduced medication errors, patient falls, development of decubiti and patient complaints (Blegen et al., 1999; Blegen & Vaughn, 1998) as well as reduced length of patient stay (Lichtig et al., 1999). While some studies have not been able to demonstrate associations between nursing care and some patient outcomes, for example Aiken et al. (1994) were unable to show a link between nursing skill mix and mortality and Tutarima et al. (1993) did

not find a link between falls and nurse-patient ratios, there is mounting evidence that improved RN numbers and nursing skill mix do have a positive impact on patient outcomes.

The majority of studies use organisationally based outcomes as data for analysis. Organisationally based outcomes use aggregate organisational data, such as mortality rates and hospital infection rates, to focus on quality. Organisational data is readily available in hospital databases and is therefore frequently used. Patient-focused outcomes relate directly to individual patients and include both disease based outcomes, such as laboratory results, as well as holistic outcomes, such as quality of life. Provider-focused outcomes consider service or professional group practice and may include aggregates of patient outcomes, for example, patient satisfaction survey (Jennings, Staggers, & Brosch, 1999). While research based on individual patient outcomes is rare, the effect on individual patients of inadequate nurse staffing in the emergency setting is highlighted by Health and Disability reports (Health and Disability Commissioner, 1998, 2003).

It is likely that the use of organisationally based data has lead to inconsistent research results when looking at correlation between nursing care and patient outcome. This is due to the tendency to generalise nursing numbers, incorporating those working in clinical and non-clinical settings, as well as the inability to focus on the specifics of a patient condition. The majority of studies still support the benefits of RN staffing in producing positive patient outcomes. Blegen and Vaughn (1998) suggest that negative patient outcomes may ensue when nurse staffing is below a certain threshold or when there are too many nurses who are unfamiliar with the unit.

However, they also found that above 85% RNs there was an increase in medication administration errors (Blegen et al., 1999; Blegen & Vaughn, 1998). This result, they suggest, may be due to the higher ratio of nurses in units such as intensive care or attributable to using generalised organisational data. The question remains, below what level of nurse staffing does the risk to patients increase? What is adequate nurse staffing?

### **Cost of Nurse Staffing**

When looking at optimality, the health benefits of adequate nurse staffing must be weighed against the cost of employing nurses. The largest single professional group within the health care team is nurses. In March 2000 nurses were calculated to make up 71% of New Zealand's health and disability workforce, a total of 36,770 nurses (New Zealand Health Information Service, 2000). Nursing costs between 30% and 40% of hospital budgets (Bridel, 1993; Campbell, Taylor, Callaghan, & Shuldham, 1997; Halloran, 1985; McCue, Mark, & Harless, 2003). The high cost of nurse staffing has resulted in it being an early target when budget reviews are undertaken. However, the costs must be considered not only in terms of employment costs of adequate nurse staffing but also in terms of the costs associated with inadequate nursing resources.

Schonenberger and Knod (1997) point out that it is the cost of poor quality that should be of concern to organisations. There is increasing evidence of a widening gap between patient needs and demand for healthcare, and the ability to provide adequate nursing staff. The ANA

House of Delegates (2000) identified that, “Registered nurse staffing levels in many health care settings is often inadequate to promote and protect the safety and quality of patient care, or to provide a safe and satisfying work environment that allows for appropriate professional practice” (p. 2). The majority of World Health Organisation (WHO) member states report an inadequate supply of Nurses (International Council of Nurses, 1999). The Global Advisory Group on Nursing and Midwifery, as part of the WHO strategy to strengthen nursing and midwifery, was formed in response to the need for adequate provision of nursing and midwifery services for populations all over the world (as cited in Thompson, 2002). In order to provide quality patient care adequate nurse staffing must be available.

In New Zealand there is also a widening gap between supply and demand of RNs. The ageing population and advances in health technology are impacting on the number of nurses required. At the same time an ageing nurse workforce, international opportunities, and the large proportion of non-practising nurses is resulting in a mismatch between need for and availability of nurses (Ministry of Health, 2001b).

Behner, Fogg, Fournier, Frankenbach, and Robertson (1990) estimate that staffing 20% below recommended levels leads to a 30% increase in the risk of patient complications and an average 3.5 day increase in length of stay with resultant increases in treatment expenses. In an effort to monitor this situation the New Zealand Ministry of Health (2001b) requires that District Health Boards monitor nurse staffing by benchmarking staffing levels and measuring nursing workloads. The widening gap between

nurse availability and patient demand is leading to increased pressures on the existing workforce.

Of the 47,694 nurses who obtained New Zealand annual practising certificates in 2002, only 37,907 (79%) are working in healthcare settings (New Zealand Health Information Service, 2002). The New Zealand Health Information Services survey (2000) found that, of those not practising, 15% cited the hours of work as unsuitable while 13% thought that the physical requirements of the job were too great or the level of support insufficient. Fourteen percent of nurses identified other reasons including workload, work stress, and safety issues related to inadequate staffing. NZNO (2002b) cites the deterioration in work conditions as a key element to the shortage of nurses. These same situations are recognised globally (Zimmermann, 2000) and have led to national and international shortages due to the difficulty in recruiting and retaining nurses (Ministry of Health, 2001b).

A key result of this shortage is the increasing use of overtime and casual nurses, working intermittently, as a means of providing adequate nurse staffing around the world. In New Zealand, the Ministerial Taskforce on Nursing (1998) identified an increased dependency on casual staff and overtime to fill gaps. International Council of Nurses (2003a) cites examples in several countries where overtime is used. These include the use of mandatory overtime in many states in the USA as well as increasing amounts of regularly worked overtime in Australia, UK, and Japan. The use of overtime and casual staff to meet demand for nursing care is indicative of an inability to maintain adequate staffing levels (Davis, 1995).

Inadequate staffing levels and the casualisation of the nursing workforce have increased nurses' concerns for patient safety and the risk of litigation (Lenehan, 2002). Along with this, the negative impacts of worklife stressors, such as shift work, weekend work, and dealing with death and dying, on nurses and their families has lead to a reluctance of some nurses to work in today's hospitals (International Council of Nurses, 2003b; Zimmermann, 2000). This creates a vicious cycle, where nurses become stressed by excessive workloads and inadequate staffing and leave clinical practice, resulting in nursing shortages and greater pressures on those left in the clinical setting. Stress in turn can lead to increased sickness, workplace injury and errors of judgement (International Council of Nurses, 2003b). For this reason, the ANA (1999) recommends that when evaluating nurse staffing, quality of worklife outcomes as well as patient outcomes should be considered.

Nurse stress and use of overtime increase the probability of negative effects on patients (International Council of Nurses, 2003a, 2003b). Higher patient fall rates have been identified in areas where nurse stress and absenteeism is reported (Dugan et al., 1996). There is also evidence of higher medication error rates (Ceria, 1992), decubiti, urinary tract infections, pneumonia and postoperative infection (Dugan et al., 1996; Taunton, Kleinbeck, Stafford, Woods, & Bott, 1994). The Joint Commission of Accreditation of Healthcare Organisations (2002, cited in Emergency Nurses Association, 2003a) reports that nearly one quarter of unanticipated events that resulted in patient death, injury, or permanent loss of function could be attributed to inadequate nurse staffing.

Healthcare organisations also incur costs associated with inadequate staffing. These costs include the increased risk burden and poor institutional status that results from unplanned events. There are also financial costs associated with inadequate staffing. Recruitment of one staff nurse in New Zealand is estimated as costing US\$22,000 and the annual cost of nursing turnover as NZ\$100 million per annum (Ministry of Health, 2001b). Research on magnet hospitals has highlighted the cost benefits of improved quality (Aiken et al., 2000; Aiken et al., 1994; Havens & Aiken, 1999). Key characteristics of magnet hospitals, recognised as attracting and retaining nurses, include high patient and nurse satisfaction with good communication and high nurse to patient ratios. In magnet hospitals this resulted in reduced nursing turnover and easier recruitment (Aiken et al., 2000). Other benefits identified included lower mortality rates as well as lower staff burnout and fewer needlestick injuries. Evidence also exists that the higher cost of staffing to higher nurse to patient ratios is offset by shorter patient length of stay and lower intensive care unit utilisation (Aiken et al., 2000; Aiken et al., 1994; Havens & Aiken, 1999) while not decreasing the profitability of organisations (McCue et al., 2003). Magnet hospital studies suggest that improved nurse to patient ratios are an important factor in reducing costs while improving outcomes for patients and nurses.

## **Optimising Nurse Staffing**

A number of methods have been used to match nursing availability to patient needs at the unit level. ANA (2000) and New Zealand Nurses Organisation (NZNO) (2002a) both advocate nurse to patient ratios as a method of ensuring adequate registered nurse staffing. Nurse to patient ratios have been implemented in both California, USA (Nevada Nurses Association, 2002) and Victoria, Australia (Australian Nursing Federation (Victorian Branch), 2001). Advocates for nurse to patient ratios state that these will improve patient safety and nurse retention while reducing costs (Department of Human Services, 2001; Nevada Nurses Association, 2002; New Zealand Nurses Organisation, 2002a, 2003). There is, however, some concern being voiced at the limitations of legislating for nurse to patient ratios.

Opponents of nurse to patient ratios believe that these will limit staffing levels to the ratios legislated. Complexities such as severity of illness, complexity of nursing work, nursing skill mix, and environmental context may not be considered when deciding on staffing levels (Almeida, 2002; Department of Human Services, 2001; Emergency Nurses Association, 2003a). There is also concern that there are not enough nurses available to meet the demands of higher nurse to patient ratios (Department of Human Services, 2001).

The basis for the developed nurse to patient ratios is not clear nor is it clear how changes in context, skill mix, or nursing work could affect these ratios and how they should be reviewed. Nurse to patient ratios appear to



assume that many of the factors affecting nursing workloads, such as patient acuity and nursing skill mix, are static and will not affect staffing requirements. Advocates for improved staffing, whether based on nurse to patient ratios or more complex calculations including acuity measure, believe that improved registered nurse levels will alleviate the negative effects of inadequate staffing on both nurses and patients (Nevada Nurses Association, 2002; NZNO, 2002a).

### **Summary**

This chapter has explored the concept of optimality in terms of the costs and benefits when examining RN staffing. Research over the past decade has demonstrated that positive patient outcomes result from nursing care. The benefit of providing additional nursing resources needs to be balanced by the cost, in terms of outcomes for patients, staff, and organisations, of not providing adequate nursing staff. Chapter two explores this for the emergency setting, by examining the literature identifying the factors affecting emergency nursing workload and adequate nurse staffing.

## Chapter 2

### Literature Review

*Kia mau koe ki te kupu a tou matua.*

Hold fast to the words your father gives you.

When looking at the workload of emergency nurses and the provision of adequate nursing numbers in the emergency setting the focus has traditionally been on annual patient attendance. In early literature the number of patients attending per annum per nurse has been used to provide a full time equivalent (FTE) figure for nurse staffing (Boam, 1977; Davis, 1995; North East Thames Regional Health Authority, 1992). While in 1977 it was considered acceptable to have a ratio of one nurse per 3000 annual patient attendances (Boam, 1977) by 1998 repeated reviews had increased the number of nurses required to a ratio of one nurse per 1000 patients per annum (Health and Disability Commissioner, 1998). At the same time the Health and Disability Commissioner recognised that in Australian EDs the range was from 1:300 to 1:900. Although this calculation is simple for estimating the nursing FTE required in an emergency setting it is unlikely to be responsive to the complex factors that affect nursing workload and quality of patient outcomes.

This chapter looks at the quantification and measurement of emergency nursing workloads in current literature and explores the factors that affect adequate nurse staffing. The interaction between the nurse and patient / family / whanau is acknowledged as the key to the therapeutic

nursing relationship. Direct nursing care time (DNCT) is therefore the focus of this thesis. While the majority of the literature addressing nurse staffing published in nursing journals is exploratory in nature, some, especially that associated with O'Brien-Pallas and Aiken (Aiken et al., 2000; Aiken et al., 1994; O'Brien-Pallas & Cockerill, 1990; O'Brien-Pallas, Cockerill, & Leatt, 1992; O'Brien-Pallas et al., 1997; O'Brien-Pallas, Leatt, Deber, & Till, 1989), is more rigorous. The chapter starts by providing a definition of emergency nursing work and identifying a framework by which nursing workloads can be examined. Evidence of the various factors, suggested by the framework as affecting emergency nurse workloads, is then presented.

### **Emergency Nursing Work**

Emergency nursing work is a complex concept not least of all because nursing is constantly evolving and no consensus exists as to what constitutes or who performs nursing care (World Health Assembly, 1992, as cited in Thompson, 2002). This thesis uses the definition of emergency nursing provided by MacPhail (1992), which states that, "... emergency nursing practice involves assessment, diagnosis, treatment, and evaluation of perceived, actual or potential, sudden or urgent, and physical or psychosocial problems that are primarily episodic or acute..." (p. 3).

The broadness of this definition underlines the difficulty in identifying the boundaries of emergency nursing. Nurses in other areas also deal with acute and episodic patient and family problems although not with the frequency of emergency nurses. MacPhail (1992) expands his definition

by adding that the unique aspects of emergency nursing include limited availability of patient information and situations involving a wide patient age range. Situational differences are also identified by Schriver, Talmadge, Chuong, and Hedges (2003), who note that EDs have no established patient load limits and virtually all patients present with diseases either undiagnosed or in the acute phase. They highlight the evolving nature of emergency nursing as practices change for the wide variety of diseases and acuity, including increased use of point of care testing and protocols in acute illness. The evolving and broad nature of emergency services means that emergency nurses' workloads are also changing.

### **Measuring Emergency Nurses Workload**

The aims of measuring nursing workload are to predict and cater for changing patient nursing care needs, prepare budgets, and analyse productivity (O'Brien-Pallas & Cockerill, 1990). Realisation that the nurse per annual patient attendance calculation was not adequately meeting these requirements has led to further exploration of the problem. However, identifying a method of measuring emergency nurses' workloads is as problematic as defining emergency nursing.

When measuring emergency nursing workload the factors that need to be considered include patient acuity, length of stay and census (Emergency Nurses Association, 2003b). College of Emergency Nurses New Zealand (2002) expands this to include skill mix of staff, including levels of practice and casual nurses; adjustments for protocols used in

departments, such as thrombolysis; and environmental factors, such as department layout. The multiple factors predicted to affect emergency nursing workloads and the need for a measurement tool that can be utilised quickly and easily results in tension between tool accuracy and ease of use.

Tools developed to measure nursing work have often relied on the measurement of tasks and standardising the nursing time associated with such tasks (Cockerill, O'Brien-Pallas, Bolley, & Pink, 1993; Emergency Nurses Association, 2003b; Helmer, Freitas, & Onaha, 1988; O'Brien-Pallas & Cockerill, 1990; O'Brien-Pallas et al., 1992; O'Brien-Pallas et al., 1989). By capturing the tasks, estimates of nursing workload can be made. O'Brien-Pallas et al. (1992) compared nursing care of 256 patients in intensive care and coronary care units using five workload measurement tools: Nursing Information System of Saskatchewan (NISS), GRASP, Medicus, Project for Research in Nursing (PRN) 76, and PRN 80 (Table 2, p. 19). Each of these tools uses a process of identifying a number of patient care activities and associating a time value with each. The sum of the time values provides an indication of the total nursing time to care for a particular patient in terms of both direct and indirect nursing. As in their previous work using three measurement tools (O'Brien-Pallas et al., 1989), there were strong correlations among the tools. However there were clear differences in average care time calculated by each tool, varying from 11 nursing hours per day using PRN 80 to seven nursing hours per day using Medicus. Neither of these studies was designed to identify which of the tools was more accurate (O'Brien-Pallas et al., 1992; O'Brien-Pallas et al., 1989).

Table 2

*Nursing Work Measurement Tools*

Tool	Input type	Method of calculation	Discussion
PRN 76	154 direct nursing care activities assessed daily for each patient.	Each item of direct nursing care is assigned a point value which when multiplied by 5 gives DNCT. Indirect nursing care is added separately and calculated through work sampling.	Canadian tool in acute and extended care facilities. Requires modification for facility characteristics.
PRN 80	214 direct nursing care activities assessed daily for each patient.	As for PRN 76 - Update of PRN 76 to increase accuracy by including 214 nursing activities.	As for PRN 76.
Medicus	37 indicators assessed daily for each patient to decide which of 5 levels of care patient is receiving.	Total hours of care are computed by multiplying a preset value (tool specific) for level of care by target hours (institution specific). Includes calculation for direct and indirect care.	Used in acute care facilities in Canada and USA. Requires modification for layout and characteristics of each institution.
GRASP	Work measurement used at each facility to determine what activities included and amount of time spent in these activities.	Tool related factors used to add non measured DNCT and then indirect nursing care time. Assumes 40-50 direct care activities account for 85% DNCT.	Validated per unit. Used in acute and long term care facilities in USA, Canada and UK. Developed from scratch at each institution.
NISS	Instruments developed for specific areas of nursing e.g. Critical Care (48 items) or Medical/Surgical (33 items).	Patients given point value daily. Point value per item standard relating to DNCT. Indirect care added via work sampling after direct care calculation.	Used in Canada.

*Note.* Sources (GRASP Systems International Inc, 2004; O'Brien-Pallas & Cockerill, 1990; O'Brien-Pallas et al., 1992; O'Brien-Pallas et al., 1989). DNCT = direct nursing care time. PRN = Project Research in Nursing.

The Guidelines for Emergency Department Staffing (Emergency Nurses Association, 2003b) also uses identification of tasks that are performed for patients, grouped by the level of care they require, and the associated time these tasks take. These guidelines use current procedural terminology (CPT) codes, a system used in the USA to identify activities performed by nurses and doctors in providing patient care. The result was a range of 15 to 120 minutes of nursing care provided within the first hour of presentation to an emergency setting with 15 to 60 minutes of additional nursing care required for each additional hour the patient remained in the setting. These figures account for direct nursing care time, spent in hands on patient care, and do not include indirect nursing care time, spent managing the environment or in non-specific activities, such as staff teaching and policy development.

### **A Conceptual Framework for Nursing Work**

O'Brien-Pallas, Irvine, Peereboom, and Murray (1997) suggest that the division of nursing care into direct and indirect time does not allow for full understanding of the factors which impact on nursing workloads. They proposed a meta-paradigm, developed through an inductive-deductive process. In this meta-paradigm four key concepts were proposed to examine nursing workloads: nurse characteristics, patient nursing complexity, medical condition and severity, and environmental complexity. They then conducted a study to test this meta-paradigm.

The mixed methods research was performed at a 489-bed tertiary paediatric care setting and involved 14 nursing units (O'Brien-Pallas et al., 1997). The emergency department was not included. The initial qualitative phase used review of literature and interview of administrative and clinical nurses to identify the nursing and environmental factors causing variability in how nurses complete their work. These two factors were grouped to create what they called unit factors. It is unclear what method of analysis was used to develop the list of unit factors.

The second phase of this study was quantitative in nature (O'Brien-Pallas et al., 1997). The dependent variable for this phase was the direct nursing care estimate as calculated by PRN 80. PRN 80 is a Canadian tool used to measure direct nursing care requirements by quantifying nursing care according to 214 indicators and tasks. O'Brien-Pallas et al. (1997) state, as their reason for developing a new meta-paradigm, that, “time-per-task-based approaches fail to incorporate the complexity of patient situations, the caregiving environment, or the caregivers themselves ...” (p. 172). The use of PRN 80, a tool using tasks to identify nursing care time requirements, as the dependent variable is questionable as, according to this premise, task based approaches fail to include the complexities affecting nursing work.

The independent variables used by O'Brien-Pallas et al. (1997) were nursing complexity, as measured by North American Nursing Diagnoses Association (NANDA); medical condition, measured by case mix group (CMG); medical severity, measured by length of stay (LOS); and unit environmental complexity and nursing characteristics, measured by the unit factors. CMG is the Canadian equivalent of the diagnostic related group



(DRG) in New Zealand. These are groupings of related discharge medical diagnoses with similar medical intervention requirements. The CMG and LOS for each patient were collected from the hospital databases and are discussed later in the chapter. The unit factors were assessed daily by the unit nurse administrator to collect the environmental complexity and nursing characteristics impacting on nursing care.

One of the objectives of this study was to test the factors identified in phase one. Three baccalaureate nurses retrospectively collected the NANDA nursing diagnoses and the PRN 80. The inter-rater reliability, in terms of percent agreement, among the three nurses was assessed at 91% to 100% for PRN 80 and 78% to 91% for nursing diagnoses. As each of these nurses calculated both PRN 80 and nursing diagnosis for the same patients there is a possibility that the identifying of one, for example nursing diagnosis of nutritional need because nil per mouth, influenced the identifying of the other, for example, task identification of intravenous catheter insertion in PRN 80. The authors do not appear to have recognised this as a confounding factor in their study.

O'Brien-Pallas et al. (1997) found a linear relationship between the number of nursing diagnoses and nursing workload as measured by PRN 80. As previously mentioned the method of collecting the data may have increased the strength of this correlation. CMGs also showed statistically significant variation when looking at nursing hours per patient day although the authors suggest that the internal variation within each CMG implies that this is not a sensitive indicator. Eleven unit factors accounted for 37% of

nursing workload variance. Overall, this framework accounted for 60% of variance in nursing workload as calculated by PRN 80.

The framework proposed by O'Brien-Pallas (1997) provides the best scope for examining factors affecting nursing workload (Shullanberger, 2000) but fails to account for the effect on patient outcomes. Houser (2003) found that nurses believe direct patient care time is not the only component of nursing work that affects patient outcome and that contextual factors had important effects on nursing intensity. In her model she proposed that leadership, teamwork, resources, staff stability, and workload all impact on patient outcomes. Outcomes measures were hospital acquired pneumonia, urinary tract infection, mortality, medication errors, and patient falls.

Moderate to strong correlation was found between quality of patient outcomes and all the proposed factors except workload (Houser, 2003). This study used midnight census and length of stay as measures of nursing workload but found no statistical significance between these and patient outcomes. This she suggested was due to midnight census and length of stay being poor measures of nursing workload. Figure 2 (p. 24) uses the framework of Donabedian (1988) to combine the works of O'Brien-Pallas et al. (1997) and Houser (2003) to suggest how the structures affecting nursing work affect the processes and outcomes of nursing care. The rest of this chapter explores the literature relating to the structural components of this framework: patient nursing complexity, patient medical condition and severity, nurse characteristics, and environmental complexity.

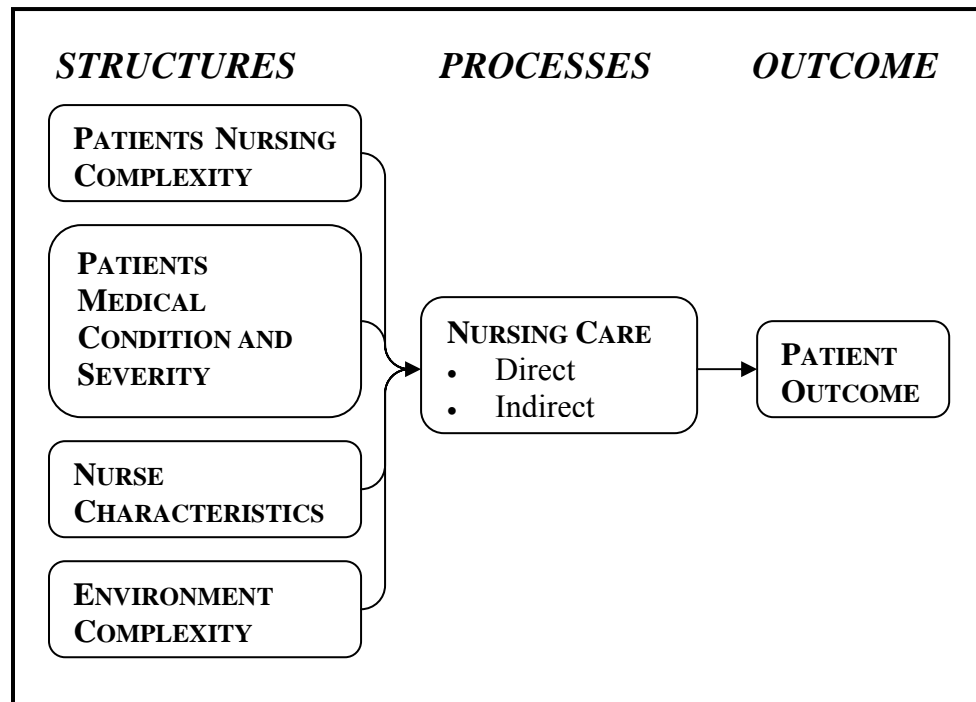


Figure 2. Proposed structures, processes, and outcome of nursing work.

#### *Patient Nursing Complexity*

Endacott and Chellel (1996) describe patient dependency and nursing dependency as factors affecting nursing workload. Patient dependency relates to the patients need to have others assist them with activities of daily living (ADLs) such as eating, washing, and walking and may be affected by illness, age, and therapeutic intervention. In contrast nursing dependency refers to the need for illness related education, treatment, and psychosocial support. This includes family support, infection control requirements, safety of the confused, multiple bed linen or dressing changes, and nurse escort or transfer. Patient nursing complexity is the combination of patient dependency and nursing dependency.

Across studies, patient nursing complexity has been measured by using nursing diagnoses or tasks associated with patient groupings (Emergency Nurses Association, 2003b; O'Brien-Pallas & Cockerill, 1990;

O'Brien-Pallas et al., 1992; O'Brien-Pallas et al., 1989). Concern regarding the lack of a gold standard and the close relationship between nursing diagnoses and current workload measurement tools has already been discussed in this chapter. These tools require a system to collect the tasks associated with patient care and may be time consuming where paper based nursing documentation is used. There is also criticism that tools, such as PRN 80, focus too much on the physical tasks of nursing and not the psychosocial and other aspects of nursing work (Campbell et al., 1997; Endacott & Chellel, 1996). Endacott and Chellel suggest that tasks may hide nursing activity through masking, multitasking, and substitution. Masking is where a nurse uses one activity to mask another, for example, assessing a patient's respiration status while appearing to take a pulse. Multitasking is where the nurse is simultaneously doing a physically observable activity and a mental non-observable activity, such as while documenting a history the nurse is planning appropriate treatment activity. Substitution is where a less demanding task is undertaken to relieve stress or allow time to think. Nurses changing bed linen may be prioritising other work that needs to be done. Focusing on tasks may fail to recognise the nursing work being done.

Around the world the multicultural mix of patients is challenging nurses (Axen & Lidnstrom, 2002; Chu, 1998; Lawrenson & Leydon, 1998; Rathore, Berger, Weinfurt, Feinleib, & et al, 2000; van Ryn & Burke, 2000; Young & Mortensen, 2003). Cultural identification and traditions create difference in the experience and portrayal of illness (Young & Mortensen, 2003) and may affect patient dependency. Nursing dependency may also be affected by the size of a family unit and communication barriers (Chu,

1998). Verbal and body language may require interpreter support as well as additional nursing time resources. Nursing complexity may be affected by the cultural expectations and traditions of the patient.

The extension of nursing roles into what has previously been the medical work arena means that nursing dependency is constantly changing. Ward (1991) found that nurses were increasingly taking on procedures that had previously been the domain of medicine. In the emergency setting, nurses have taken over the role of ordering tests, monitoring patients and administering intravenous drugs, such as thrombolytics (Gabolinscy, 2000; Sbaih, 1995; Ward, 1991).

Nursing workload measurement tools must be flexible enough to take into account the changing role of the nurse as well as the changing face of the patient. Tasks focus on what is being done and, as new roles are incorporated into nursing work, these can be added to the task list. It is more difficult to account for the cultural requirements of patient care such as communication, extended family dynamics, and health practices and the impact these may have on time allocated for nursing.

#### *Medical Condition and Severity*

The second structural component suggested in the framework is medical condition and severity. Medical condition and severity was measured by O'Brien-Pallas et al. (1997) using length of stay (LOS) and case management group (CMG). LOS, in the ED, has multiple causative factors and is discussed later in this chapter as a measure of environmental complexity. The two factors, LOS and CMG, accounted for 18% of nursing

intensity in the study by O'Brien-Pallas et al.. Campbell et al. (1997) likewise found that 18% of variability in nursing workload for cystic fibrosis patients was accounted for by the CMG. However, they did not find any significant relationship between other CMGs and nursing workload. The work of Campbell et al. was limited in being retrospective with 20% of patients not being assigned a CMG.

A more rigorous study was performed using the records of 2560 patients in the acute inpatient setting (Halloran, 1985). This study measured nursing workloads and related them to both nursing condition, as measured by number of nursing diagnoses, and medical condition, as measured by diagnostic related group (DRG). Halloran found that, when considered on its own, DRG accounted for 26% of nursing workload. When nursing diagnosis was also included in the model this reduced to 15%. Halloran speculated that this indicated that although some nursing is related to the medical condition the remainder relates more closely to the patient's other physical and psychosocial requirements.

All of the published studies have measured nursing workload in inpatient settings. It is unclear how the patients' medical conditions relate to nursing workload in the emergency environment. Some studies, looking at ED workloads as indicated by costs, have demonstrated a relationship with medical severity and acuity (Duckett, Jackson, & Scully, 1997). Duckett et al. report work by Jelinek (1992) at three Australian hospitals resulting in the development of Urgency Disposition Groups (UDGs) and Urgency Related Groups (URGs). UDGs relate urgency (as denoted by the five triage categories (need to treat within seconds; minutes; an hour; hours;

days), and disposition (admitted/transferred; died; discharged; did not wait) and were found to account for 47% of variation in cost. The addition of a variable identifying whether there was a minor or major injury or, if no injury, the body system that the illness was related to, accounted for a further 11% of variation in cost. Jelinek referred to these as URGs. Another model, utilising urgency, disposition, and age groups (UDAGs), was developed Erwich-Nijhout, Bond, and Phillips (1997) at Flinders Medical Centre. This model was found to account for 52% of cost variations. These studies suggest that triage code, as a measure of urgency, may be useful in looking at nursing workloads.

Triage is the process by which patients, on arrival at the emergency department, are assessed and urgency for treatment is designated. In New Zealand EDs the National Triage Scale (NTS) and Australasian Triage Scale (ATS) have been used for up to 14 years (Australasian College of Emergency Medicine, 2000b; Bebbington, 1999, 2000). The ATS is an updated version of the NTS which, although the scale is unaltered, has more clarity with regard to the types of patient presentation that might fit each code (Australasian College of Emergency Medicine, 2000a). Patients are categorised into 5 groups depending on the urgency for treatment as outlined in Table 3 (p. 29). Although this scale is designed primarily to identify urgency for treatment it is recognised that it can be used to measure casemix and resource requirements, and as a quality indicator for the emergency setting (Australasian College of Emergency Medicine, 2000a, 2000b).

Table 3

*Triage Code and Treatment Time*

Triage Code	Treatment Acuity (Maximum waiting Time)
ATS 1	Immediate
ATS 2	10 minutes
ATS 3	30 minutes
ATS 4	60 minutes
ATS 5	120 minutes

*Note.* Adapted from “Policy document - The Australasian triage scale” (2000), by Australasian College of Emergency Medicine. Section 4. Retrieved from <http://www.acem.org.au/open/documents/triagepolicy.htm>, November 2002.

Table 4 (p. 30) summarises six reports that have explored triage or severity code as an indicator of nursing workload. The majority of these are not based on ATS or NTS as used in New Zealand. Between three and six patient visit categories are used in these studies. Validation between centres is included only in ENA (2003b). This was based on two centres that self reported good staffing with low turnover and high staff satisfaction. Further work is needed to develop a tool for predicting nursing workloads in the New Zealand emergency setting.



Table 4

*Reports and Studies Allocating Nursing Time to Triage or Severity Codes*

Author, Date	Report / Study	Nursing time by variable	Comment
(Ardagh, 1999)	Emergency Nurse Resource calculations Based on Case Number and Acuity.	Code 1 – 2 nurses per patient. Code 2 – 1 nurse per patient. Code 3 – ½ nurse per patient. Code 4 – ¼ nurse per patient. Code 5 – ⅛ nurse per patient.	Ardagh looked at what happens in the ED from a pragmatic approach. It is not clear whether he used ATS or NTS as his triage code. His figures do not appear to have been validated. Direct care only.
(Emergency Nurses Association, 2003b)	ENA guidelines for Emergency Department Staffing.	Level 1 (L1) – 15 minutes (min) / hour (hr). L2 – 15 min / hr. L3 – 30 min first hr then 15 min/hr. L4 – 45 min first hr then 30 min/hr. L5 – 60 min first hr then 45 min/hr. L6 – 120min first hr then 60 min/hr.	Utilised Centre of Nursing Classification, which estimates time to perform 486 different nursing interventions. Matched this with interventions expected for each level of patient to produce expected direct nursing care time. Direct care only.
1996 ENA scientific assembly (as cited in Zimmerman, 1999)	Staffing Standards [Managers Forum].	Level 1 – 20 minutes. Level 2 – 40 minutes. Level 3 – 60 minutes. Level 4 – 120 minutes. Level 5 – 180 minutes.	Acuity level as presented at 1996 annual ENA scientific assembly (no reference cited). Does not define levels. Direct care only.

Table 4 (continued).

*Reports and Studies Allocating Nursing Time to Triage or Severity Codes.*

Author, Date	Report / Study	Nursing time by variable	Comment
(Fullam, 2002)	Acuity-based ED nurse staffing; A successful 5-year experience.	Category 1 – 1.51 hrs. Category 2 – 0.98 hrs. Category 3 – 0.33 hrs.	Uses 3 level acuity system and direct observation of emergency nursing time for top 3 chief complaints for each acuity. Time is door to disposition decision with additional nursing time if delay in patient admission. No attempt to validate use of top 3 chief complaints to obtain nursing time. Direct nursing care.
(James, 1998)	Patient Classification Systems.	Code 0 – 5-15 minutes. Code 1 – 15 minutes. Code 2 – 30 minutes. Code 3 – 60 minutes. Code 4 – 120 minutes. Code 5 – 260 minutes.	Derived from discussion and observation in one emergency department. Unclear from report whether figures have been validated. Direct nursing care only. No account for length of stay. Code 0 = passing through ED. Codes 1-5 equivalent to NTS 5-1.
(Tolbert & Sutton, 1981)	Emergency Services and nurse staffing: Trauma centre vs. suburban emergency department.	Minor – 20 minutes. Intermediate – 30 minutes. Major – 60 minutes.	Work sampling and direct observation used to analyse direct nursing care time. Patient illness and injury divided into 3 levels of severity (1 example given). Direct care only. Validation of categories not apparent. Statistical significance between severity scores not tested.

There is disagreement over whether triage should be used as an acuity measure. Some authors believe that triage is not sufficiently robust to prioritise treatment, particularly for the semi-urgent and non-urgent categories of patients (Brillman et al., 1996; Williams, 1996). Brillman et al. compared the triage decision made by both physicians and nurses. They found that, using a four-scale triage code, there was only fair agreement (68%) between physicians and nurses in assigned level of urgency ( $\kappa = 0.45$ ), with nurses more frequently allocating higher (less urgent) triage scores than physicians. Their study did have limitations as the nurses were assessing the whole patient while the physicians did the assessment from the documented nursing note. It is unclear whether formal triage training of the nursing or medical staff had occurred other than a two hour briefing session. Inter-rater reliability of NTS was found to be statistically acceptable when 115 nurses from eight Australian hospitals were tested (Jelinek & Little, 1996). Similar results were demonstrated among 82 nurses from seven major New Zealand hospitals (Bebbington, 1999). In both the study by Jelinek and Little and that by Bebbington, it was considered acceptable for nurses to allocate one triage code either side of the modal code. The authors considered that this reflected the use of written patient profiles and did not provide nurses the verbal and non-verbal cues that they would normally use in their assessment. Clinically this degree of variation would not be acceptable.

There is also concern that the use of triage for purposes other than patient prioritisation may lead to factors other than the patient's condition affecting the assigned triage code. Duckett et al. (1997) suggests that there

is potential for triage to be manipulated where greater resource allocation is linked to the more emergent triage codes. There appears to be no evidence that this occurs. Bebbington (2000) used a grounded theory approach to examine how the triage decision is made. She found that influencing factors included department activity and staffing; the values and attitudes of the nurse; and the rules, both formal and informal, associated with triage. Her study does not support the concept that manipulation might occur. It suggests that nurses consider multiple factors when balancing the needs of the patient newly presenting at triage and those patients already in the ED.

The Emergency Nurses Association (ENA) (2003b) believes that triage code cannot predict the intensity of nursing care and intervention. This appears to conflict with earlier recommendations from the ENA Scientific Assembly (1996, as cited in Zimmerman, 1999), which suggested allocated nursing times by triage code. No supporting literature is offered to explain the change of opinion between 1996 and 2003. When comparing the facility levels proposed in the ENA guidelines (Emergency Nurses Association, 2003b) with the triage categories suggested by the Australasian College of Emergency Medicine (2000a) there is marked congruence (Table 5, p. 34). This suggests that ATS can be used in a model for predicting nursing workload.

Table 5

*Comparison of Australasian Triage Scale (ATS) and ENA Facility Levels*

ACEM ATS		ENA facility level		Examples
Score	Definition	Level	Nursing time allocated	
1	Treat immediately	6	120 minutes in first hour then 60 minutes per hour	Major Multi System Trauma, Major Burn, Cardiac or Respiratory Arrest
2	Treat within 10 minutes	5	60 minutes in first hour then 45 minutes per hour	Chest Pain, Dyspnoea, Stridor, GI Bleed, Seizure
3	Treat within 30 minutes	4	45 minutes in first hour then 30 minutes per hour	Abdominal Pain, Nausea and Vomiting, Closed head injury with loss consciousness
4	Treat within 60 minutes	3	30 minutes in first hour then 15 minutes per hour	Cough, Rash, Constipation, Sprain, Strain
5	Treat within 120 minutes	2 and 1	15 minutes in first hour then 15 minutes per hour	Medicine refill, Suture removal, Dermatitis

*Note.* Adapted from *Policy document - The Australasian triage scale* by Australasian College of Emergency Medicine (2000). Retrieved November, 2002, from <http://www.acem.org.au/open/documents/triagepolicy.htm>, and *ENA guidelines for emergency department nurse staffing* by Emergency Nurses Association. (2003).

### *Nurse Characteristics*

The third structural factor of the proposed framework is nurse characteristics. These include the configuration of the nursing workforce and the way it works together. Staffing characteristics are proposed by the Emergency Department Clinical Advisory Group (2002), who recommend postgraduate emergency training for “some” or “many” nurses, depending on the ED level of service. The report does not quantify what would qualify as ‘some’ or ‘many’. Many authors recognise the need for postgraduate qualifications in the emergency setting (College of Emergency Nurses New Zealand, 2002; Emergency Nurses Association, 2003b; Ward, 1992). No literature is available to quantify the effect of formal knowledge and skills learning on emergency nursing processes and patient outcomes.

Nursing work was divided into three subunits by Leatt and Schneck (1984), who suggested that it involved uncertainty, instability, and variability. Uncertainty was described as complexity of nursing related to insufficient information and need to use intuition in providing care. Instability was the need for close monitoring and observation. Variability related to the mix of patients and if the nurse could utilise the same decision making for more than one patient. Leatt and Schneck studied these three aspects in the acute care setting and Leppa (1999) used Leatt and Schneck’s tool in long term elderly services. Both found moderate to strong relationships between this tool and perceived nursing workloads. When these subunits are compared to the definition and nature of emergency nursing work it seems likely that there are high levels of uncertainty, instability, and variability in the emergency setting. Leppa proposed that

knowledge and experience allowed nurses to better manage the workloads associated with uncertainty, instability, and variability. If knowledge or experience improves the ability for nurses to manage workloads, it is logical that nurses who have little experience or knowledge will take longer to provide the same level of care. This is supported by the work of O'Brien-Pallas et al. (1997) who found that the presence of relief staff accounted for 2.4% of the variation explained by their unit factor.

The ability to work in and lead teams is promoted as a way for nurses to manage increasing workloads (Forte & Forstrom, 1998). O'Brien-Pallas et al. (1997) found that nurses' leadership skills and teamwork accounted for 3.1% of variation in workload. Strong leadership allows knowledge and experience to be utilised where it will have the greatest impact while ensuring workloads are shared through delegation. Forte and Forstrom hypothesised that development of nursing leadership and supervision skills would result in better management of nursing workloads. This they proposed would result in improved patient outcomes.

No studies quantifying the effect of team approach or level of practice on nursing workload or patient outcomes were identified. As discussed in chapter one some studies have demonstrated that better RN to non-RN ratios leads to improved patient outcomes as measured by medication administration error, falls, decubiti development and patient complaints (Blegen et al., 1999; Blegen & Vaughn, 1998; Houser, 2003). These studies were conducted on inpatient units rather than in emergency departments. CENNZ (2002) states that RN skill mix, turnover, and use of casual staff all impact on nursing workload. Although studies demonstrate

that better RN to non-RN ratios and greater numbers of RNs result in better patient outcomes there are no studies relating RN levels or skill mix to workload or patient outcomes.

### *Environmental Complexity*

Emergency nurses and the departments they work in do not exist in a void. The fourth factor in the framework, environmental complexity, recognises that the environment and the expectations for nurses' work are shaped by the political, organisational, and social milieu. ENA (1999) recognised that department characteristics, support services, non-nurse staffing, organisational structure, and regulatory requirements all impact on nursing workloads. Some factors, such as government level of service expectation, may be identical across some emergency departments while others, such as physical layout, may be unit specific. This section looks at the environmental factors which impact on nurses' workloads in the ED.

O'Brien-Pallas et al. (1997) proposed that organisational and operational factors impacted on the structures and processes within departments. They developed "unit factors" to measure two different components in their model, environmental complexity and nurse characteristics. They identified 11 factors, including physical layout, competing demands, and characteristics and composition of the health care team, which accounted for 37% of variance in nursing workload on 14 units in a paediatric tertiary setting (Table 6, p. 38). Although this study did not include the emergency setting, a large number of the factors are likely to affect emergency nurses' workloads. The contribution of these factors



towards predicting nursing workload in the ED may vary from that for the inpatient setting. Some of these factors do not fit well into the concept of environmental complexity or nursing characteristics. For example, given the holistic view of the family, it could be argued that a large family support requirement is a patient nursing complexity factor rather than an environmental factor. Likewise, patient instability and severity of illness relate more to medical condition than to environmental factors. O'Brien-Pallas et al. recognised the limitations of their unit factor in describing this work as a pilot to test potential factors.

Table 6

*Unit Factors and their Impact on Nursing Workload*

Unit Factor	Examples	Impact
Multiple procedures	Multiple medications, Isolation techniques, Frequent vital signs, Blood transfusion	8.5 %
Indirect / non-nursing tasks	Unexpected arrival, Clerical work, Charting and paperwork	4.9 %
Students	Supervision, Coordination	3.7 %
Short staffing	Relief requested not available, RN absent	3.5 %
Skills	Leadership skills, Ability to work in teams	3.1 %
Long Procedures	Peritoneal dialysis, Intermittent catheterisation	2.7 %
Psychosocial	Large number family supports, Limit setting required, Behavioural problems	2.5 %
Relief	Use or orientation of relief staff, RN illness	2.4 %
Administrative support absent	Unit clerk or aid absent	2.2 %
Surgical operations	Preoperative preparation and teaching, RN escort, RN stay with patient in x-ray	2.0 %
Discharge	Delays in discharge, Discharge teaching	1.8 %

*Note.* Adapted from “Measuring nursing workload: Understanding the variability”, by O'Brien-Pallas, L., Irvine, D., Peereboom, E., & Murray, M. (1997). *Nursing Economics*, 15(4), p. 177-178

Emergency departments in the New Zealand public health system are divided into levels of service according to their hospital environment. These levels range from Level 2, rural and remote hospitals, with limited capacity to manage resuscitation and stabilisation of acute illness or injury, to Level 6 hospitals, with the ability to provide definitive treatment for all major illness and injury. The Ministry of Health outlines the key differences, in terms of both emergency department function and structure, according to their levels of service (Emergency Department Clinical Advisory Group, 2002; Ministry of Health, 1999, 2002). Table 7 (p. 40) summarises these documents. This table demonstrates that government expectation of service varies throughout New Zealand and with it the structure and resources within the departments. Triage is consistently required at all times for all levels of emergency department.

Institutional expectation of public hospital emergency departments reflects the government and community expectations. Donabedian (1990) refers to this as legitimacy. These expectations include structural requirements, such as separate resuscitation areas; process requirements, such as all triage category 1 patients will be seen and given treatment immediately 100% of the time; and outcome requirements, such as thrombolysis within one hour of arrival (Ministry of Health, 2002). New Zealand government also requires that health boards be responsive to the communities they serve.

Table 7

*Emergency Department Structures and Services*

	Level 2	Level 3	Level 4	Level 5	Level 6
Hospital	Sub-acute / Rural.	Secondary.	Major Secondary.	Tertiary.	Higher Level Tertiary.
Manages	Acute illness, injury, resuscitation, limited stabilisation.	Acute illness, injury, resuscitation, assisted ventilation, stabilisation, transfer.	As for level 3 plus: Definitive care for most cases. Advice and treatment for cases referred from level 2, 3.	As for level 4 plus: Resuscitation, initial treatment for all emergencies. Tertiary advice, stabilisation complex cases.	As for level 5 plus: Full cardiothoracic, neurosurgical facilities.
Structure	Designated assessment, treatment area, separate resuscitation.	Provision for: Children, whanau in waiting room, treatment areas. Violent, disturbed patients. Purpose built resuscitation area.	As for level 3 plus: Capacity for extended assisted ventilation.	As for level 4.	As for level 5 plus: Sophisticated resuscitation area. Capacity for frequent life threatening trauma, emergencies. Invasive monitoring, short term assisted ventilation.
Support Services	Operating rooms pathology, pharmacy in normal hours, on-call.	Operating rooms pathology, radiology, pharmacy 24 hours.	As for level 3.	As for level 4 plus: Normal hours access to nuclear medicine	As for level 5 plus: 24 hr availability of CT, angiography. Extended access to interventional radiology, and MRI.

Table 7 (continued).

*Emergency Department Structures and Services.*

	Level 2	Level 3	Level 4	Level 5	Level 6
Medical Staff	Medical officers with advanced life support (ALS) within 10 minutes, 24 hours.	Full-time medical director. Medical officers with ALS, 24 hours.	As for level 3 plus: Extended hours specialist support.	As for level 4 plus: Full-time medical director with specialist qualifications.	As for level 5 plus: Out-of-hours specialist cover. Training registrars, 24 hours.
Nurses	Designated clinical charge nurse (CCN). Triage nursing available 24 hours. Access to clinical nurse educator (CNE). Nurses with relevant postgraduate studies.	As for level 2 plus: Nursing leader for organisation. Accessible clinical nurse consultant (CNC). Accessible CNE. CCN 16 hrs/day. Postgraduate trained emergency nurses.	As for level 3 plus: Dedicated triage nurse 16 hrs/day. Dedicated nurse co-ordinator 16 hrs/day	As for level 4 plus: Dedicated CCN. Dedicated Emergency Nurse Practitioner (ENP). Dedicated Triage nurse 24 hrs/day. Dedicated postgraduate trained emergency nurses.	As for level 5 plus: Dedicated CNC. Dedicated CNE. Dedicated nurse co-ordinator 24 hrs/ day.

*Note.* Adapted from *Guidelines for Staffing and Skill Mix in New Zealand Emergency Departments*, by Emergency Department Clinical Advisory Group. (2002), *Roadside to Bedside. A 24-hour Clinically Integrated Acute Management System for New Zealand*, by Ministry of Health. (1999), and *Service Specifications: Emergency Departments*, by Ministry of Health. (2002)

The government and community expectations and the availability of alternative services in the primary care sector affect ambulatory attendance to the ED. The New Zealand Service Specifications for Emergency Departments states entry criteria as, “Individuals with real or perceived injury, illness, or obstetric complications ... that could not be appropriately provided in a primary care setting...” (Ministry of Health, 2002 , p. 2). Differentiating what can appropriately be treated in the primary setting is difficult for the public and the professional. One Australian report found that of all ambulatory patients attending an ED, 15% definitely had needs that could be managed in the primary care setting and 70% were appropriate for treatment by emergency services (National Health Strategy, 1992). However emergency specialists and GPs were unable to differentiate which service was most appropriate for the further 15% of ambulatory patients. With health professionals unable to easily differentiate which service should most appropriately treat these cases it is not surprising that education programs fail to alter the public expectations for treatment in the ED (New Zealand Health Technology Assessment, 1998).

Ambulatory attendees to emergency departments tend to be of lower socio-economic status, aged between 15 and 24 years, and tend to have injury rather than illness (National Health Strategy, 1992). These attendances occur predominantly at times when no primary health alternative is available. In addition, smaller emergency departments are likely to see more return patients than major urban EDs (Ward, 1992). Wilson (1987; 1989; 1991) identified the effect of community service availability, such as accident and medical clinics, in reducing trauma

attendance in the urban New Zealand setting. These environmental factors relate to the accessibility and acceptability of EDs in comparison to primary health care facilities. Emergency presentation is more common in lower socio-economic regions and areas where alternative healthcare facilities are not available (New Zealand Health Technology Assessment, 1998).

Many EDs also offer a hospital referral service for General Practitioners and other community based health facilities, providing space for specialist assessment and treatment. Gabolinsey (2000) demonstrated that hospital attendance in one New Zealand tertiary ED followed a daily pattern, with attendances rising at approximately 10am and declining after midnight. The 10am start was related to the referral process from GPs while the maintenance of high numbers after GP closure was related to the unavailability of primary services outside normal working hours. Gabolinsey used information from only one week's attendances but showed daily consistency during that week. Findings were consistent with results by Tandberg and Qualls (1994), who used two years data in an American teaching hospital, and Ceglowski, Churilov, and Wasserthiel (2005), who reported results of one year of visits from a major metropolitan Australian hospital. ED attendance is affected by the referral expectation of the community.

Table 7 (p. 40) also differentiates how other services are expected to relate to an ED. Support services such as laboratory and radiology are required for the emergency department to investigate, diagnose, and treat the plethora of patients presenting. The relationship between these services and the ED is a component of environmental complexity. Time taken for results

to become available to the treating clinicians will impact on patient length of stay (Zimmerman, 1999). Delays in result availability cause prolonged patients waits before admission or discharge decisions are made. As patients are nursed continually throughout the visit, longer stays in the department result in nursing care continuing for patients who may have earlier been discharged or transferred.

The physical layout of the ED and co-location of support services, such as radiology, also has an impact on nursing work. Isolated and remote areas require staffing to provide care, while nurse escort services to remote areas are necessary for continuous monitoring and patient safety (American Nurses Association House of Delegates, 2000; Davis, 1995; Emergency Nurses Association, 2003b). EDs which are large, split into many smaller sections, or are physically remote from their support services will need more nurses than those which are more compact and co-located with their support services.

Non-nurse staffing is a structural component that impacts on nursing work and the quality of the outcomes from that work. Personnel, such as reception, orderly, plastering, ECG technicians, phlebotomy, physiotherapy, health care assistants, and senior and junior medical staffing, all impact on the ability of the nurse to provide adequate nursing care (Davis, 1995).

In the workload framework developed by O'Brien-Pallas et al. (1997) LOS was used as a measure of severity of illness in patients. Houser (2003) also used LOS as a factor contributing to nursing workload while Aiken et al. (2000) consider it to be a measure of patient outcome. This

highlights the complex interrelationships factors can have with each other and the importance of a framework when considering the relationships. Houser found that the combination of midnight census and LOS used to identify nursing workload on inpatient units was not supported by nursing staff as an accurate guide to nursing workload. In her study she demonstrated that, as a nursing workload measure, LOS did not relate to patient outcomes. In contrast O'Brien-Pallas et al. found that LOS as a measure of patient severity accounted for 5% of nursing workload.

In the ED the assumption that LOS is an indicator of patient severity is also inaccurate. Gabolinscy (2000) showed that triage code 1 patients stayed an average 3.58 hours in the ED. Triage code 1 patients have life threatening problems such as cardiac arrest or major trauma. He identified an example of one patient in triage code 1 who only stayed eight minutes in the emergency department before being taken to theatre. In his report, patients in triage code 3, those with moderate injury or illness, stayed an average 4.2 hours while those in triage code 5, with minor illness only, stayed a shorter two hours on average in the ED. These figures indicate that for severe cases such as triage code 1 and for those with minor illness or injury such as triage code 5 shorter stays may exist compared to those of triage code 3. Some factors that might affect LOS have already been discussed. There would appear to be a more complex relationship than severity alone accounting for LOS in the emergency setting.

Bed or access block is the term increasingly used to identify the difficulty of many EDs to move people into inpatient beds. Literature suggests that, as hospitals have downsized and populations increased, the



ability for inpatient wards to absorb fluctuations in admissions has been exhausted with many wards running at over 100% capacity (Reeder & Garrison, 2001; Sobie, Gaves, & Trengali, 2000). As a result patient length of stay in the ED is increasing. This results in nurses not only caring for new arrivals but also those waiting for beds. Placing patients in corridors while they await beds leads to environmental problems of congestion further impacting on the work of nurses.

In the ED there is clear support that as LOS increases so does the workload for nursing staff (Davis, 1995). Unlike medical staff, whose care provision is often episodic in nature, nurses are responsible for direct care of patients throughout the stay. Fullham (2002) recommends that extra nursing time is required above that allocated for a triage category if the patient length of stay is extended beyond the decision to admit time. ENA guidelines (2003b) add between 15 and 60 minutes extra nursing time for each hour patients stay in an ED beyond the first hour. ENA tested their guidelines using American EDs identified as having sufficient staff. There appears to be no literature available that relates LOS in New Zealand EDs to emergency nurse direct care time.

### **Summary**

In the emergency setting several tools have been used to predict nursing FTE requirements. Traditionally, number of nursing FTE per 1000 patient attendances has been used in New Zealand. The need to account for the acuity of patients has lead to the use, by some authors, of triage scores as

a proxy to acuity (Ardagh, 1999; James, 1998). The use of triage as an acuity tool is not supported by ENA (2003b). However, the ENA guidelines propose groupings of patients that are similar to the outcomes of triage using ATS. This suggests that ATS may be useful as an indicator of acuity.

This chapter has proposed a framework developed from the meta-paradigm suggested by O'Brien-Pallas et al. (1997) and linked to the model of Houser (2003). This framework suggests how the structures of environmental complexity, nursing characteristics, patient nursing complexity, and patient medical condition and severity, might impact on the processes of nursing work and the outcomes of nursing care. Triage has potential to be used as a measure of medical condition and severity.

Further work is needed to develop a model that is sensitive to the factors affecting nursing work in New Zealand EDs. Measurement and prediction of nursing workload will assist managers and clinicians to identify nurse-staffing requirements and to optimise patient outcomes. Any model developed needs to utilise accessible data and be simple to use. The aim of this thesis is to identify whether triage code, as measured by ATS, can be used to predict nursing workload in the emergency setting. Specific questions that will be answered are:

1. How much direct nursing care time do patients receive when visiting an emergency department?
2. What associations do triage code, length of stay, age, ethnicity, disposition category, and complaint type, have to direct nursing care time?

3. Is triage code an independent predictor of direct nursing care time controlling for age, ethnicity, length of stay, complaint type and disposition category?

## **Chapter 3**

### **Methods**

*He rei nga niho, he paraoa nga kauae.*

A whale's tooth in a whale's jaw.

It is important in doing research that the methodology is appropriate to the intended study purpose. This chapter iterates the study purpose and questions and relates these to the choice of methodology, study design, and methods including steps taken to ensure rigour. Ethical and cultural considerations taken into account during this process are also outlined.

#### **Purpose**

The main goal of this thesis was the development of a simple and accurate tool for predicting emergency nurse staffing. The research proposed investigates how much direct nursing care time (DNCT) patients in one New Zealand emergency department receive and whether triage code can be used as a predictor of DNCT.

#### **Study Questions**

In order to explore the relationship between triage category and direct nursing care time this study aimed to answer three questions:

1. How much direct nursing care time do patients receive from emergency department nurses?
2. How does direct nursing care time relate to patients triage code, length of stay, age, ethnicity, complaint type, and disposition category?
3. Is triage code an independent predictor of nursing care time controlling for age, ethnicity, length of stay, complaint type and disposition category?

## **Methodology**

Grant and Giddings (2002, p14) identified the positivist paradigm as where “knowledge is to be discovered so people ... can explain, predict or control events.” The reason for exploring the relationship between triage code and direct nursing care time was to identify whether triage code can be used as a workload measure in New Zealand emergency departments. As discussed in chapter two, workload measurement tools are useful in that they allow the prediction and management of nursing workloads and budgets (O'Brien-Pallas & Cockerill, 1990). The positivist paradigm was therefore chosen for this research.

The positivist paradigm is underpinned by the epistemology of objectivism (Crotty, 1998). This philosophical framework has the key belief that an object is the same no matter whom the observer and can be measured or counted. In the context of this study direct nursing care time can be

measured with a clock and minimal variation in measurement will occur between observers.

### **Study Design**

A prospective, non-experimental design was used for this study. The study was based on the work of Helmer, Freitas, and Onaha (1988), who used a work sampling technique to develop a staffing model for their ED. In their research nurses and clerical staff recorded the amount of time spent doing both direct and indirect patient care. The aim of their research was to analyse the number of nurses required on each shift.

As the purpose of this study was to examine whether triage code could predict the direct nursing care time (DNCT) provided to patients, the study was designed specifically to measure DNCT as the dependent variable. Triage code, as measured by the Australasian Triage Scale (ATS), was the independent variable being tested for its ability to predict variation in DNCT. Potential confounding variables were chosen to represent components of the framework discussed in chapter two of this thesis. When selecting confounding variables, it was felt that variables that were readily accessible to an emergency department manager would be more useful in the final model for calculating DNCT. Therefore, selection was based on potential ability to predict DNCT as well as ease of data accessibility. The study design is depicted in Figure 3 (p. 52). The unit of analysis was the patient visit.

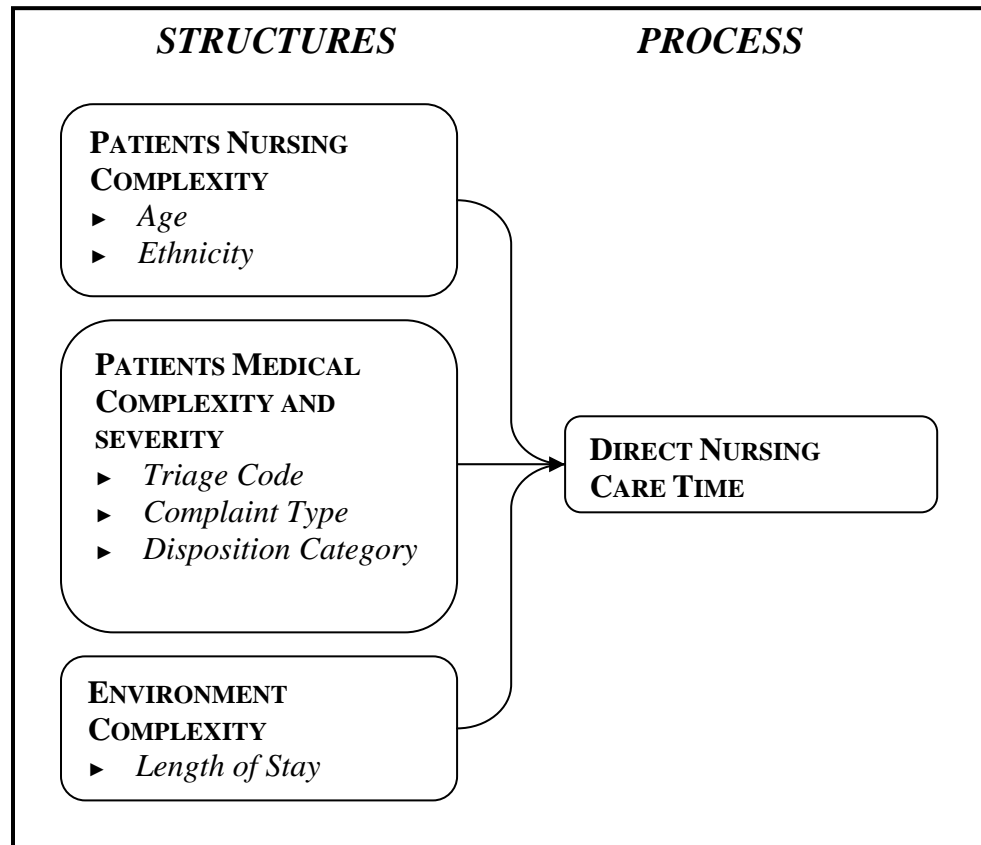


Figure 3. Proposed focus for this thesis.

## Methods

### *Setting*

The emergency department setting chosen for this study was a tertiary hospital in an urban centre of New Zealand. This hospital served both rural and urban communities directly and via referral from other hospitals. The population of the District Health Board catchment area was 436,000 (Ministry of Health, 2003). Table 8 (p. 53) outlines the demographics for the region.

Table 8

*Population Characteristics for District Health Board Catchment*

Variable	Characteristic	Percentage
Gender	Male	48.7%
	Female	51.3%
Age	0-15yrs	20.3%
	15-64 yrs	65.2%
	65+	12.1%
Ethnicity	European	91.8%
	Maori	6.8%
	Asian	4.1%
	Pacific Peoples	1.8%
	Other Ethnicity	0.5%

*Note:* Information from Statistics New Zealand (2001).

The selected ED had an annual attendance of approximately 65,000 patient visits (Australasian Society for Emergency Medicine, 1998) and provided both adult, and paediatric services. Some paediatric patients were referred directly from triage to a separate paediatric assessment unit outside the ED and some orthopaedic patients went to orthopaedic clinic without being treated in the ED. Mental health patients without concomitant medical problems were referred directly from triage to psychiatric services.

At the time of this study the nursing full time equivalent (FTE) was 64, made up of 110 individual nurses including ten senior nursing positions. No formal system was in place at this hospital to differentiate levels of nursing practice. Some nurses in this service had postgraduate qualifications in emergency nursing and all were either participating in or had completed an in-house training programme. Nurses undertaking the triage role had all been trained to do so through an internal course consisting of two days



classroom education, a workbook, and shifts in the triage role with an experienced triage nurse. Some had also undertaken a national triage course.

Triage was performed at two separate locations in the department. One location triaged patients who arrived by car or walked into the department while the other location was for those patients arriving by ambulance.

### *Sample*

The primary variable of interest for this study was DNCT provided to individuals during each visit. Taking into account the proportion of visits in each triage category (Table 9, p. 55), a sample size calculation was conducted using PC-Size: Consultant [shareware] (Dallal, 1990), to determine the number of patients needed to detect a difference of 20 mean nurse time minutes between triage codes 3 and 4 ( $\alpha = 0.05$ , power = 0.80, SD = 32). The decision to use a mean difference of 20 minutes and triage code 3 and 4 was based on the various reports of DNCT summarised in Table 4 (p. 30). Triage code 3 and 4 were believed to be important categories with the smallest detectable variation. Using the triage percentages in the selected ED, it was calculated that 84 patients would be needed to differentiate between these two groups: 42 from both triage code 3 and triage code 4.

Table 9

*Proportion of Attendees by Triage Code*

Triage Code	Percentage
1	0.6%
2	9.8%
3	43.5%
4	43.2%
5	2.9%

*Note.* Figures supplied by Newsome (2003)

To account for exclusion criteria, the proportions of each triage code attendances, and any staff or patients choosing to opt out of the study it was estimated that a 3-day period would capture sufficient patients for triage codes 2 to 5 (Table 10). Triage code 1 would need to be collected for three weeks due to the infrequency of this attendance type.

Table 10

*Proposed Patient Attendance Numbers Over Collection Period*

Triage Code	Patients	Sample period
1	22	21 days
2	52	3 days
3	232	3 days
4	230	3 days
5	15	3 days

The unit of analysis was the patient visit. All patient visits starting with nurse triage were included. Excluded visits were those where the

patient moved directly from the ED triage to the orthopaedic clinic or paediatric assessment unit. Those patients whose care was solely provided by psychiatric services within the ED were also excluded. Eligible patients were entered consecutively during the designated data collection days.

### *Variables of Interest*

The variables of interest were identified in Figure 3 (p. 52). The data dictionary (Table 11, p. 57) explains the operationalisation of the dependent, independent, and potential confounding variables.

DNCT was the dependent variable being measured. The definition of DNCT was based on the work of Helmer et al. (1988) who identified direct patient care as hands on, patient interviewing, charting, medication administration, and patient and family teaching or counselling. A modification was made to this, after discussion with nursing staff, to include the time spent discussing the individual patient's care with other staff.

The researcher tested reliability of DNCT by observing 10 visits, recording the DNCT for each with a stopwatch, and comparing inter-rater reliability with the time documented by the nurses. One risk of this process was that nurses, aware of being observed, would record more accurately. This is referred to as the "Hawthorne effect" and has potential to introduce bias to research (Seaman, 1987). To minimise this, nurses were told, prior to the study, that they may be observed during data collection. They did not know for which visits the researcher was independently measuring DNCT. Paired sample t-test, showed no significant difference in DNCT documented by the nurse and the researcher ( $p = .33$ , two-tailed) (Table 12, p. 59).

Table 11

*Data Dictionary*

Concept	Variable Name	Variable Type	Measurement	Response type	Level of Measurement
Nursing Care	Direct Nursing Care Time	Dependent	Total time spent post triage, as recorded by nurses on data collection form, providing care to each patient. Includes all time spent with patient and time spent discussing individual patient with other members of health team.	Minutes	Continuous
Medical Condition and Severity	Triage Code	Independent	Australasian Triage Score as designated by trained triage nurse on arrival.	1 = ATS 1 2 = ATS 2 3 = ATS 3 4 = ATS 4 5 = ATS 5	Ordinal
Medical Condition and Severity	Complaint Type	Confounding	Primary grouping as designated by nursing staff based on patient complaint. Orthopaedic and surgical complaint type was divided into either Trauma (if a result of injury) or Surgical (if a non-injury based complaint).	1 = Medical 2 = Surgical 3 = Trauma 4 = Psych 5 = Other	Nominal
Medical Condition and Severity	Disposition Category	Confounding	Where patient was sent from Emergency Department. Admitted patients were admitted to the same hospital. Those discharged were discharged to a private dwelling. Transfers were to another health care facility.	1 = Admit 2 = Discharge 3 = Transfer 4 = Other	Nominal

Table 11 (continued)

*Data Dictionary*

Concept	Variable Name	Variable Type	Measurement	Response type	Level of Measurement
Nursing Complexity	Ethnicity	Confounding	Ethnicity as reported to Emergency Reception. Ethnicity information collection was based on the question used in the New Zealand Population Census.	1 = NZ European 2 = NZ Maori 3 = European 4 = Pacific Island 5 = Asian 6 = Indian 7 = Other	Nominal
Nursing Complexity	Age	Confounding	Patient age (years) calculated by the number of days between Date of Birth and Date of presentation divided by 365.25.	Years	Continuous
Environmental Complexity	Length of Stay	Confounding	Time from arrival in department (as recorded by time of triage) until departure from department (as recorded by nurse on data sheet).	Minutes in ED	Continuous
Demographic	Sex	Demographic	Pt sex as recorded at reception.	1 = M 2 = F	Binary

Table 12

*Reliability Tests for Direct Nursing Care Time*

Rater	Mean DNCT (minutes)	N	Std. Deviation	Std. Error Mean
Researcher	43.60	10	24.78	7.84
Nurse	42.40	10	24.02	7.60

	Paired Difference					t	df	Sig. (2-tailed)
	Mean (mins)	Std. Deviation	Std. Error Mean	95% Confidence				
				Interval				
				Lower	Upper			
Researcher								
- Nurse	1.20	3.71	1.17	-1.45	3.85	1.02	9	.33

*Note.* Calculated using SPSS Student Version 10.0 for Windows (2000)

Triage Code, as measured using the Australasian Triage Scale (ATS), was the independent variable and seen as a component of patient medical severity in the conceptual framework (Figure 3, p. 52). Inter-rater reliability of nurse triage using the National Triage Score (NTS) has been tested by Jelinek (1996) and Bebbington (1999). ATS is used in all New Zealand emergency departments. ATS was developed from NTS by the Australian College of Emergency Medicine (2000b) to include psychiatric complaints, greater definition, and more examples of type of patient presentations. Comparison of NTS, ATS, and triage teaching at the study hospital demonstrated that all three resulted in similar patients being grouped in the same triage codes (Gabolinscy, 2001). Both Jelinek and

Bebbington found that nurses consistently triaged within one triage category of each other when responding to 100 written patient profiles.

The potential confounding variables were selected to represent aspects of the proposed model (Figure 3, p. 52) that may also impact on DNCT. Medical severity and complexity were operationalised by measuring complaint type and disposition category. The complaint type and disposition category were collected on the data form, and then checked by the researcher against discharge information recorded in the patient computer record. No disagreement was found between complaint type or disposition category and patient record.

Ethnicity, as a proxy for culture, and age were seen as potentially adding to patient nursing complexity. Ethnicity was collected at reception according to the standard recommended by Statistics New Zealand in the 2001 New Zealand Population Census (Lang, 2002). This allows for multiple ethnicities to be entered for one person. However, no patients were recorded to have dual ethnicity suggesting that standard questioning was not used in collecting this information. Age was calculated as the difference between date of birth recorded on the patient label and presentation date recorded by the nurse on the data collection tool. For eight patients no date of birth was transcribed from the label to the de-identified forms by the researcher. These patients all had age in years recorded on their data collection form by the nursing staff. This was used in the age data in these instances. Patient gender was also collected for demographic completeness.

LOS, as discussed in Chapter two, represented environmental complexity. The triage nurse was the first point of contact for patients

presenting to the ED. Time of triage was used as the visit start time for calculating LOS. Nurses documented the departure time of the patient. The researcher checked the documented departure against the time recorded in the electronic record. There was consistency between the nurse recorded discharge time, the electronic discharge time and the last nursing care time.

### *Procedure*

The research was undertaken in three phases. The initial pilot phase was followed by detailed teaching of staff and then, in the third phase, by data collection.

#### *Phase 1: Pilot testing*

Three nurses over one shift piloted the data collection tool. They recommended that time spent discussing individual patients with other health care workers be added to the direct nursing care definition, arguing that these discussions impacted on patient outcomes. This was subsequently included in the definition of DNCT. No other alterations were required.

#### *Phase 2: Training and consent*

Prior to the study being undertaken, meetings were held with nurses outlining the study and how they were expected to collect data. The ethical issues of consent were discussed for both patients and nurses. Nurses were advised that New Zealand Nurses Organisation (NZNO) delegates were available should they have concerns or not wish to participate in the research component of the study. The Researcher, or Clinical Nurse



Specialists in the absence of the researcher, was available for patients who wished to discuss their participation in the research. All nurses also received an information sheet (Appendix A) summarising the study. The researcher met with reception staff to ensure that, for all presentations to the ED, they added the labelled data collection tool to patient notes.

A separate meeting, detailing the research and consent considerations, was held with senior nurses who were the first point of query when the researcher was not present. This meeting, like that for nurses, outlined the research and ethical issues. It also outlined how the researcher would be supporting the study by physical presence in the first three days and by phone for the full data collection period.

### *Phase 3: Data collection and monitoring*

At the beginning of the research period posters outlining the study being undertaken were placed at all entries to the ED and in all patient areas (Appendix B). The researcher was present at the beginning of all shifts for the first three days and available by phone throughout the research period to answer questions. Clinical Nurse Specialists were present throughout the data collection period to answer questions or contact the researcher if unable to answer.

Clerical staff added a data collection form (Figure 4, p. 63), with patient label attached, to the emergency record of all patients attending the ED. Nurses attached the data collection form to a clipboard once the patient was placed in the ED. This remained with the patient until discharge.



Nurses completed the demographic and independent variable information as well as documenting the beginning and end times for each episode of direct patient care on the form. Data collection forms were collected at three points in the ED. The researcher reviewed all forms for data completeness. Where demographic, confounding, or independent data were not completed, the researcher used the patient's electronic ED record to add this information to the data sheets.

Data on the data collection form were checked against electronic records for 20 patients to verify accuracy. No differences were found between the two sources. Once this process was complete the data collection forms were de-identified by removal of the top section containing the patient label.

### **Ethical and Cultural Considerations**

This study had potential benefit in that it could be used to develop a better match between staff nurse resources and patient needs and advance the understanding of how patient profile impacts on nursing care time in New Zealand EDs. Although nursing workload measures have been developed in EDs internationally and in wards in New Zealand, no research has been done looking specifically at the time New Zealand emergency nurses spend in direct patient care.

Ethics approval was gained from the Canterbury Ethics Committee (Appendix C). Key ethical considerations were that patients be informed of the study and have the right not to be included in the study. Posters

throughout the department provided this information. Individual consent was not needed as aggregate, de-identified data was used. Patients with questions were able to talk to the researcher or senior nurses and opt out of the study. No patients chose to opt out. Managerial approval from within the ED was obtained as part of the ethics proposal (Appendix D, E)

There was also a concern that, as the researcher held a role where staff reported to him, some nurses might feel under duress to participate in the study. Union representatives within the department agreed to intervene on behalf of any staff having concerns or wishing to opt out of the study (Appendix F). This was publicised in the communication book of the department. No staff utilised this service.

To ensure confidentiality, once all data were verified on the data collection tool the upper portion containing the sticker with unique patient information was removed. The resulting de-identified data was stored in a locked filing cabinet. Only aggregate data is reported.

The Maori health service for the district health board, Te Komiti Whakarite, was consulted as to how the obligations of the Treaty of Waitangi could best be included in the study. The main recommendation was to use the census 2001 question to collect the ethnicity data (Appendix G). The researcher discussed this with the clerical staff in the emergency department who were collecting this data and was told that this was standard practice.

During the study there was no impact on treatment or patient care. The time spent on data collection was less than five minutes per patient and was considered to be part of nursing audit.

## **Data Management and Analysis**

Data were entered into an excel spreadsheet. Ten percent of visits were randomly chosen to check that data entry was correct. Only one error was found in the checking process where a patient gender was incorrectly entered. Microsoft Excel was used to calculate total DNCT for all patients. All data were then transferred to SPSS. SPSS Student Version 10.0 (SPSS Inc, 2000) was used for statistical analysis.

Descriptive analysis was undertaken for the baseline characteristics of all independent variables and demographic data. Data were checked for ranges, outliers, and normal distribution. Where outliers were found consideration was made as to whether these should be included in further statistical analysis. This is presented in chapter four.

The first objective of this study was to answer the question, “How much direct nursing care time do patients receive from emergency department nurses?” This was explored through descriptive analysis of the dependent variable, DNCT, including calculation of central tendency, spread, normalcy, and identification of outliers.

The second objective was, “How does direct nursing care time relate to patients triage code, length of stay, age, ethnicity, complaint type, and disposition category?” Bivariate analysis was used to relate the continuous variable, direct nursing care time, with the independent variables. Table 13 (p. 67) outlines the statistical analyses used in this process.

Table 13

*Statistical Analysis Used*

Independent variable (IV)	Level of measurement	Comparative statistic used
Triage Code	Ordinal	ANOVA
Length of Stay	Continuous	Correlation
Age	Continuous	Correlation
Sex	Binary	ANOVA
Ethnicity	Nominal	ANOVA
Complaint Type	Nominal	ANOVA
Disposition Category	Nominal	ANOVA

The final objective for this study was to answer the question, “Is triage code an independent predictor of nursing care time controlling for age, ethnicity, length of stay, complaint type and disposition category?” Multiple linear regression was used to answer this question. Multiple linear regression requires continuous or dichotomous independent variables, continuous dependent variable, and assumes normal distribution (Tabachnick & Fidell, 2001). Recoding of triage codes into dichotomous dummy variables was performed as outlined in Table 14.

Table 14

*Dummy Variable Recoding of Triage Code*

Dummy Variable	Triage Code Variable				
	ATS 1	ATS 2	ATS 3	ATS 4	ATS 5
Ones	1	0	0	0	0
Twos	0	1	0	0	0
Threes	0	0	1	0	0
Fours	0	0	0	1	0
Fives	0	0	0	0	0

The final model was developed in three steps. Model one was the forced entry of the dichotomous triage variables. This decision was made based on the primary question to be answered, which was, “How much can direct nursing care time be explained by triage code?”. In the second step, Model 2, LOS was entered after the triage variables. This decision was based on the belief that LOS has a component of environmental impact and can therefore be altered in the clinical setting. The remaining significant confounding variables were entered stepwise to create the final model, Model 3. Stepwise entry was used for the last variables to exclude variables with minimal impact on DNCT.

### **Summary**

This chapter has outlined the process that was undertaken to attain ethical approval, and collect and analyse data for this study. The use of the positivist paradigm, as most appropriate where control and prediction is desired, and the specific questions to be answered guided this researcher to the method utilised. Chapter four contains the results of the analysis undertaken while Chapter five will discuss these results in light of current literature and research.

## **Chapter 4**

### **Results**

*Iti noa ana, he pito mata.*

Only an ordinary little morsel,  
but it has not been cooked.

The main purpose of this research was to develop a simple and accurate tool for predicting nurse staffing. This chapter describes the data collected according to the methods outlined in chapter three. The results are discussed in relation to the literature and the research purpose in chapter five.

### **Sampling**

This study was conducted between 18<sup>th</sup> November 2003 and 9<sup>th</sup> December 2003. The majority of sampling occurred on the first three days, which were a Tuesday, Wednesday, and Thursday, while the sampling for triage code 1 patients occurred over the 3-week period. During this 3-week period 3411 patients were triaged into the emergency department, 468 of these visits were in the first three days of data collection. Data collection forms were completed for 261 visits. Data collection for triage code 3 and 4 was stopped on day three having met the minimum sample requirements. This allowed nurses to focus on collection of data for triage codes 1, 2, and 5. Sampling rates on days 1 and 2 were 88% and 83%



respectively. Despite collecting data for triage code 1 over a three-week period only three visits had completed forms. Triage code 5 also had a low number of completed data forms ( $n = 9$ ). Table 15 summarises the sampling over the 3-day period.

Table 15

*Sample*

	Total ED Visits ( $n = 468$ ) 3days	Study Sample ( $n = 259$ ) 3 days
Day		
1	150	106
2	165	109
3	153	44*
Triage Code		
1**	12 (0.4%)**	3 (1%)**
2	47 (10%)	39 (15%)
3	206 (44%)	126 (48%)*
4	196 (42%)	84 (32%)*
5	17 (3%)	9 (3%)

Note: \*Triage Code 3 & 4 sampling was stopped on Day 3

\*\*Triage Code 1 based on 3 week collection period

### Sample Characteristics

The sample was explored, using descriptive statistics. Graphic representation is provided for continuous variables to support understanding and exploration of assumptions of normality required for statistical analysis. Sample characteristics are summarised in Table 16 (p. 71).

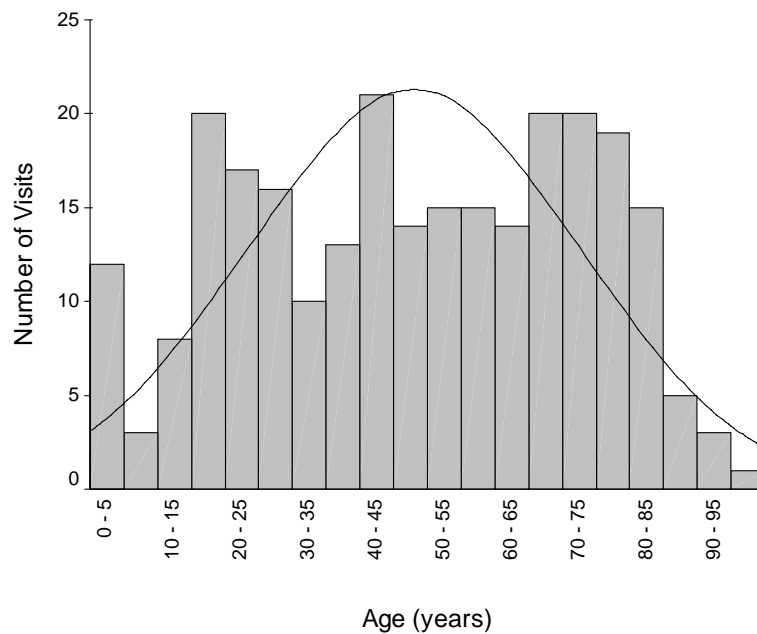
Table 16  
*Sample Characteristics (N = 261)*

Variable	<i>n</i> (%)
Sex *	
Male	126 (50%)
Female	126 (50%)
Ethnicity	
NZ Maori	13 (5.0%)
NZ European	163 (62.5%)
Non-NZ European	36 (13.8%)
Pacific Islander	4 (1.5%)
Chinese	4 (1.5%)
Indian	3 (1.1%)
Other / Unknown	38 (15.0%)
Complaint Type	
Medical	150 (57.5%)
Surgical	54 (20.7%)
Trauma	48 (18.4%)
Psychiatric	3 (1.1%)
Other	6 (2.3%)
Disposition Category	
Discharged	131 (50.2%)
Admitted	124 (47.5%)
Transferred	3 (1.1%)
Deceased	3 (1.1%)
Age (years)	
Range	(0 – 97)
Mean (SD)	48 (24.41)
Median	48
Length of Stay (minutes)	
Range	(7 – 1332)
Mean (SD)	279 (258.68)
Median	204
Geometric Mean	200

*Note.* \* 9 visits did not have patient sex noted.

The sample divided evenly into male ( $n = 126$ ) and female ( $n = 126$ ) with 9 patients not having their sex recorded. Most patients were either NZ European (62.5%) or Non-NZ European (13.8%). The remaining patients were Maori (5%), Chinese (1.5%), Pacific Island (1.5%), Indian (1.1%) or of other/unknown ethnicity (14.6%).

The age distribution, with a superimposed reference normal curve, is presented in Figure 5. The mean and median were both 48 years with a standard deviation of 24.4 years. There were multiple modes in this distribution, centred on ages 0-5, 15-20, 40-45, and 65-75 years. The age distribution had minimal negative skew (-0.13) but showed significant negative kurtosis (-1.08). Non-normality was confirmed using Shapiro-Wilk test ( $p < .01$ ).



*Figure 5.* Age distribution for sample.

Tabachnik and Fidell (2001) recommend that transformation of data may improve normality and suggest trialling several transformation types to find the one which improves normality most. Square root, logarithmic, and inverse transformations were all attempted with no improvement in Shapiro-Wilk test for normality ( $p < .01$ ). As transformation did not improve normality, and the distribution was multi-modal, it was decided to accept non-normality of age distribution in further testing.

Figure 6 represents the LOS of the sample with a superimposed reference normal curve. This graph shows marked positive skew (2.3) with a median of 204 minutes and range between 7 and 1332 minutes. The mean LOS for this sample was 279 minutes with a standard deviation of 259 minutes. There was also marked positive kurtosis (5.3) indicated by high peaks around the median. Shapiro-Wilk test confirmed non-normality ( $p < 0.01$ ).

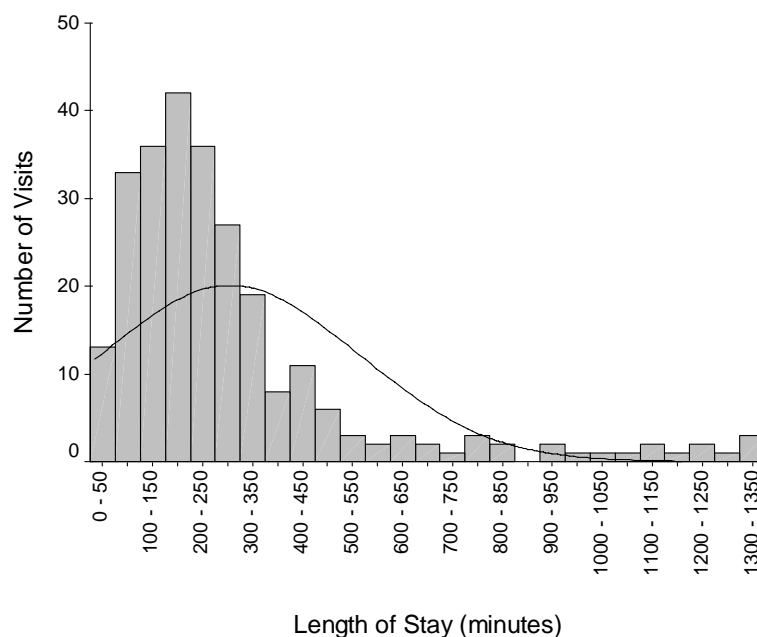
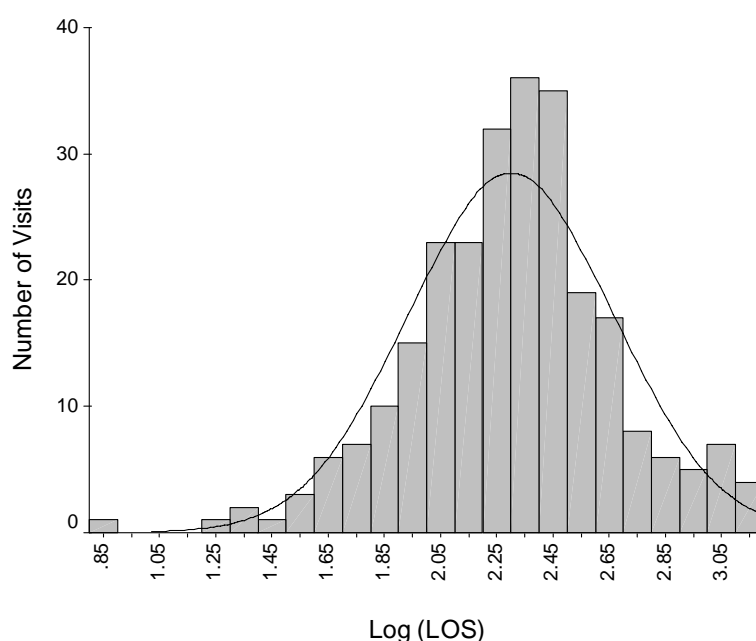


Figure 6. Length of stay.

Attempts were made to transform the LOS data using both logarithmic and square root transformation. Square root transformation improved skewness (1.2) and kurtosis (1.6) but the distribution remained non-normal when tested with Shapiro-Wilk ( $p < .01$ ). Logarithmic transformation (Figure 7) improved skewness (-0.3) and kurtosis (0.9) with kurtosis only being moderately positive. Testing of Log(LOS) using Shapiro-Wilk showed reasonable support for normality ( $p = .077$ ). It was therefore decided that Log(LOS) be used in future analysis. The mean Log(LOS) was 2.30 ( $SD = 0.37$ ) equating to a geometric mean for LOS of 200 minutes.



*Figure 7. Log(length of stay).*

The majority of the sample fell into the complaint type of medical (58%), while trauma (18%) and surgical (21%) accounted for most of the

other presentations reported. Only 1% of patients were psychiatric while there were nine cases (2%) that did not fall into these categories. These cases were ear, nose and throat, woman's health, or dental patients. Complaint type is summarised in Table 16 (p. 71).

In the sample 50% of visits to the ED ended with the patient being discharged and 48% resulted in admission. One per cent of patients died and 1% were transferred to other health care facilities.

### **Direct Nursing Care Time**

The first research question asked, "How much direct nursing care time do patients receive in the emergency department?" Figure 8 (p. 76) graphs the direct nursing care time (DNCT) provided to the sample group with a reference normal distribution curve superimposed. For the 261 visits the calculated average DNCT was 49 minutes ( $SD = 44$  minutes). The median was 36 minutes and the range was between two and 312 minutes. There were five occasions where DNCT exceeded 200 minutes. There was marked positive skewness (2.65) and kurtosis (10.42) in the distribution of DNCT. Testing using Shapiro-Wilk confirmed non-normality ( $p < 0.01$ ).

Logarithmic transformation (Figure 9, p. 76) reduced skew to moderately significant (0.3) and kurtosis to 0.1, while with square root transformation both skewness (1.0) and kurtosis (1.8) remained significant. Using the Shapiro-Wilk test, the square root of DNCT ( $p < .01$ ) remained non-normal but normality of Log(DNCT) was supported ( $p = .062$ ). Log(DNCT) was therefore used for future statistical analysis. The mean for

Log(DNCT) was 1.54 ( $SD = 0.38$ ). This equates to a geometric mean for DNCT of 34.8 minutes.

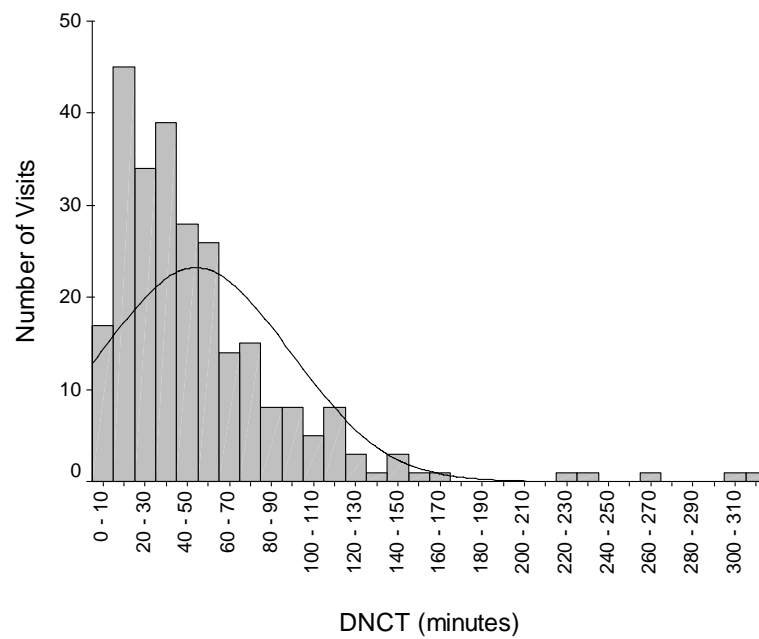


Figure 8. Direct nursing care time.

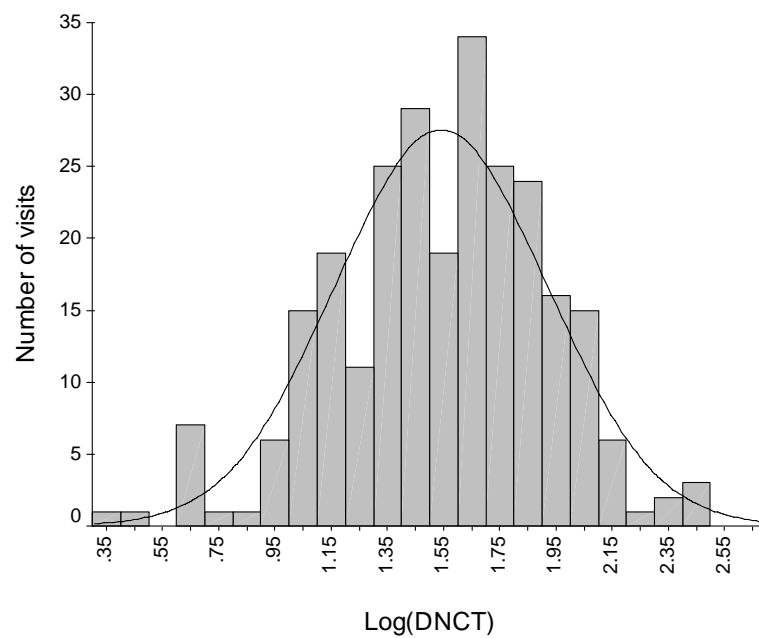


Figure 9. Log(direct nursing care time)

Table 16 (p. 71) summarised the independent and confounding variables in this research, while Table 17 summarises DNCT. Geometric mean of Log(DNCT) is included as a comparison to mean and median for the non transformed data.

Table 17

*Direct Nursing Care Time*

Direct Nursing Care Time (minutes)	
Range	(2 – 312)
Mean ( <i>SD</i> )	49.15 (44.77)
Median	36
Geometric Mean	35

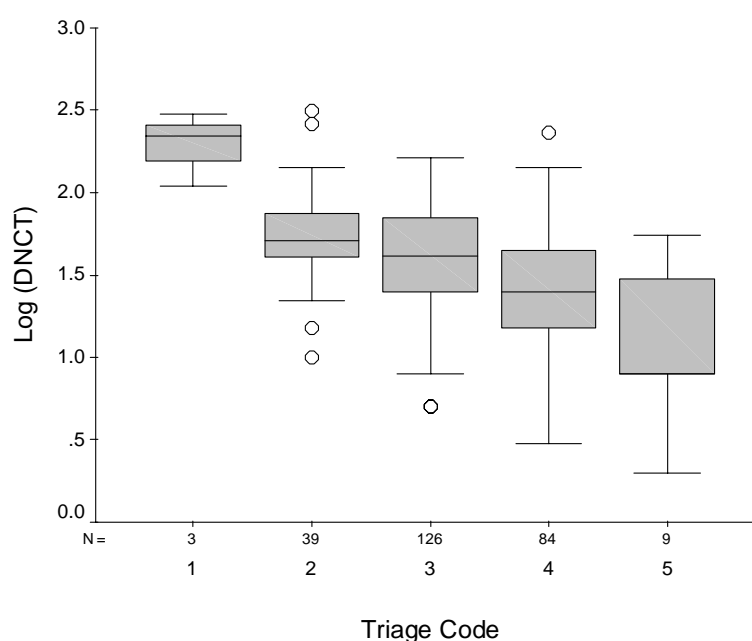
### **Associations with Direct Nursing Care Time**

Log(DNCT) is used in this and future questions as it meets normality requirements. To visualise the associations between Log(DNCT) and the independent and potential confounding variables graphic representation was first performed. This was followed by analysis using ANOVA or correlation statistics using SPSS software (SPSS Inc, 2000) to identify the significance level of relationships within the data. These results are explored under separate headings and summarised at the end of this section.



### *Direct Nursing Care Time vs. Triage*

Figure 10 presents Log(DNCT) related to triage code. Visually there is progressive reduction in median Log(DNCT) as triage code becomes less urgent. Outliers exist although none are extreme. There are small numbers of visits reported for triage code 1 ( $n = 3$ ) and triage code 5 ( $n = 9$ ) making interpretation difficult for these two codes. The geometric mean ranged from 194 minutes for triage code 1 to 11 minutes for triage code 5. Triage codes 2, 3, and 4 had mean DNCT of 54, 39, and 25 minutes respectively. These are summarised in Table 26 (p. 91).



*Figure 10. Log(direct nursing care time) vs. triage code*

Mean nursing time varied significantly among the triage codes ( $p = .000$ ) (Table 18, p. 79). Levene's test demonstrated unequal error variance across the groups ( $p = .071$ ) and triage codes 1 and 5 had particularly small sample sizes. Post hoc testing showed significant

differences: between triage codes 1 and 5, 2 and 4, 2 and 5, 3 and 4, and 3 and 5 ( $p = 0.05$ ) (Table 19, p. 80).

Table 18

*ANOVA Log(DNCT) vs. Triage Code*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.376(a)	4	1.844	15.926	.000
Intercept	132.834	1	132.834	1147.240	.000
Triage	7.376	4	1.844	15.926	.000
Error	29.641	256	.116		
Total	657.202	261			
Corrected Total	37.017	260			

Note. (a) R Squared = .199 (Adjusted R Squared = .187)

*Direct Nursing Care Time vs. Length of Stay*

LOS, like DNCT, meets normality testing only when transformed logarithmically. As both variables are continuous, a scatter diagram was used to compare Log(DNCT) and Log(LOS) (Figure 11, p. 81). A trend line has been superimposed to better visualise the relationship. Because both variables were normally distributed Pearson's correlation was used to examine the statistical relationship between the two. Pearson's correlation coefficient, calculated at .558 ( $p < .01$ , two-tailed), shows the relationship is positive and significantly different from zero.

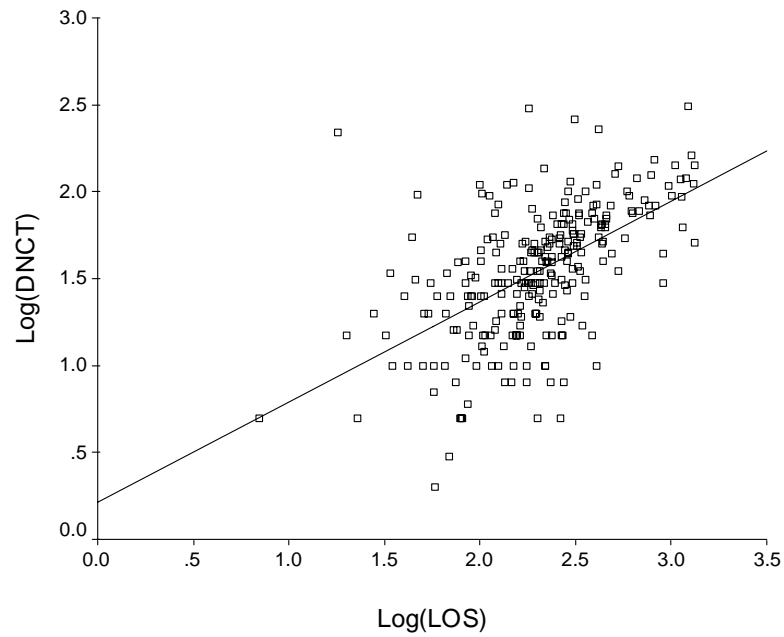
Table 19

*Post Hoc Test of Log(DNCT) vs. Triage Code*

Triage (I)	Triage (J)	Mean Difference (I-J)	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1	2	0.5544	0.13652	-0.4236	1.5323
	3	0.6907	0.13194	-0.2939	1.6753
	4	0.8910	0.13536	-0.0877	1.8697
	5	1.2317*	0.19544	0.1967	2.2668
2	1	-0.5544	0.13652	-1.5323	0.4236
	3	0.1363	0.05352	-0.0155	0.2881
	4	0.3366*	0.06146	0.1627	0.5105
	5	0.6774*	0.15380	0.1539	1.2008
3	1	-0.6907	0.13194	-1.6753	0.2939
	2	-0.1363	0.05352	-0.2881	0.0155
	4	0.2003*	0.05049	0.0598	0.3408
	5	0.5410*	0.14975	0.0275	1.0546
4	1	-0.8910	0.13536	-1.8697	0.0877
	2	-0.3366*	0.06146	-0.5105	-0.1627
	3	-0.2003*	0.05049	-0.3408	-0.0598
	5	0.3408	0.15277	-0.1795	0.8610
5	1	-1.2317*	0.19544	-2.2668	-0.1967
	2	-0.6774*	0.15380	-1.2008	-0.1539
	3	-0.5410*	0.14975	-1.0546	-0.0275
	4	-0.3408	0.15277	-0.8610	0.1795

Note. Dunnett's C test used due to unequal error variance and small group size

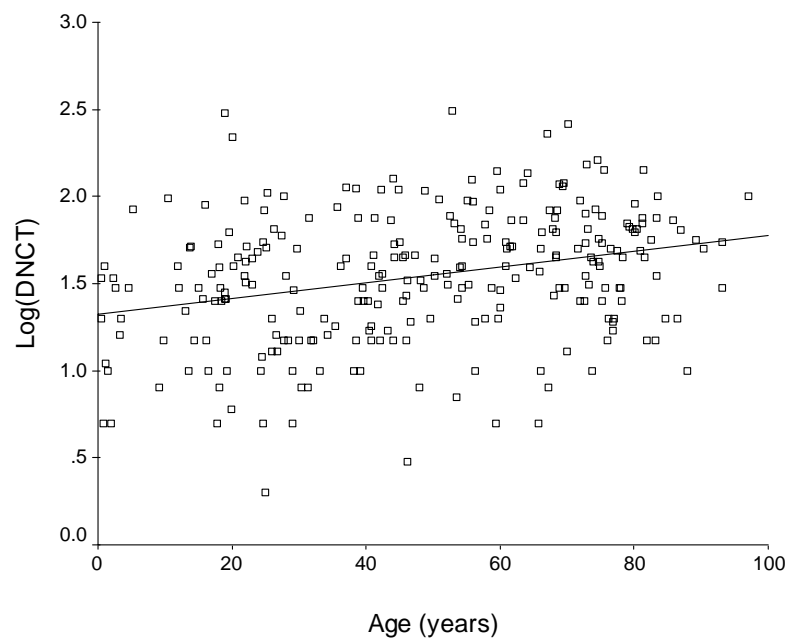
\* The mean difference is significant at the 0.05 level.



*Figure 11. Log(direct nursing care time) vs. Log(length of stay)*

#### *Direct Nursing Care Time vs. Age*

As both age and Log(DNCT) are continuous variables these are graphically represented with a scatterplot (Figure 12). A trend line has again been superimposed for reference.



*Figure 12. Log(direct nursing care time) vs. age.*

Age was not transformed into a normal distribution. Spearman's correlation coefficient was therefore used, as this is a non-parametric statistic. The correlation statistic calculated at .298 ( $p < .01$ , two-tail), is small. This is supported by the small gradient of the trend line, despite a significant  $p$  value.

#### *Direct Nursing Care Time vs. Ethnicity*

The relation of ethnicity to Log(DNCT) is represented in a boxplot (Figure 13). Four cases appear as outliers but there are no extreme outliers. The graphic representation does not appear to indicate any significant variations among the ethnic groups although this is difficult to interpret due to the small numbers in Indian ( $n = 3$ ), Chinese ( $n = 4$ ) and Pacific Island ( $n = 4$ ) groups.

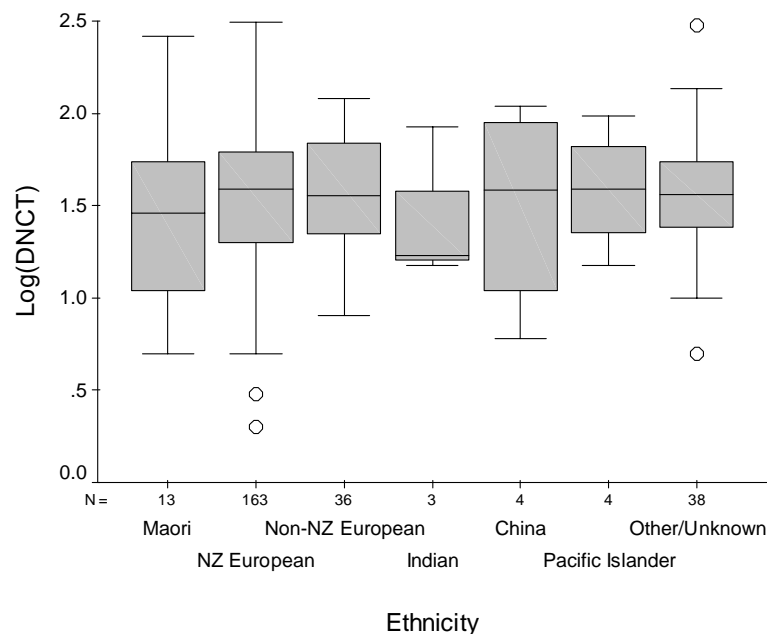


Figure 13. Log(direct nursing care time) vs. ethnicity.

ANOVA works on the assumption that the dependent variable is normally distributed in each group. According to Green, Salkind, and Akey (2000) where each group has greater than 15 cases this assumption may be violated while results remain relatively valid. To meet the need for larger groups, and because the ‘Other/Unknown’ category did not differentiate between those who chose not to answer the ethnicity question and those that did not fit into the ethnicities provided, it was decided to recode this variable (Table 20). The new ethnicity codes were used in all further statistics.

Table 20

*Recoding of Ethnicity Variable*

Code	New Groupings ( <i>n</i> , %)	Old Groupings ( <i>n</i> )
1	NZ Maori (13, 5.0%)	NZ Maori (13)
2	NZ European (163, 62.5%)	NZ European (163)
3	Non-NZ European (36, 13.8%)	Non-NZ European (36)
4	Other (23, 8.8%)	Chinese (4) Indian (3) Pacific Island (4) Other ethnicities from Other/Unknown group (12)
5	Unknown (26, 10.0%)	All those from Other / Unknown group who did not give an ethnicity (26)

The box plot of Log(DNCT) vs. ethnicity (Figure 14, p. 84) uses the new ethnicity codes. The group sizes have improved with the smallest group being NZ Maori ( $n = 13$ ). Visually there appears to be little difference among the groups. The means of Log(DNCT) for the new groups range from 1.5 ( $SD = 0.6$ ) for NZ Maori, to 1.6 ( $SD = 0.4$ ), in the unknown group.

These correspond to geometric means of 29 minutes and 36 minutes respectively. ANOVA was performed on the new ethnicity data. No statistical differences were found ( $p = .958$ ) (Table 21). The means and geometric means of Log(DNCT) are summarised at the end of this section (Table 26, p. 91).

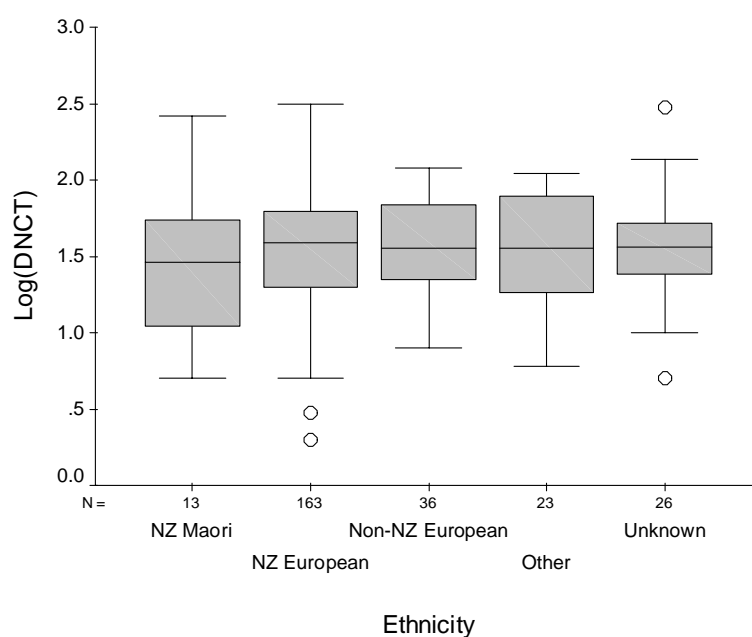


Figure 14. Log(direct nursing care time) vs. ethnicity.

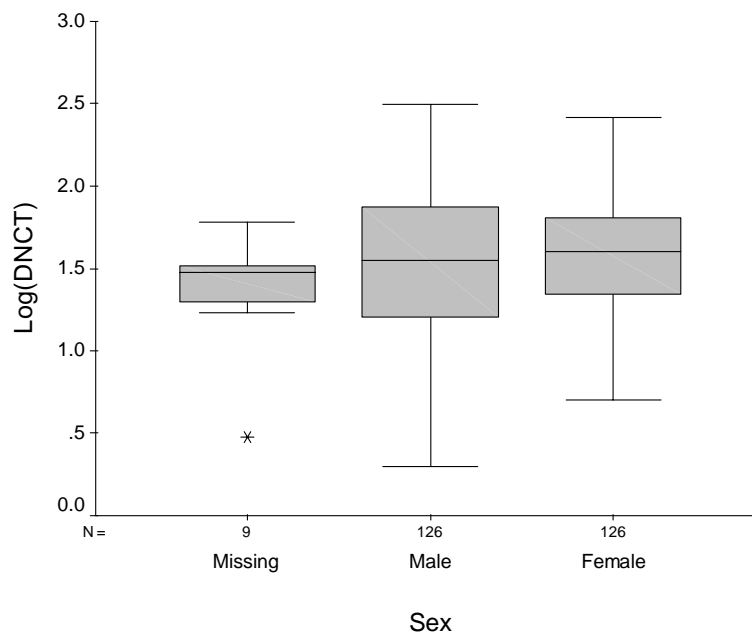
Table 21

ANOVA for Log(DNCT) vs. Ethnicity

Source	Type III Sum of Squares	df	Mean Square	F	<i>p</i>
Corrected Model	0.092(a)	4	0.023	0.160	.958
Intercept	305.625	1	305.625	2118.895	.000
Ethnicity	0.092	4	0.023	0.160	.958
Error	36.925	256	0.144		
Total	657.202	261			
Corrected Total	37.017	260			

### *Direct Nursing Care Time vs. Sex*

Log(DNCT) vs. sex was graphically represented with a boxplot (Figure 15). There were nine occasions where the sex was not recorded. Visually there appears to be no difference in Log (DNCT) among males, females, and the 'missing' cases, with no sex recorded. One extreme outlier exists for the 'missing' group. This group was not used in the ANOVA. The mean Log(DNCT) for males was 1.5 ( $SD = 0.4$ ) which calculates to a geometric mean DNCT of 34 minutes. The mean Log(DNCT) for females was 1.6 ( $SD = 0.3$ ) equating to a geometric mean of 37 minutes. ANOVA (Table 22, p. 86) demonstrated no significant difference between males and females in terms of Log(DNCT) ( $p = .558$ ).



*Figure 15. Log(direct nursing care time) vs. sex*



Table 22

*ANOVA for Log(DNCT) vs. Sex*

Source	Type III Sum of Squares	df	Mean Square	F	<i>p</i>
Corrected Model	0.086(a)	1	0.086	0.606	.437
Intercept	603.585	1	603.585	4243.522	.000
Sex	0.086	1	0.086	0.606	.437
Error	35.559	250	0.142		
Total	639.231	252			
Corrected Total	35.645	251			

*Direct Nursing Care Time vs. Complaint Type*

The boxplot of Log(DNCT) vs. complaint type (Figure 16, p. 87) is difficult to interpret due to the small size of two of the groups, psychiatric ( $n = 3$ ) and other ( $n = 6$ ). There appears to be a higher median Log(DNCT) for the ‘Other’ category while trauma appears to have the lowest median. Statistical exploration of the relationship found that mean Log(DNCT) for the medical group was the highest ( $M = 1.6$ ,  $SD = 0.36$ ) corresponding to a DNCT geometric mean of 40 minutes. The lowest Log(DNCT) ( $M = 1.4$ ,  $SD = 0.38$ ) was for the trauma group corresponding to a geometric mean of 23 minutes DNCT.

Because small group sizes can lead to violation of the assumption of normality within groups required for ANOVA the decision was made to recode this variable. Two options were considered when recoding. The first option was to remove the psychiatric group and to recode the “other” group into surgical or trauma. This option was rejected as it was unclear whether some of the “other” group fell into the trauma or surgical categories. One

case, for example, was dental but it was not stated whether this was a result of trauma. The second option was to code all visits as medical or non-medical. This option allowed for accurate recoding and the grouping felt intuitively more appropriate as the “other” category consisted of groups that loosely fell under the surgical auspices plus the psychiatric group. A dichotomous variable was also more useful when regression was attempted. Table 23 summarises the recoding of complaint type, which is used for all further analysis.

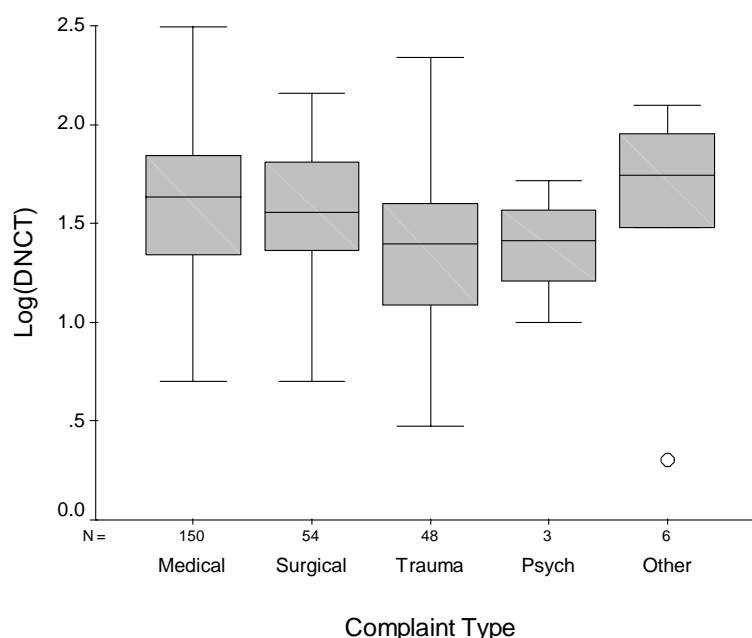


Figure 16. Log(direct nursing care time) vs. complaint type.

Table 23

*Recoding of Complaint Type*

Code	New Variable (n, %)	Old Variable (n)
1	Medical (150, 57.5%)	Medical (150)
2	Non-medical (111, 42.5%)	Surgical (54)
		Trauma (48)
		Psychiatric (3)
		Other (6)

Statistical difference was found between Log(DNCT) for the two groups ( $p < .01$ ) (Table 24). Medical patients on average received 40 minutes DNCT while non-medical received 29 minutes. This is summarised at the end of this section (Table 26, p. 91). The effect of complaint type in predicting Log(DNCT) is small (adjusted R squared = 0.027).

Table 24

*ANOVA for Log(DNCT) vs. Complaint Type*

Source	Type III Sum of Squares	df	Mean Square	F	<i>p</i>
Corrected Model	1.137(a)	1	1.137	8.205	.005
Intercept	598.517	1	598.517	4320.342	.000
Complaint	1.137	1	1.137	8.205	.005
Error	35.880	259	.139		
Total	657.202	261			
Corrected Total	37.017	260			

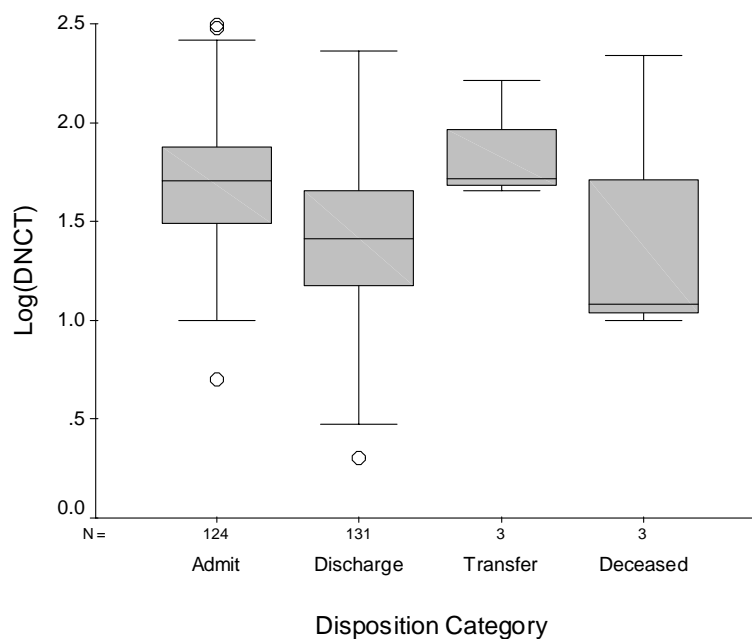
Note. R Squared = .031 (Adjusted R Squared = .027)

#### *Direct Nursing Care Time vs. Disposition Category*

The boxplot of Log(DNCT) vs. disposition category (Figure 17, p. 89) is difficult to interpret due to small sample sizes for transfers ( $n = 3$ ) and deaths ( $n = 3$ ). Four outliers are evident in the admission and discharge groups, none of which are identified as extreme.

The disposition category was recoded due to the low numbers in the transferred and deceased categories. Recoding was based on whether the patient was well enough to be discharged from the ED or not. The non-discharged group ( $n = 130$ ) included admissions, transfers to other health

providers, and deaths. The new disposition category groups therefore became “discharged” and “not discharged” and are used for all further statistical analysis. This (new) disposition category also has the advantage of being dichotomous and therefore useful for regression.



*Figure 17.* Log(direct nursing care time) vs. disposition category

Significant difference exists between the two groups ( $p < .01$ ) (Table 25, p. 90). The geometric mean DNCT for discharged patients (24 minutes) was less than that for non-discharged patients (50 minutes) (Table 25). The predictive value of disposition category for Log(DNCT) appears significant ( $R^2 = .17$ ).

Table 25

*ANOVA for Log(DNCT) vs. Disposition Category*

Source	Type III Sum of Squares	df	Mean Square	F	<i>p</i>
Corrected Model	6.138(a)	1	6.138	51.484	.000
Intercept	620.649	1	620.649	5205.731	.000
Disposition	6.138	1	6.138	51.484	.000
Error	30.879	259	0.119		
Total	657.202	261			
Corrected Total	37.017	260			

Note. R Squared = .166 (Adjusted R Squared = .163)

Research question two asked what the associations were between the dependent variable (DNCT) and the independent and potential confounding variables. Table 26 (p. 91) summarises the data for this question. Log (DNCT) and Log(LOS) were used in the statistics as they met normality requirements. Ethnicity, complaint type, and disposition category were all recoded to increase group size and therefore allow for potential non-normality within groups. No changes were made to age, sex, or triage variables. Significant associations with Log(DNCT) were found for triage code, Log(LOS), age, complaint type, and disposition category. No relationship was demonstrated between Log(DNCT) and ethnicity or sex.

Table 26

*Summary Statistics for Associations with Log(DNCT)*

Variable	<i>n</i> (%)	Mean ( <i>SD</i> )	Geometric Mean (DNCT)	<i>p</i>
Total	261	1.5 (0.38)	35 minutes	
Triage				.00
1	3 (1%)	2.3 (0.22)	194 minutes	
2	39 (15%)	1.7 (0.28)	54 minutes	
3	126 (48%)	1.6 (0.3)	39 minutes	
4	84 (32%)	1.4 (0.38)	25 minutes	
5	9 (3%)	1.1 (0.44)	11 minutes	
Sex				.44
Male	126 (50%)	1.5 (0.42)	34 minutes	
Female	126 (50%)	1.6 (0.33)	37 minutes	
Ethnicity*				.96
NZ Maori	13 (5%)	1.5 (0.550)	29 minutes	
NZ European	163 (62.5%)	1.5 (0.38)	35 minutes	
Non-NZ European	36 (13.8%)	1.6 (0.33)	36 minutes	
Other	23 (8.8%)	1.6 (0.35)	36 minutes	
Unknown	26 (10.0%)	1.6 (0.36)	36 minutes	
Complaint Type*				.01
Medical	150 (57.5%)	1.6 (0.36)	40 minutes	
Non-medical	111 (42.5%)	1.5 (0.39)	29 minutes	
Disposition Category*				.00
Discharged	131 (50.2%)	1.4 (0.38)	24 minutes	
Not Discharged	130 (49.8%)	1.7 (0.31)	50 minutes	
Log Length of Stay				
Correlation coefficient (Pearson)			.52	.01
Age				
Correlation coefficient (Spearman)			.30	.01

Note. \* Recoded variables

## **Regression Analysis of Direct Nursing Care Time**

Question three asked “How much can direct nursing care time be explained by triage code controlling for other factors”. Triage code 1 consisted of only three visits in this sample and, due to the small group size, the decision was made not to include this in the regression analysis. Log(DNCT) and Log(LOS) had already been demonstrated to have normal distribution and were continuous. Ethnicity and sex had been demonstrated to have no significant variation of Log(DNCT) between each of their groups and were therefore not included in the regression. Although not normally distributed, age was entered into the regression as a continuous variable. The recoded values for complaint type and disposition category were dichotomous in nature and could therefore be used. The dummy variables for triage code as outlined in Table 14 (p. 67) were used for the regression.

Table 27 (p. 93) summarises the three models found in each step of the regression. Model 1 demonstrates that triage variables accounted for 16% of the variation in Log(DNCT). Log(LOS) accounted for a further 31% of variation (Model 2) and a further 2% variation could be accounted for by patient disposition (Model 3). ANOVA of model 3 (Table 28. p. 93) showed that Log(DNCT) was significantly related to triage code, Log(LOS), and disposition category ( $F(5, 252) = 49.24, p = .000$ ).

Table 27

*Summary of Models Predicting Log(DNCT)*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change
1(a)	.402	.161	.152	.34104	.161
2(b)	.689	.474	.466	.27052	.313
3(c)	.703	.494	.484	.26593	.020

Note (a) Predictors: (Constant), Dichotomous triage variables

(b) Predictors: (Constant), Dichotomous triage variables, Log(LOS)

(c) Predictors: (Constant), Dichotomous triage variables, Log(LOS), disposition category

Table 28

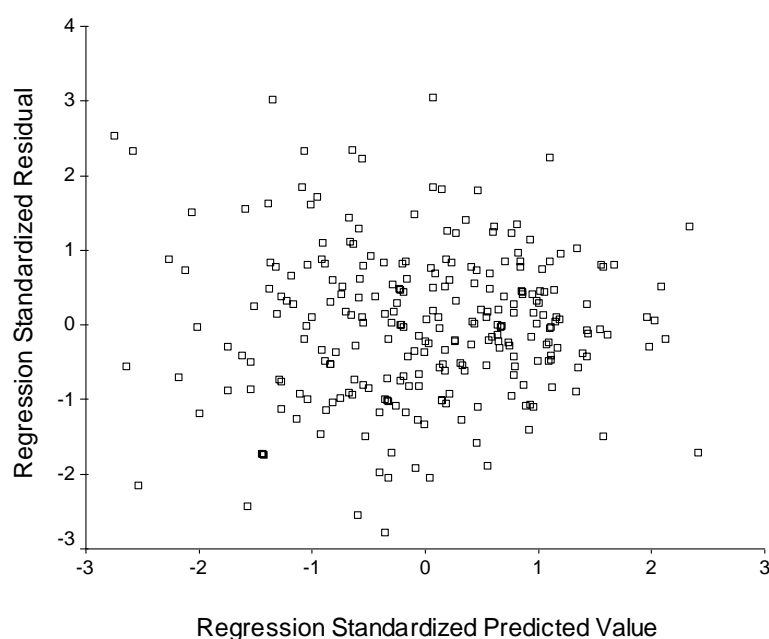
*ANOVA for Final Model Predictiong Log(DNCT)*

	Sum of Squares	df	Mean Square	F	<i>p</i>
Regression	17.409	5	3.482	49.24	.000
Residual	17.822	252	0.071		
Total	35.231	257			

The assumptions of multiple linear regression were then checked to ensure the model proposed was supported. No extreme outliers were found in previous sections and none were found during the regression. Tabachnick and Fidell (2001, p. 117) suggest the formula, “ $N \geq 50 + 8m$  (where  $m$  is the number of independent variables)”, can be used to predict the required sample size for a multiple regression. In this case there were seven potential independent variables.  $N$  using this formula needed to be greater than 106 and in this study was 252 cases, meeting the recommendation.



Figure 18 shows the scatterplot of regression standardised residual against regression standardised predicted value. The even rectangular distribution of the plot supports assumptions of normality, linearity, and homoscedasticity of residuals. This is supported by the P-P plot of regression standardised residuals for Log(DNCT) (Figure 19, p. 95).



*Figure 18.* Predicted value of Log(direct nursing care time) vs. residuals

The SPSS training manual (SPSS Inc., 2001) on regression states that collinearity may be significant where tolerance values are near .01, coefficient correlations are significantly greater than .9, condition index is greater than 30, or variance proportions are near one for two or more variables. These statistics are presented in Tables 29 (p. 96), 30 (p. 97) and 31 (p. 98). None of the criteria for significant collinearity were met therefore all variables were found acceptable to remain in this regression.

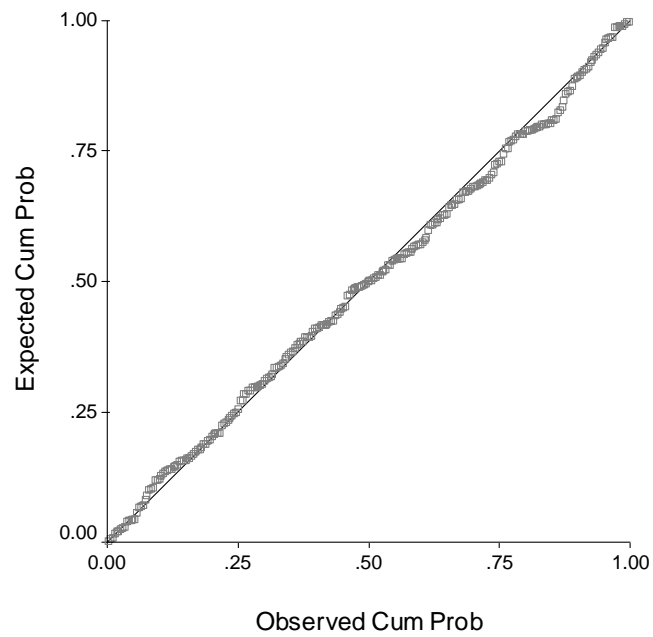


Figure 19. Normal P-P plot of regression standardised residuals

Table 29

*Correlation of Coefficients for Final Model.*

	Fours	Twos	Threes	Log(LOS)	Discharge Category
Fours	1.000				
Twos	.853	1.000			
Threes	.917	.877	1.000		
Log(LOS)	-.056	-.070	-.056	1.000	
Discharge Category	.103	.232	.191	.248	1.000

Note. Dependent variable is Log(DNCT)

Table 30

*Collinearity Diagnostics for Final Model*

Dimension	Condition Index	Variance Proportions					Disposition Category
		(Constant)	Twos	Threes	Fours	Log (LOS)	
1	1.000	.00	.00	.00	.00	.00	.02
2	1.828	.00	.07	.01	.04	.00	.02
3	1.878	.00	.08	.03	.01	.00	.00
4	3.037	.00	.00	.00	.03	.00	.80
5	11.484	.01	.64	.71	.68	.32	.00
6	20.164	.99	.21	.25	.23	.68	.15

*Note.* Dependent variable is Log(DNCT).

Table 31

*Coefficient Calculation for Final Model*

	Unstandardized		t	p	95% Confidence		Collinearity Statistics	
	Coefficients				Interval for B			
	β	Std. Error			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	.027	.146	0.187	.852	-.259	.314		
Twos	.436	.102	4.272	.000	.235	.637	.205	4.873
Threes	.359	.094	3.822	.000	.174	.545	.124	8.061
Fours	.212	.094	2.252	.025	.027	.397	.141	7.094
Log (LOS)	.544	.048	11.323	.000	.449	.638	.917	1.090
Disposition Category	-.114	.036	-3.132	.002	-.186	-.042	.826	1.210

*Note.* Dependent variable is Log(DNCT).

As the assumptions for regression appeared to be satisfied, the coefficients for the separate variables (Table 31, p. 97) were examined. The  $\beta$  values provide the coefficients for each of the variables in this regression. All coefficients are significant at the .05 level except the constant ( $p = .852$ ). This is evident from the 95% confidence interval for the constant, which passes through zero (-0.259 to 0.314). Despite the constant not being significant it was decided not to repeat the regression without a constant because the assumption of intercept at zero could not be made for this regression. The formula for the final model is given in Equation 1.

$$\begin{aligned} \text{Log (DNCT)} = & 0.027 + 0.436 * \text{Twos (0,1)} + 0.359 * \\ & \text{Threes (0,1)} + 0.212 * \text{Fours (0,1)} + 0.544 * \\ & \text{Log(LOS)} - 0.114 * \text{Disposition Category (0,1)} \end{aligned} \quad (1)$$

### Summary

This chapter has presented the statistical analysis of the data for 261 visits to one emergency department in New Zealand. Sampling and sample characteristics have been explored and summarised. To satisfy analysis requirements transformation was explored on continuous variables that did not meet the assumption of normality. Logarithmic transformations were used for LOS and DNCT.

Recoding of ethnicity, complaint type, and discharge category was performed to improve group size. This was a requirement for analysis using

ANOVA. Dummy coding of triage, to create dichotomous variables, was used prior to multiple linear regression modelling.

Analysis, using correlation and ANOVA statistics, showed significant relationships between (Log) DNCT and triage code, (Log) LOS, age, complaint type, and discharge category. No statistically significant relationship was found between either sex or ethnicity and (Log) DNCT.

Multiple linear regression was performed with forced entry of the dummy triage codes followed by entry of Log(LOS) and stepwise inclusion of the other significant confounding variables that had shown significance: age, complaint type, and disposition category. The model created accounted for 49% of variation in Log(DNCT) using triage code (16%), Log(LOS) (31%) and disposition category (2%) as predictors. This model is summarised in the Equation 1 (p. 98).

Chapter five discusses the results presented in this chapter including the limitations of this research. In doing so it incorporates knowledge gained through the reviewed literature outlined in chapter two and identifies potential areas for further research.

## **Chapter 5**

### **Discussion**

*He kapiti hono, he tatai hono.*

That which is joined together becomes an unbroken line.

The need to identify a simple and accurate method for calculating nurse staffing requirements was the trigger for this thesis. Literature review led to the formation of a framework proposing that environment, patient medical condition and severity, patient nursing complexity, and nurse characteristics impact on the processes of nursing and patient outcomes (Figure 2, p. 24). Triage code was suggested as a measure of medical severity. The study investigated the direct nursing care time (DNCT) received during 261 patient visits to one ED over a 3-day period and asked how much of this time could be predicted by triage code. This chapter revisits the framework. The implications and limitations of the research, along with opportunities for further research into nursing workloads and optimising patient outcomes in the ED, are suggested prior to the conclusion.

#### **A Model of Emergency Nursing Workload**

Nursing work has the aim to promote quality outcomes for patients. Donabedian (1988) suggested seven components of quality: efficacy, effectiveness, efficiency, optimality, acceptability, legitimacy, and equity.

In terms of the nursing workforce, optimality can be viewed as maximising the benefit less cost of nursing care. Donabedian recognised that structures impact on processes to shape the outcomes of healthcare provision. Figure 3 (p. 52) identified the research variables used in this thesis. The research variables are discussed in this section while the limitations and potential areas of further study are discussed later in this chapter.

### *Direct Nursing Care Time*

Direct nursing care was operationalised as the dependent variable, DNCT, for this research. The framework proposed that nursing care can be broken down into that which is direct and that which is indirect. Indirect nursing care supports direct nursing care and includes measures performed by nurses to provide a safe environment and develop effective systems. This includes equipment and environmental maintenance and checks, as well as policy development and discussions about patient groups and departmental workloads. DNCT was defined as the total time spent by nurses providing care to each patient and their family, whanau, or significant others, and included all time spent with the patient and time spent discussing the individual patient with other members of health team. Triage nursing time was excluded from this definition as, according to guidelines (Bebbington, 2000; College of Emergency Nurses New Zealand, 2002; Emergency Department Clinical Advisory Group, 2002; Emergency Nurses Association, 2003b; Ministry of Health, 2002), this should be manned separately in the emergency department.



In this study each patient received an average 49 minutes of direct nursing care. Tolbert and Sutton (1981) found that average nursing time per patient visit ranged from 1.93 hours to 2.7 hours. However they also factor in a non-productive time of 55%-65%. When 60% non-productive time is removed from the nursing allocation this leaves between 69 and 97 minutes direct nursing time per patient visit. Calculation of direct nursing time from the data presented by Fullam (2002) suggests an average of 58 minutes. The average DNCT in this study appears to be lower than that suggested by American studies (Fullam, 2002; Helmer et al., 1988; Tolbert & Sutton, 1981).

The majority of patients (98%) received less than 180 minutes DNCT during the visit, while 5 patients received between 220 and 320 minutes. Nursing comments for these patients included, “massive trauma, a lot of nursing concurrently”, and “patient unwell with difficult circumstances, requiring RN special and no bed available on wards”. Review of the data collection forms suggests that very few episodes of concomitant nursing occurred in the visits sampled and where these occurred DNCT was above the mean of 49 minutes.

The range of DNCT appears consistent with the ranges found in the literature (Ardagh, 1999; Emergency Nurses Association, 2003b; Fullam, 2002; Helmer et al., 1988; James, 1998; Tolbert & Sutton, 1981; Zimmerman, 1999). Helmer et al., whose work was the basis for the data collection method used in this study, found a range, across diagnoses, from an average 20 minutes nursing care time for skin related allergic reactions, to an average 118 minutes for major trauma, motor vehicle accidents, and

multi system trauma. Studies that relate nursing time to triage codes or severity scores (Ardagh, 1999; Emergency Nurses Association, 2003b; Fullam, 2002; Helmer et al., 1988; Tolbert & Sutton, 1981; Zimmerman, 1999) also offer an indication of range. James (1998) used information from one New Zealand emergency department and found the widest range of average nursing care time. This was from an average 15 minutes for the group of patients in NTS 5 up to 260 minutes for those in NTS 1. All of these studies provide mean nursing care time without standard deviation. It is therefore difficult to appreciate the variation within the studies.

The skew created by the high nursing care time for very few patients raises the average DNCT. A more accurate prediction of DNCT received by individual patients is suggested by the median (36 minutes) and geometric mean (35 minutes). There are no indicators of skew or spread provided in the literature. This makes it difficult to discern whether this is a result of the specific population sampled or common to a number of EDs. The concept of a skewed response is supported by the literature suggesting use of triage or severity codes for predicting nursing time (Ardagh, 1999; Emergency Nurses Association, 2003b; James, 1998; Tolbert & Sutton, 1981; Zimmerman, 1999). Ardagh, for example, doubles the amount of nursing resource required for each increase in urgency using Australasian Triage Score (ATS). The relationship between triage and DNCT is explored later in this chapter.

DNCT was used as a measure of nursing process. The average patient was likely to receive 35 minutes of direct nursing care. The framework suggests that the process of indirect nursing care is also

important to patient outcomes. Indirect nursing care time is alluded to by a number of authors (Emergency Nurses Association, 2003b; Gabolinscy, 2000; Tolbert & Sutton, 1981) and is a potential area for further research.

### *Triage Code*

Triage code was proposed as a measure of medical severity that impacted on nursing care and patient outcomes and could potentially be used to plan nurse staffing. In this study Australasian Triage Scale (ATS) was used. Relative proportionality among the triage codes, when comparing attendance during the sample period and the sample, appears to have been achieved, with the largest difference being between the proportion of triage code 2 attending (10%) and sampled (15%). The low number of patients allocated ATS 1 ( $n = 3$ ) and ATS 5 ( $n = 9$ ) is a limitation of this study.

The mean DNCT provided to each of the triage categories falls between that suggested by Ardagh (1999) and James (1998). Ardagh suggested allocations for each of the triage codes ranging from 7 minutes for ATS 5 patients to 120 minutes for those in ATS 1. James presents a range from 15 minutes to 260 minutes. In this research patients scored as ATS 5 received an average 11 minutes DNCT, while ATS 1 patients received an average 194 minutes DNCT. Patients allocated scores of ATS 2, 3, and 4 received 54 minutes, 39 minutes, and 25 minutes of DNCT respectively. The assumptions in the reports by Ardagh and James are not clear. Although this limits comparison, it would appear that results of this research are consistent with the average DNCT suggested by these two New Zealand authors.

Triage code, without adjustment for confounding variables, was found to predict 20% of variance in DNCT. When confounding variables were considered the predictive value of triage code became 16%. The geometric mean of DNCT was greater for more urgent triage codes than for those with less urgency. Post hoc testing identified ratios of DNCT which were significant between triage groups. DNCT received by triage code 5 was less than that received by triage codes 1, 2, and 3. ATS 4 received significantly less DNCT than ATS 2 or 3. These results support the literature in identifying a greater nursing resource requirement for more urgent triage codes (Ardagh, 1999; College of Emergency Nurses New Zealand, 2002; Davis, 1995; Emergency Nurses Association, 2003b; Fullam, 2002; Ministry of Health, 1999, 2002; Tolbert & Sutton, 1981; Ward, 1992). Table 32 summarises the differences in geometric means found to be significant.

Table 32

*Significant Differences in DNCT by Triage Code*

Triage Code (I) (Geometric Mean)	Triage Code (J) (Geometric Mean)	Difference (I-J)
ATS 1 (194 minutes)	ATS 5 (11 minutes)	183 minutes
ATS 2 (54 minutes)	ATS 4 (25 minutes)	29 minutes
ATS 2 (54 minutes)	ATS 5 (11 minutes)	43 minutes
ATS 3 (39 minutes)	ATS 4 (25 minutes)	14 minutes
ATS 3 (39 minutes)	ATS 5 (11 minutes)	28 minutes

### *Complaint Type*

Complaint type was suggested as an indicator of medical condition and severity. Groupings of patients according to diagnosis may indicate levels of nursing workload in inpatient settings (Campbell et al., 1997; Halloran, 1985; O'Brien-Pallas et al., 1997) while, in emergency settings, there is evidence that such grouping can be associated with overall department workloads (Duckett et al., 1997).

The majority of patients presenting to the ED had a medical condition ( $n = 150$ ) while 54 were surgical in nature and a further 48 were trauma related. Only three patients fell into the psychiatric complaint type. The practices of this ED were that the psychiatric service was the sole provider of care for their patients unless needing medical clearance. The majority of psychiatric patients were therefore excluded from this study.

Patients with a complaint type of medical received more DNCT (40 minutes) than those who did not fall into the medical complaint type (29 minutes). Complaint type alone was found to predict 3% of variation in DNCT. Once triage and confounding variables were taken into consideration complaint type was not found to be predictive for DNCT. Jelinek (1992, as cited in Duckett et al., 1997) suggests that 11% of ED workload variation could be accounted for by injury type and body systems involved. Although this research did not find complaint type to independently predict DNCT, there may be merit in further exploration of complaint categorisation as a potential source of variation.

### *Disposition Category*

This variable was incorporated as a measure of patient medical severity. In the sample three patients died and three were transferred. The majority of patients ( $n = 131$ ) were discharged while 124 were admitted. Departmental statistics (Newsome, 2003), with a 46.5% discharge rate, were consistent with the 50% discharge rate found in this sample.

Disposition category when considered alone accounted for 17% of variation in DNCT. Patients who were discharged received 24 minutes of DNCT while patients who were not received 50 minutes DNCT. This is consistent with the work of Erwich-Nijhout et al. (1997) and Jelinek (1992, as cited in Duckett et al., 1997), who both demonstrated relationships between emergency department workloads and whether a patient was admitted, discharged, died, or did not wait. Patients who were more severely ill would appear to require more nursing care time in the ED.

The independent variation in DNCT, related to whether a patient was discharged or not, reduced to 2% when variation due to triage code and LOS was included. Departmental statistics (Newsome, 2003) suggest high correlations between triage code and discharge with 95% of patients being admitted in triage code 1 and 5% of triage code 5 being admitted. Triage code 1 includes complaints, such as major trauma and cardiac arrest, while triage code 5 includes request for script or suture removal. ENA (2003b) suggests a nursing time of 15 minutes for suture removal while Helmer (1988) found average nursing time required for major trauma to be 118 minutes. The reduced predictive value of discharge in this research is consistent with the nursing care time by complaint found in other research,

the complaint types associated with triage codes, and the discharge frequency for triage codes.

### *Length of Stay*

LOS was proposed as a component of environmental complexity. This is evident where patient admission to the inpatient setting is delayed due to shortage of inpatient beds (Reeder & Garrison, 2001; Sobie et al., 2000). However length of stay may be multifactorial in nature (Houser, 2003) and has been considered a measure of severity of illness (O'Brien-Pallas et al., 1997) and a measure of patient outcome (Aiken et al., 2000). These studies were based on inpatient settings and, although the association of nursing care time and LOS is supported in emergency nursing literature (College of Emergency Nurses New Zealand, 2002; Emergency Nurses Association, 2003b; Helmer et al., 1988), the determinants of LOS have not been explored.

In this study patient LOS ranged between 7 minutes and 22 hours 10 minutes. Geometric mean for the sample was 3 hours 20 minutes. Ninety-five percent of patients stayed less than 15 hours in the department. Eighty three percent of visits were less than 6 hours duration. EDs commonly use six hours as a maximum LOS as this allows for triage code 5 patients to wait up to 2 hours before initial treatment followed by a time of four hours during which assessment, treatment, and a disposition decision can occur.

The relationship between DNCT and LOS was significantly positive. Log(LOS) had a correlation coefficient of 0.56 with Log(DNCT). Intuitively it is logical that, as a patient stays longer they will require more DNCT. This

is supported by CENNZ (2002) who recognise that nursing care continues throughout the duration of a visit and is less episodic in nature than physician care. Intensive nursing care is required during the first hour of attendance (Emergency Nurses Association, 2003b). This study examined the DNCT over the entire patient stay. No attempt was made to identify concentrated periods of care during the stay.

### *Age*

Age was incorporated in this research as a factor that may impact on patient nursing complexity. As patients age their ability to perform activities of daily living independently may decrease increasing dependency on nursing care (Endacott & Chellel, 1996).

There was no data available with regard to the age distribution of the population presenting to the emergency department. Comparison was made with the catchment population for the district health board. Only 9% of the patient sample in this study were less than 15 years old compared with 20% of the catchment population; while those aged between 15 years and 65 years accounted for 59% of the sample compared to a catchment population of 65%. The elderly, aged over 65 years, represented a higher proportion of sampled patients (32%) than the district health board regional population (12%). As the data is not available for the age distribution of those presenting at triage it is not possible to identify representativeness of the sampling.

The mean and median age of the patient sample was 48 years. However, the distribution was multi-modal in nature with peaks at 0 to 5



years, 15 to 20 years, 40 to 45 years, and 65 to 75 years. The group of patients under five years could represent the early childhood diseases while the large proportion of over 65 years could represent the frailty of age. Alcohol and motor vehicle related trauma are cited as common presentations for the 15 to 25 year age group (National Health Strategy, 1992). The mode relating to the 40 to 45 year age group is more difficult to explain. There may be strong correlations between age and complaint types. Further investigation of this association is required.

It is also possible that sampling bias may have skewed the sample. Sampling occurred over a mid-week period of three days. Alcohol related injury commonly occurs during weekends as do sport injuries (National Health Strategy, 1992; New Zealand Health Technology Assessment, 1998). Both include a high proportion of younger patients. As the weekend was not included in the sampling period the age group presenting with this type of complaint may be under-represented.

The correlation between age and (Log)DNCT was significant with a coefficient calculated at 0.20. Age distribution was non-normal ranging from less than one year old to 98 years. Multiple linear regression found that age did not contribute independently to the variation in DNCT. Age has been found to be a factor in predicting emergency workloads (Cameron & Baraff, 1990; Ceglowski et al., 2005; Erwich-Nijhout et al., 1997). Cameron and Baraff found that disposition, diagnosis, procedures and age accounted for 63% of variation in ED costs. Erwich-Nijhout et al. found 52% of variation in emergency department costs could be accounted for by urgency, disposition and age. Further study is required to identify whether age could

be a factor in nursing workload if variables such as complaint were standardised.

### *Ethnicity*

Ethnicity was collected as a proxy for the cultural identity of the individual. Literature suggests that cultural identity may impact on the nursing care that needs to be provided to a patient (Young & Mortensen, 2003) as well as the responses exhibited by health professionals (Chu, 1998; Rathore et al., 2000; van Ryn & Burke, 2000). Bradby recognised the cultural component of ethnicity by highlighting the importance of self-assignment and the use of free text and multiple ethnicity identification. At the same time she stressed that ethnicity is complex and as a measure can make invisible the variation within groups. Culture reflects shared behaviours within groups (Seaman, 1987). There are risks in using ethnicity data as a proxy for culture. Ethnicity, as a terminology, has commonly been used interchangeably with race (Anand, 1999; Bradby, 2003). Where ethnicity is assigned rigidly or by an external agent racial rather than cultural identity is at risk of being reported (Bradby, 2003). To minimise this risk, data in the ED were reportedly collected according the guidelines of statistics New Zealand 2001 census (Lang, 2002), which allowed for self-identified, multiple ethnicities to be entered. However, no patients were identified as having multiple ethnicities suggesting that guideline recommendations were not met. Ethnicity in this study may not be a good indicator of cultural identity.

The majority of patients (76.3%) in this study were either New Zealand European (62.5%) or non-New Zealand European (13.8%). The population for the region was identified as 91.8% European (Statistics New Zealand Te Tari Tatau, 2001). Maori made up 5% of the sample and were 6.8% of the regional population while the percentage for the 'other' ethnicities was 8.8% compared to 6.4% regionally. The proportions of European and NZ Maori presentations are consistent with that of the regional population. The slightly higher proportion of other ethnicities presenting may reflect health disparities or cultural norms of using emergency departments as a primary health facility (Axen & Lidnstrom, 2002; Young & Mortensen, 2003). As the presentation figures for ethnicity for the ED in question were not available, assessment of the representativeness of the sample for ethnicity is not possible.

The relationship between ethnicity and DNCT did not demonstrate significance in this study. The geometric means ranged from 29 minutes for NZ Maori to 36 minutes in the group who did not report an ethnicity. Literature discussing the impact of ethnicity and culture on health care suggest that more work may be required in terms of language and cultural differences (Young & Mortensen, 2003) while the difference in ethnicity between patient and healthcare worker may alter the amount and type of care provided (Rathore et al., 2000; van Ryn & Burke, 2000). The Health Research Council of New Zealand (2004) stresses the need for research to meet the obligations of the Treaty of Waitangi as well as explore areas which may lead to Maori health improvements. Further research into the

impact of difference between caregiver and patient may clarify the effect of ethnicity and culture on DNCT and patient outcomes.

### *Sex*

Sex was included for demographic completeness. No literature was found that suggested sex was a determinant of nursing care requirement in the ED. The sample divided evenly into male and female. This is consistent with the population for the district health board catchment which is 48.7% male and 51.3% female (Statistics New Zealand Te Tari Tatau, 2001)

No significant relationship was found between DNCT and sex ( $p=0.437$ ) with the geometric mean for males being 34 minutes and that for females being 37 minutes. As with age there are links between presentation type and patient sex. Young males are associated with alcohol and road traffic accident presentations while young females have high incidence of overdose compared to males (National Health Strategy, 1992; New Zealand Health Technology Assessment, 1998). Presentation type may be a better predictor of nursing care time than sex.

## **Implications**

The main aim of this study was to identify how much variation in DNCT could be predicted by triage code. The need to identify a better means of calculating nurse staffing requirements was the driver. Traditional use of patient visits per annum as a tool for estimating nursing numbers were not sensitive (College of Emergency Nurses New Zealand, 2002;

Ward, 1992). Several authors (Ardagh, 1999; Fullam, 2002; James, 1998; Zimmerman, 1999) suggest tools which include triage or severity codes as possible predictors of nursing care requirements while in America the Emergency Nurses Association (2003b) rejects triage as a predictor. This research demonstrated that controlling for other variables 16% of variation in DNCT could be accounted for by triage code.

This research demonstrated 49% predictive value for variation in DNCT using three variables. Triage accounted for 16% of variation, length of stay for 31%, and discharge for a further 2%. This work indicates that triage, LOS, and whether a patient was discharged, have potential to be incorporated into a tool for predicting RN requirements in the ED setting. The relationship is quantified using the equation  $DNCT = 10^x$ , where  $x = 0.027 + 0.436 * Twos(0,1) + 0.359 * Threes(0,1) + 0.212 * Fours(0,1) + 0.544 * Log(LOS) - 0.114 * Disposition\ Category(0,1)$ .

In this model triage codes are each factored separately as they were turned into a dichotomous variables for regression purposes. There are therefore four potential equations derived from the model, one for each triage code 2 to 5 (Equations 2, 3, 4, & 5). The equations demonstrate that patients from triage code 2 receive more DNCT than for ATS 3 patients. ATS 3 patients in turn receive greater DNCT than ATS 4 who receive more than ATS 5.

$$\begin{aligned} \text{Log(DNCT) for triage code 2} & \quad (2) \\ &= 0.563 + 0.544 * \text{Log(LOS)} - 0.114 * \\ &\quad \text{Disposition Category (0,1)} \end{aligned}$$

$$\text{Log(DNCT) for triage code 3} \quad (3)$$

$$= 0.386 + 0.544 * \text{Log(LOS)} - 0.114 *$$

$$\text{Disposition Category (0,1)}$$

$$\text{Log(DNCT) for triage code 4} \quad (4)$$

$$= 0.239 + 0.544 * \text{Log(LOS)} - 0.114 *$$

$$\text{Disposition Category (0,1)}$$

$$\text{Log(DNCT) for triage code 5} \quad (5)$$

$$= 0.027 + 0.544 * \text{Log(LOS)} - 0.114 *$$

$$\text{Disposition Category (0,1)}$$

The model also demonstrates a positive relationship between Log(DNCT) and Log (LOS) with a coefficient of 0.544. The result of this equation is to indicate that, controlling for other variables, as LOS increases DNCT increases. This supports the arguments that nursing continues throughout the emergency episode (College of Emergency Nurses New Zealand, 2002; Emergency Nurses Association, 2003b). The final component of the equation states that if the patient is discharged log(DNCT) reduces by 0.114. This means that less nursing time is spent with patients who are discharged.

The model was tested using four scenarios to examine the results. The scenarios were taken from the average LOS for patients in the review by Gabolinsey (2000) with the most common disposition category for that

triage group being used (Table 33). There is consistency between the model and literature in that more urgent triage categories are associated with greater DNCT. The work from New Zealand (Ardagh, 1999; James, 1998) appears to show closer agreement than the work from the USA (Emergency Nurses Association, 2003b; ENA Scientific Assembly, 1996, as cited in Zimmerman, 1999). For triage code 2 the model DNCT is most similar to Ardagh's prediction. Triage code 3 shows similarity to James and Zimmerman. Triage codes 4 and 5 lie between Ardagh and James. It is difficult to identify potential causes for the differences with the predictions of these writers as they do not provide detail of how the figures were derived nor do they state whether length of stay is accounted for.

Table 33

*Predicted DNCT for Models*

Triage Code	LOS (min)	Disposition Category	Predicted DNCT (minutes) for models				
			Thesis*	Ardagh**	James***	ENA****	ENA*****
2	252	Admit	59	60	120	120	210
3	284	Admit	53	30	60	60	156
4	204	Discharge	24	15	30	40	66
5	120	Discharge	11	7.5	15	20	30

Note: Predictions based on Average LOS cited by Gabolinsey (2000).

\* As predicted by model for this thesis.

\*\* As predicted by formula proposed by Ardagh (1999).

\*\*\* As predicted by formula proposed by James (1998).

\*\*\*\* As predicted by ENA formula reported by Zimmerman (1999).

\*\*\*\*\* As predicted by ENA Guidelines (2003b).

The ENA guidelines consistently predict much higher DNCT than the model. Some of the factors that appear to be included in the ENA guidelines would not be included in the model. For example, ENA

guidelines include work that may be done by a health care assistant or technician while the model consists of time for RNs only.

Practically this research could be used to predict DNCT requirement for triage code 2 to 5 patients attending the department studied. In order to do this average length of stay, and the number attending and percentage discharged for each triage category would be required. To predict nursing FTE for the department adjustments would need to be made for indirect nursing care time and leave requirements.

### **Limitations**

It was not possible to judge representativeness of this sample. The population sampled in this study consisted of 261 visits to one ED. The collection period was three days. The three days were midweek. As patient attendance reasons may be different in weekends compared to weekdays, there is a potential for bias. As details on the population being triaged were not collected it is difficult to assess whether the sample was representative. On days one and two sampling rates were 106 (71%) and 109 (66%) of patients triaged respectively. No figures were available on patients who went directly from triage to other areas of the hospital and would therefore have been excluded from the study. A conversation with a department manager (P. O'Donovan, personal communication, 21 April, 2003). suggested that approximately 15% of triaged patients bypass the ED, by going to areas such as orthopaedic clinic and paediatric assessment, directly from triage. While most of these are from triage category 4 and 5, some



patients that fell into higher categories also bypassed the ED. For example, one patient, who was triage code 1, had been stabilised by an air retrieval team and went directly to the intensive care unit. If 15% is used as the likely ratio excluded from the population being triaged this would suggest that 128, 140, and 130 were potential sample sizes for the Tuesday, Wednesday, and Thursday making sampling rates 83%, 78%, and 34% respectively. Sampling rates for days one and two were very good while the rate for day three is difficult to assess due to the decision not to sample visits for triage code 3 and 4 patients.

It is difficult to assess how representative the sample for triage code 1 was due to the small sample ( $n = 3$ ) and low sampling rate (25%). This made triage code 1 visits a potential source of error when statistical analysis was done. For this reason triage code 1 was excluded from the final modelling. Triage code 5 patients, with a sample size of nine (53% of attendances), had better sampling but remains a potential source of error. The other triage codes have much larger sample numbers and sampling rates between 43% and 83%. The variability in sampling rate and size for triage groups had the potential to impact on statistical analysis.

The positivist approach, used in this research, has limitations. It has as a core belief that observer and the observed do not interact (Crotty, 1998). This study required nurses to be both the observed and the observer in that they documented their own nursing care time as well as the independent and confounding variables. The process of collecting study data may have altered the amount of time nurses spent with patients.

Another limitation of the positivist approach is that it does not measure the lived experience. For example, a nurse may feel she has spent a long time with a patient after providing 30 minutes of continuous nursing care. The same patient may feel that they have been left alone for a long period without care after waiting for an hour in the waiting room. The experienced time could be seen as what Galileo referred to as a secondary property (Crotty, 1998). He suggested that properties such as taste, smell, and colour are secondary properties, while real properties could be measured and counted. The world addressed by positive science is not the everyday world we experience.

Validity is whether an “instrument accurately measures what it is supposed to measure” (Beanland, Schneider, LoBiondo-Wood, & Haber, 1999). DNCT was used as a measurement of the process of nursing in the proposed model (Figure 3, p. 52). As a construct the validity of using DNCT provided may lead to misrepresentation of the direct nursing care required by a patient. For example, during busy periods nurses may provide less nursing care than is optimal while in quieter periods more time may be spent with patients.

This study was conducted in one ED in New Zealand. The research was used to examine the relationship between triage, as the dependent variable, and DNCT as the independent variable. Six confounding variables (sex, age, ethnicity, LOS, complaint type, and disposition category) were used to represent other aspects of the theoretical framework relating structures and processes of nursing to patient outcomes (Figure 2, p.24). The confounding variables suggested were explorative only. Some variables,

such as ED doctor cover and nursing skill mix, may have had effects on DNCT provided in the ED studied while others such as physical environment may lead to variation at other sites. As not all potential variables were examined and only a single ED was used, the study findings are not generalisable.

It is important to recognise that, in this study, DNCT was actual time spent in caring for the patient. The collection method used showed good reliability in that no significant difference was found between external observation of DNCT and that reported by nurses. However, no attempt has been made to identify the relationship between DNCT and patient outcomes. As a result it is not possible to identify whether the quality of nursing care has been optimised. The time nurses were spending with their patients may have been limited by the number of patients that they were caring for and at times, when their patient loads were lower, may have been higher than optimal. Additionally, no attempt has been made to account for indirect nursing care time. The framework proposed in chapter two suggests that the processes of direct and indirect patient care link the structures impacting on nursing care provision and the outcomes for the patient. The links between direct nursing care, indirect nursing care and patient outcomes are opportunities for further research.

### **Further Research**

The main purpose of this study was to investigate how much direct nursing care time received by patients in one emergency department could

be predicted by their triage code. A framework was proposed outlining the way that structures and process of nursing impacted on patient outcomes (Figure 2, p. 24). The research used variables, suggested to represent the framework to examine the interaction between study variables (Figure 3, p. 52). This section outlines potential areas for further study.

The theoretical framework (Figure 2, p. 24) used in this thesis was developed as a way of looking at provision of optimal nursing care in the ED. This framework was constructed primarily from the work of O'Brien-Pallas (1997) and Houser (2003). These researchers focused on inpatient settings and the validity of this framework for the ED setting has not been tested.

Figure 20 (p. 122) revisits the theoretical framework that was the basis for this study. This figure highlights triage code, LOS, and disposition category as variables that this study found to be significant predictors of DNCT. The figure also includes variables found not to be significant in predicting DNCT which still have potential in a model of ED nurse work: age, ethnicity, and complaint type. Finally, the figure incorporates variables not tested in this study that literature has identified as having potential value in future research.

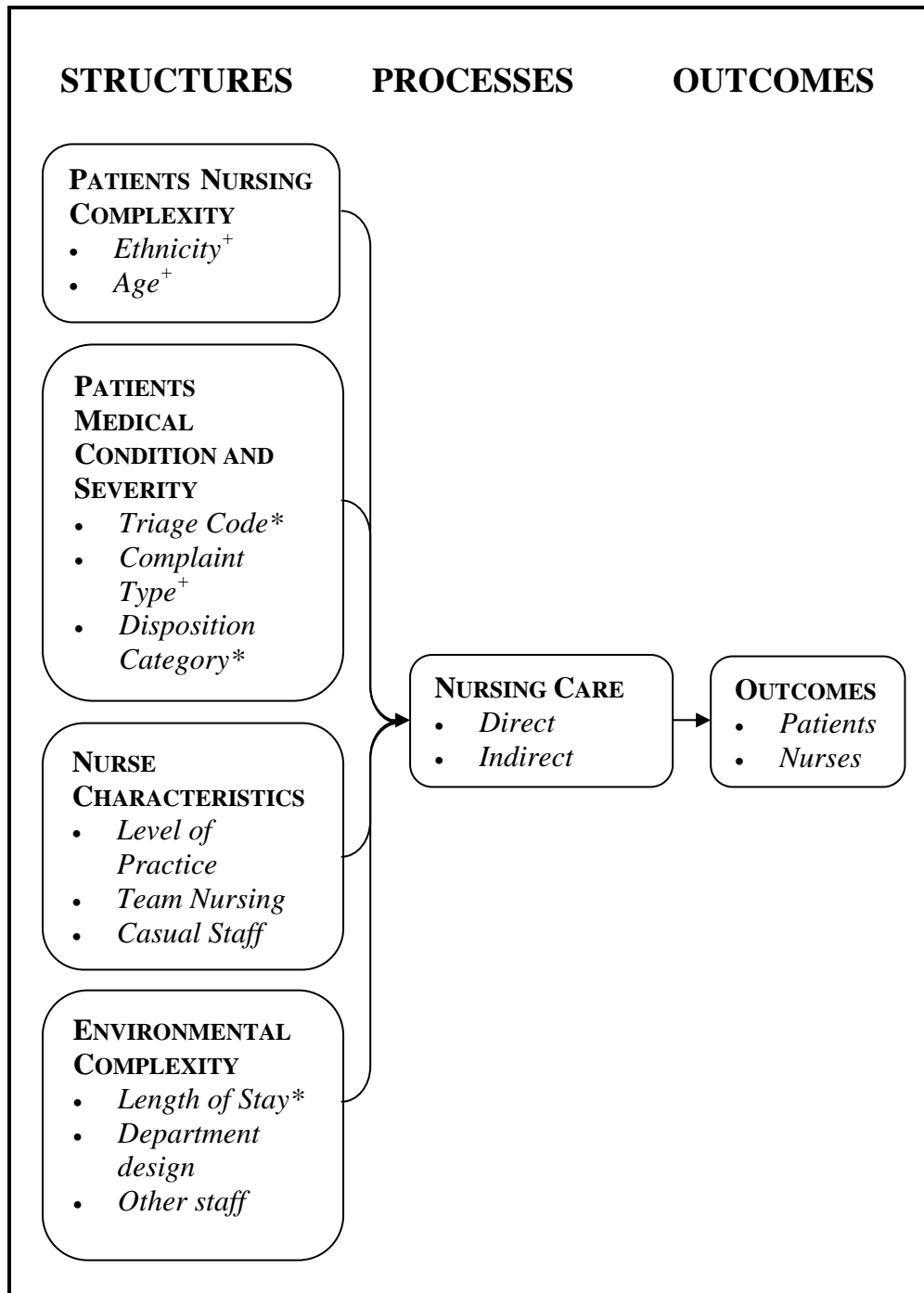


Figure 20. Framework for nursing work revisited. Items found to be significant in this study are identified with (\*) while items found not significant but considered worthy of further exploration are identified with (+).

## **Conclusion**

The purpose of this research was to examine the relationship between DNCT and triage code. A framework was proposed using the work of Donabedian (1988; 1990), O'Brien-Pallas (O'Brien-Pallas et al., 1997), and Houser (2003) relating the structures affecting and processes of nursing care to optimal patient outcomes (Figure 2, p. 24). Components of this framework were operationalised and researched in one emergency department, over a three day period, to identify relationships with DNCT.

Statistically significant associations were found between DNCT and triage code, LOS, age, complaint type, and disposition category. No relationship was found between DNCT and sex or ethnicity. A model was developed in an attempt to explain variability in DNCT. This model accounted for 49% of variability in observed DNCT using the variables triage (16%), LOS (31%), and disposition category (2%). This study demonstrated that triage code has predictive value in measuring nursing work in the emergency setting. It therefore may be useful for calculating emergency nurse staffing requirements.

Further research is needed to explore this relationship and the proposed framework. Clarification of how nursing characteristics, environmental complexity, patient nursing complexity, and patient medical condition and severity impact on nursing processes to affect patient outcomes has the potential to provide tools which will allow nursing care in the emergency setting to be optimised.

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## **Appendices**

## **Direct Patient Care Time Audit Information Sheet for Nursing Staff**

The direct patient care time audit has been developed in order to better understand how nurse staffing relates to patient attendance, acuity, and length of stay.

Brian Gabolinscy, Clinical Nurse Specialist, will be utilising the data collected in the audit for a research project that aims to test whether triage code and length of stay along with a number of other factors can be used to model the direct patient care time of nurses. This will hopefully be used to better match nurse to patient ratios.

The factors being looked at in the model will be:

- ✓ Triage Code
- ✓ Length of stay (Time of arrival to time of departure)
- ✓ Age (in years)
- ✓ Ethnicity (as collected by reception staff currently)
- ✓ Complaint type (Medical, Surgical, Psych, Trauma, other)
- ✓ Disposition category (Admission, Discharge, Transfer, other)

The data collection form overleaf will be used. Data collection will take place for 3 days in October for Triage 2,3,4, and 5 patients. Because of the low number of patients of triage code 1 the data collection for this category will last 3 weeks.

Nursing staff are asked as part of the audit to ensure every patient gets a Data Collection sheet and that each sheet has a patient label on it, as well as time of arrival and leaving the ED. Also nurses are asked to fill in the complaint type and disposition category for each patient.

As well each nurse is asked to record start and end times for each episode of direct patient or family care that they undertake. If more than one nurse undertakes the care e.g. two nurses change and wash a patient then both nurses should write in start and end times. No details of the nurse are required and all information used will be aggregate ensuring nurses and patients cannot be identified.

There is an additional comments section that can be used by nurses who feel that the nursing care time or any of the other data points are extremely long or short.

Patients excluded will be those going direct from triage to CAA, OOPD or Psych. Triage nurses do not write in the time taken for triage.

Patients and their family will be made aware of the audit by posters placed at all entries. Should they require further information the Clinical Nurse Specialists will talk to them.

Audit as a part of continuous quality improvement is a requirement of employment at CDHB. However if you do not wish the data collected during audit to be used in the research you can mark the box on the form.

Brian is available to discuss any concerns you have with this audit and research. Likewise the departments NZNO delegates, [REDACTED] and [REDACTED], are available if you have concerns with regards to this research and will take your concerns to Brian for you.

# **To All Patients And Visitors**

## **Christchurch Hospital**

### **Emergency Department**

is undertaking an audit to allow us to better match our staffing with patient needs.

*This will include documentation of*

### **Nursing Time Spent with Patients**

In addition we will note:

- ✓ Triage code
- ✓ Age
- ✓ Ethnicity
- ✓ Length of stay
- ✓ Discharge type
- ✓ Complaint type

This will not affect the nursing care that you receive.  
All data will be reported anonymously.

**If you have any concerns or queries related to this audit please mention it to a staff member and a nurse specialist will discuss these with you.**

*AppendixC: Letter from Canterbury Ethics Committee.*



24 September 2003

Mr B Gabolinscy  
5 Brockworth Place  
Riccarton  
Christchurch

Level 4  
Charles Lunny House  
250 Oxford Terrace  
P.O. Box 3877  
Christchurch  
New Zealand  
Phone (03) 372 1000  
Fax (03) 372 1015

Dear Mr Gabolinscy

**Does triage code predict direct nursing care time in the emergency department**  
**Investigator: B Gabolinscy Supervisor: A/P Jane Koziol-McLain**  
**Ethics reference: CTR/03/09/156**

Thank you for the new Part V signed by the Acting General Manager, Christchurch Hospital and confirmation of the Emergency Department support.

Ethical approval is now confirmed for the above study.

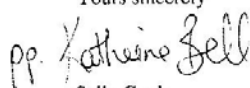
Approval is until 31 December 2003.

A final report is required at the end of the study and a form to assist with this is available from the Administrator. If the study will not be completed by the above date, please forward a progress report and an application for extension of ethical approval in November 2003.

Please refer to the above ethics reference number in all correspondence related to the study and advise the Committee promptly of any adverse events, if the study does not commence or is altered in any way.

The Committee wishes you well with your research.

Yours sincerely

pp. 

Sally Cook  
Ethics Committee Administrator



*Appendix D: Letter of Support from Emergency Department Nurse Manager*

Canterbury DHB

District Health Board

Te Pahi Hauora o Waitaha

Mark Newsome  
Nurse Manager  
Emergency Department, EOA  
& IV/ECG Technicians  
Christchurch Hospital  
Private Bag 4710  
Christchurch  
New Zealand  
mark.newsome@cdhb.govt.nz  
www.cdhb.govt.nz/ed

Friday, 04 April 2003

Canterbury Ethics Committee

Dear Ethics Committee Members

**RE: Letter of Support for Research on "Does Triage Code Predict Direct Nursing Care Time in the Emergency Department" by Brian Gabolinscy**

This letter is written in support of Brian Gabolinscy who will be performing an audit for the Christchurch Hospital Emergency Department and using the audit data to complete his Thesis.

I believe that this research will advance our understanding of the nursing requirements of New Zealand Emergency Departments and will be useful in improving the ability to meet patient needs through matching nurse staffing within the department.

Should you have any further queries please feel free to contact me at Christchurch Hospital Emergency Department.

Yours Sincerely



**Mark Newsome**

EMERGENCY DEPARTMENT, CHRISTCHURCH HOSPITAL

Private Bag 4710, Christchurch, N.Z.

Telephone: 64 (03) 364 0270 Fax: 64 (03) 364 0286

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*AppendixE: Letter of Support from Emergency Department Clinical Director (Acting)*

Canterbury DHB  
District Health Board  
Te Pōari Hauora o Waitaha

23 September 2003

Sally Cook,  
Canterbury Ethics Committee,  
P.O. Box 3877,  
CHRISTCHURCH.

Dear Sally,

re: "Does Triage Code Predict Direct Nursing Care Time in the Emergency Department?"  
by Brian Gabolinsky.

This letter is to support Brian Gabolinsky in the above research as he will be performing an audit for the Christchurch Hospital Emergency Department and using audit data to complete his thesis. I believe that this research will further emergency nursing understanding and also the requirements of a tertiary level hospital Emergency Department.

Yours sincerely,



**Scott Pearson**  
Emergency Physician  
Acting Clinical Director  
Emergency Department

c.c. File.

SP/KM

EMERGENCY DEPARTMENT, CHRISTCHURCH HOSPITAL  
Private Bag 4710, Christchurch, N.Z.  
Telephone: 64 (03) 364 0270 Fax: 64 (03) 364 0286

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*Appendix F: Letter of Support from NZNO Delegates*

To: Canterbury Ethics Committee

RE: Letter of Support for Research on “Does Triage Code Predict Direct Nursing Care Time in the Emergency Department” by Brian Gabolinsey

Dear Ethics Committee Members

This letter is written in support of Brian Gabolinsey who will be performing an audit for the Christchurch Hospital Emergency Department and using the audit data to complete his Thesis.

As the New Zealand Nurses Organisation Delegates for the Christchurch Emergency Department we have made a commitment to act as intermediaries should any nursing staff have concerns with regards to their participation in this research.

Should you have any further queries please feel free to contact us at Christchurch Hospital Emergency Department.

Yours Sincerely





*Appendix G: Letter of Support from Te Komiti Whakarite.*

12 August 2003

*Te Komiti Whakarite*  
Annette Finlay  
Quality Division  
Christchurch Hospital  
Private Bag 4710  
Christchurch

Brian Gabolinsky  
Emergency Department  
Private Bag 4710  
Christchurch

Dear Brian,

Thank you for submitting your research project, "Does triage code predict direct nursing care time in the emergency department", to Te Komiti Whakarite.

Te Komiti Whakarite have reviewed this study and note that you are collecting ethnicity data, we advise the use of the census 2001 ethnicity data question. One question that the committee would like to know is how is the ethnicity data collected in the emergency area, is this during routine 'clerking in' of the person?

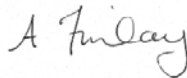
It would be appropriate to state that your study has been submitted to Te Komiti Whakarite rather than any individual, but I am happy to be named as the contact person for our committee.

Te Komiti Whakarite would be interested in a summary of findings and would be also be happy to assist you with any further suggestions or advice in reference to part of your study.

At this stage there are no other specific Maori issues and Te Komiti Whakarite are looking forward with interest to any further research projects that you may bring to us.

If there are further questions feel free to contact me.

Yours sincerely



Annette Finlay  
Te Kai Hapai Tikanga Maori  
(Project Facilitator Maori Cultural Development)  
for Te Komiti Whakarite