THE IMPACT OF NURSING STAFF MIX MODELS AND ORGANIZATIONAL CHANGE STRATEGIES ON PATIENT, SYSTEM AND NURSE OUTCOMES

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Key Findings

- More than sixty percent of the hospital units in this study utilize a staff mix comprised of both *regulated and unregulated* staff, with most of these employing RNs and URWs
- *System quality variables* (perceptions of technical quality of care, approaches to coordination of care) were found to be important predictors of the nurse outcomes (level of job pressure, job threat and role tension)
- *Nursing leadership* was found to have an important influence on all of the nurse outcomes studied (job satisfaction, job pressure, job threat and role tension)
- *Patient complexity* was found to have a strong influence on the nurse outcomes of job satisfaction, job pressure, job threat and role tension and on nursing hours utilization
- Staff mix models that included a *lower proportion of regulated staff* utilized more nursing hours in this study
- Patient age and complexity were found to be predictors of *nursing hours utilization* within the medical-surgical patient population in this study, with more nursing hours utilized for patients that were older and for patients with higher complexity levels
- Significant *improvements in the health outcome scores* between admission and six weeks following discharge were found, although at the time of discharge patients actually experienced reductions in many of the health outcomes
- *Staff mix* was a significant predictor of five of the patient health and quality outcomes (functional independence, pain, social functioning, and satisfaction with obstetrical care) with higher proportions of RN/RPNs in the staff mix associated with better health and patient satisfaction outcomes and with lower unit rates of medication errors and wound infections
- The *technical quality of care* on the inpatient unit was associated with better pain outcomes for medical-surgical patients and obstetrical patients
- The *quality of communication* among nurses, and between nurses and other disciplines was positively associated with patients' functional independence scores at discharge and with obstetrical patients' satisfaction with nursing care
- *Nurses job satisfaction* was related to medical-surgical patients' satisfaction with nursing care, and with better pain outcomes for women after childbirth
- Nurses' *role tension* had a negative effect on patients' functional independence outcomes at discharge

Executive Summary

The Nursing Staff Mix Outcomes Study (NSMOS) was a province-wide research project that was designed to assess the impact of changes in the composition and mix of nursing care staff in acute care teaching hospitals on patient, nurse and system outcomes. The study was conducted at 19 teaching hospitals across Ontario, and included questionnaires, interviews, focus groups, and data from selected official databases. Approximately 2,046 patients, 1,116 nurses, 63 unit managers, and over 50 senior executives participated in the study.

Data describing the structure variables were acquired through interviews (organizational change model), administrative records (unit census, operating beds), questionnaires (nurse staffing patterns, care delivery model, unit communication, baseline measures for patient outcomes), and chart abstraction (baseline patient characteristics). Process data were acquired through chart abstraction and outcome data through administrative records (LOS, readmission, nursing hours cost) and questionnaires (subjective patient outcomes, subjective nurse outcomes).

STAFF MIX AND NURSE OUTCOMES

More than sixty percent of the hospital units in this study utilized a staff mix comprised of both *regulated and unregulated* staff, with most of these employing RNs and URWs in their staff mix. The proportion of registered nurses employed as part of this staff mix varied across the hospital units examined, with the majority having between 60 and 89% of their staff mix comprised of registered nurses.

Most units in this study utilized *total patient care* as the patient care delivery model. On units that did not utilize total patient care, nurse's perceptions of job pressure were higher. Contrary to our expectations, a patient care delivery model that was associated with lower *continuity of care* for patients contributed to nurse's job satisfaction, while a care delivery model that promoted continuity contributed to their perceptions of job pressure.

The majority of findings related to the staff mix and nurse outcomes in this study underscore the importance of the environment in which nurses work. Almost all of the system quality variables were found to be important predictors of the nurse outcomes. The higher the nurses' perception of the *technical quality of the care* provided on the unit, the higher their level of job satisfaction. In contrast, the lower the nurses' perception of the technical quality of the care provided on the unit, the higher their level of job pressure, job threat and role tension. At the unit level, the less that nurses were required to use *programming approaches for coordinating patient care*, the more satisfied they were. In contrast, at the individual level, nurses were more satisfied with using programming approaches for patient care, and reported higher levels of role tension if these approaches were not used. *Nursing leadership* was also found to have an important influence on all of the nurse outcomes in this study.

The lower the average *complexity of patients* on the unit, the higher nursing job satisfaction and the lower their perceptions of job pressure, job threat and role tension. As expected, patient complexity was also found to have an influence on *nursing hours cost*. Patients who were more complex utilized more nursing care resources. Staff mix models that included a *lower proportion of regulated staff* utilized more nursing hours in this study. As well, patient age and complexity were found to be predictors of nursing hours utilization within the medical-surgical patient population.

STAFF MIX AND PATIENT OUTCOMES

Significant improvements were found in the *patient health outcome* scores between admission and six weeks following discharge, although at the time of discharge patients actually experienced reductions in many of the health outcomes. This reduction in functional and pain outcomes at discharge is not unexpected because a large proportion of the sample were surgical patients who were recovering from the immediate effects of surgery and anaesthetic. *Nursing staff mix* was found to be a significant predictor of five of the patient health and quality outcomes: *functional independence, pain, social functioning, and satisfaction with obstetrical care*. In all cases, higher proportions of RN/RPNs were associated with better health and satisfaction outcomes. The effect of staff mix on patient outcomes was evident at hospital discharge but not at the time of the six week follow-up.

The environment in which nurses practice also influenced patient outcome achievement. *The technical quality of care* on the inpatient unit was associated with better pain outcomes for medical-surgical patients and obstetrical patients. Furthermore, medical-surgical patients were less likely to make a visit to an emergency ward following discharge when they had been cared for on units of high quality. These findings underscore the importance of nursing resources in acute care and tertiary care hospitals. The quality of *communication* among nurses, and between nurses and other disciplines was positively associated with patients' functional independence scores at discharge and with obstetrical patients' satisfaction with nursing care.

Several nursing outcomes were associated with the patients' health and quality outcomes. There was a positive relationship between nurse job satisfaction and medical-surgical patients' satisfaction with nursing care. Nurses' role tension had a negative effect on patients' functional independence outcomes at discharge, but a positive influence on patients' mental health outcomes.

STAFF MIX AND QUALITY OUTCOMES

Data were collected on unit rates of medication errors, patient falls, wound infections, urinary tract infection, and pneumonia, in addition to the data that were collected on nurses' perception of the quality of nursing care and patients' satisfaction with nursing care (discussed above). Nurse staffing was related to two of these secondary outcomes. On units where there was a lower proportion of RNs/RPNs there was a higher number of medication errors and wound infections.

SUMMARY

In summary, the results of this study suggest that a higher proportion of RNs/RPNs on inpatient units in Ontario teaching hospitals is associated with better health and quality outcomes for patients at the time of hospital discharge and with lower rates of medication errors and wound infections. Thereafter, the effect of the staff mix variable is less evident. However, to the extent that nurses are able to contribute to the short-term functional recovery of patients, it appears that these patients will recover healthy functioning in the longer-term. Functional recovery at hospital discharge was predictive of health outcomes six-weeks later.

As well, the importance of the environment in which nurses work has been evidenced in this study. Patient complexity and system quality variables were found to be important predictors of the nurse and patient outcomes studied. These findings provide useful information for nurse executives, senior hospital personnel, and policy leaders about the linkages between nurse staffing and patient care, nurse, and system outcomes.

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BACKGROUND

Background

The hospital industry in Canada has undergone wide-spread reorganization in response to fiscal constraints and funding reductions within the public sector. In an effort to reduce costs and improve the efficiency of services they provide, Ontario hospitals have responded with large scale organizational change which can be characterized by terms such as downsizing, re-engineering, or rightsizing/restructuring (Baumann, et al., 1996; Leatt, Baker, Halverson, & Aird, 1997). Change has occurred at all levels within the organization, as the hospitals re-configured their services and structures, redesigned patient care systems and processes, and introduced new staff mixes and models for providing patient care.

Recent changes in the structure and composition of the nursing workforce as a result of hospital downsizing and restructuring have prompted concern in the nursing community regarding the quality of care provided to patients. The American Nursing Association (ANA, 1997) published the findings of a study in which patient morbidity indicators for preventable conditions, such as decubitus ulcers, pneumonia, postoperative infections, and urinary tract infections, were found to be inversely related to Registered Nurse skill mix, and to a lesser extent, nurse staffing per acuity-adjusted day.

The Nursing Staff Mix Outcomes Study (NSMOS) is a province-wide research project that was initiated by a team of investigators at the Faculty of Nursing, University of Toronto led by Linda McGillis Hall, PhD and Diane Irvine Doran, PhD. This study was designed to address the imperative for reliable and valid data on the impact of changes in the composition and mix of nursing care staff in acute care teaching hospitals on patient, nurse and system outcomes. The study examined nursing staff mix models, organizational change strategies, patient outcomes, nurse outcomes, and system outcomes. The study was conducted at 19 teaching hospitals across Ontario (see Appendix A), and included questionnaires, interviews, focus groups, and data from selected official databases. Approximately 2,046 patients, 1,116 nurses, and 63 unit managers participated in the study.

A project advisory working group was struck that included membership from the Nursing Executive group of the Ontario Council of Teaching Hospitals (OCOTH), liaison representatives from the Ontario Hospital Association (OHA), and a chief executive officer from the OCOTH (see Appendix B). The study proposal was reviewed by relevant stakeholder groups in September, 1997 receiving strong endorsement and approval to proceed (see Appendix C). Following a comprehensive peer-review process, the project was contracted in August, 1998 by OCOTH with management support provided by the OHA. Senior executive personnel from each of the teaching hospitals in Ontario were asked to indicate their commitment to participate in the study by signing a letter of support. Due to the estimated costs of conducting a study of this size which included a high volume of primary data collection, the research team was encouraged by the project advisory group to seek alternative funding sources. With the support of OCOTH and the OHA, the researchers successfully competed for supplementary grant funding from the Canadian Health Services Research Foundation (CHSRF), a Federal health services research granting agency which focuses on partnerships between university researchers and the community.

Literature Review

ORGANIZATIONAL CHANGE

A number of organizational structural changes have occurred in the hospital industry in response to the pressure to reduce costs. Widespread recognition that labour costs represent the largest portion of a hospital's budget has led to initiatives designed to trim these costs. These strategies include changes that have resulted in downsizing, re-engineering and rightsizing/restructuring. Hospitals may employ different strategies to implement change in organizational structure. The implementation strategies include the approach to planning and decision making related to the change, mechanisms for communicating the change, mechanisms for educating the staff and customer about the change, and systems for monitoring the effectiveness of the change. Gustafson et al. (1992) created a model for a successful change based on four factors: (1) creating a tension for change; (2) identifying an actionable alternative; (3) insuring that knowledge and skills are available to make the change; and (4) offering social support to those who need to make the change. Without these four elements, there is likely to be a high level of resistance to change and limited success from the change. Kotter and Schleslinger (1979) noted that successful change efforts are those in which the strategic choices on implementation are consistent. For example, efforts that involve large numbers of people but are implemented quickly usually become either stalled or less participative.

Downsizing refers to the deliberate cost-reduction strategies utilized by senior managers of a hospital to reduce staff while maintaining or improving the efficiency and effectiveness of care processes (Evans, Gunz & Jalland, 1996; Freeman & Cameron, 1993; & Leatt et al., 1997). The goal of downsizing is to maintain the same levels of output while reducing the resources required (e.g. reducing the RN-FTE/patient ratio). *Re-engineering* refers to the radical redesign of care and work processes to achieve dramatic improvements for the customer (Hammer & Champy, 1993; Kissler, 1996; Leatt et al., 1997). The goal is to increase the output from existing resources, which then permits the reduction of the current complement if necessary. *Rightsizing/restructuring* refers to an integrated and internally consistent approach to the re-configuration of the organization's work processes guided by a strategic long-term mission, vision or plan (Hitt, Keats, Harback & Nixon, 1994; Leatt et al., 1997). The principal mechanism for restructuring is the formation or redesign of key business units or programs by adding or deleting programs.

Downsizing, re-engineering and rightsizing have certain elements in common, but can be differentiated along several dimensions. Leatt et al. (1997) have developed a framework that identifies the defining characteristics of each of these organizational change strategies. The framework proposed by Leatt et al. (1997) was used to categorize the change strategies undertaken by OCOTH hospitals according to the defining characteristics of a downsizing, re-engineering, or restructuring/rightsizing strategy. Categorization of the change strategies into reasonably mutually exclusive categories was necessary in order to explore the impact of the change strategy on the staff, patient, and system outcomes.

CHANGES TO STAFF MIX

The changes in organizational structure and design described above can result in changes in staff complement. The changes that have occurred in Ontario hospitals in *nursing staff mix* include the introduction of unregulated health care workers, changes in the proportion of regulated and unregulated workers, and changes in the proportion of Registered Nurses (RNs) and Registered Practical Nurses (RPNs) (McGillis Hall, 1998). As organizations downsize, re-engineer, or rightsize/restructure, often there is a change in service levels provided by some of the departments in the hospital. This may include a decrease in coverage to a patient care unit of, for example, physiotherapy services. As a result, because of the 24 hour nature and presence of nurses on the unit, they tend to pick up these "skill related" activities from the other disciplines, which may affect the nurse's ability to provide comprehensive nursing care.

Staff mix is the combination of different categories of health care workers that are employed for the provision of care to patients in hospitals (McGillis Hall, 1997). Spurred by the nursing shortage and fiscal constraints, shifts in staff mix have occurred in hospitals with the introduction of unregulated workers as part of the care delivery team. A wide variety of staff mix models have evolved as hospitals try to achieve the most efficient, flexible, and cost-effective use of health personnel. Changes in staff mix involve changes in the composition of direct patient care providers such as nurses and unregulated health care workers, and changes in the composition, roles and responsibilities of other professional and paraprofessional staff who provide a service to patients (Marshall, 1995; McGillis Hall, 1997; Smeltzer, Formella & Beebe., 1993). Several models of staff mix have been reported in the literature. These include: a) an all RN staff mix who manage, coordinate and provide all aspects of direct and indirect patient care, b) Registered Nurses and Registered Practical Nurses who manage, coordinate and provide all aspects of direct and indirect patient care, c) unregulated workers who perform some direct and indirect care activities, and d) unregulated workers who perform non-nursing care activities (McGillis Hall, 1997). Service assistants (SA) are examples of unregulated workers who may perform non-nursing tasks such as delivering meal trays and transporting patients (Marshall, 1995).

There is an interdependence between the model of patient care delivery employed in a hospital and the staff mix. Some models of patient care such as primary nursing or total patient care can only be found with an all RN staff mix. However, the way in which unregulated workers are utilized within the patient care system can vary irrespective of the regulated staff mix (i.e., proportion of RNs and RPNs). In a review of the staff mix literature, McGillis Hall (1997) described two dominant ways in which unregulated workers have been integrated into patient care settings. Under a substitution model, unregulated workers have been employed to assume some routine tasks in patient care (e.g., personal care, feeding patients) under the supervision of registered nurses (McGillis Hall, 1997). Under a complementary model, unregulated workers have not engaged in any nursing tasks, but have been employed to perform 'non-nursing' tasks such as delivering meal trays, transporting patients, and housekeeping (Marshall, 1995; McGillis Hall, 1997). There is no empirical evidence to suggest one model is better than the other, although theoretically, one might expect that nurses' job satisfaction and quality outcomes would be higher under the complementary model than the substitution model. This is because under the complementary model, RNs are able to focus on their patient care responsibilities and because their attention is not diverted by the competing demands of non-nursing tasks, they are in a better position to observe subtle changes in a patient's health condition and to

institute an appropriate response. The close observation and timely response can result in the prevention of complications and better health outcomes for patients and better job satisfaction for nurses.

OUTCOMES OF STAFF MIX AND ORGANIZATIONAL CHANGE

Valid quality indicators are based on outcomes of care. The outcomes of nursing care include those experienced by the patient, the nursing staff, the informal caregivers (family, friends, volunteers), and the system (OCOTH hospitals). The outcomes of interest to consumers, health care providers and policy makers demonstrate three characteristics:

- They are measurable by efficient, valid, and reliable methods.
- They are relevant to the patient, informal or formal care provider, provider agency and/or government.
- They represent intended or unintended effects of hospital nursing care.

At the patient level, the intended effects of nursing care might include very specific clinical outcomes such as wound healing or pain management (Gillette & Jenko, 1991) and higher level outcomes such as improvement or maintenance of physical, mental, or emotional functioning (Gillette & Jenko, 1991; Irvine & Keatings, 1999; Lang & Clinton, 1984). The unintended effects of nursing care might include the occurrence of adverse occurrences such as medication errors, patient falls, decubiti, and nosocomial infections (American Nurses Association (ANA), 1997; Blegen, Goode & Reed, 1998; Heinemann, Lengacher, VanCott, Mabe & Swymer, 1996).

Outcomes such as these have been associated with nursing variables and changes in staff mix models. Heinemann et al. (1996) evaluated the impact of a partners in patient care model employing nurse extenders, and reported significantly higher satisfaction with the courtesy of nursing staff and treatment of family and visitors on the experimental unit. The experimental unit also had lower rates of medication errors and patient falls per patient day over an 18 month period. Costs, on the other hand, were higher on the experimental unit, which were measured as total salary and supply costs (Lengacher, et al., 1996a). Neidlinger, Bostrum, Stricker, Hild & Zhang (1993) evaluated a program to incorporate nursing assistive personnel (NAP) and found that personnel costs on all units increased, and quality indicators declined from 97% to 81% compliance on the experimental units. Patient satisfaction improved slightly on the experimental units, while staff satisfaction remained stable and work satisfaction decreased following implementation of the NAP intervention. The authors suggested that a multitude of factors confounded these findings rendering the results impossible to generalize to other health care settings. Bostrom & Zimmerman (1993) used a pretest-posttest design to evaluate a redesign initiative that included the introduction of certified nursing assistants (CNAs) and licenced vocational nurses (LVNs). The study results indicated that the change in staff mix had a substantial impact on the distribution of work between care providers and on patient care costs, while no impact was noted on patient satisfaction or quality of care. A significant shift in time spent on non-nursing care activities from RNs to CNAs occurred.

The American Nurses Association (ANA) published the results of a pilot study in which they evaluated a Nursing Care Report Card which was developed to monitor the quality of nursing care for acute care settings (ANA, 1997). Patient morbidity indicators for preventable conditions, such as decubitus ulcers, pneumonia, postoperative

infections, and urinary tract infections, were found to be inversely related to registered nurse skill mix, and to a lesser extent, nurse staffing per acuity-adjusted day. Similar results were reported by Blegen et al. (1998) who found, however, that the relationship between the proportion of RN care hours per patient day and adverse outcomes was curvilinear; as the RN proportion increased, rates of adverse outcomes decreased up to a proportion of 87.5%. Above this level, as RN proportion increased, the adverse outcome rates also increased. The authors offered as an explanation, the fact that patient acuity tends to increase on units with high proportions of RN staff and acutely ill patients are at greater risk of adverse occurrences such as nosocomial infections. These findings underscore the importance of controlling for patient acuity prior to evaluating the effect of staffing model on patient outcomes.

Hartz, et al. (1989) analyzed the data from the Health Care Financing Administration 1986 published mortality rates for 3100 American hospitals. Mortality rates were adjusted for each hospital's case mix and other characteristics of its patients. Hartz et al. (1989) found that the percentage of nurses who were RNs explained a significant amount of the variation in adjusted mortality rates between hospitals. In a study of mortality rates among inpatients receiving care under Medicare, Shortell & Hughes (1988) found that the percentage of RNs among the hospital employees was associated with lower mortality rates, but the relationship was not statistically significant. Aiken, Smith & Lake (1994) found hospitals known for good nursing care, defined as "magnet" hospitals, had 4.8% less excess mortality than comparative hospitals.

(A) PATIENT OUTCOMES.

The empirical literature was used as a basis for selecting outcomes that could be expected to be sensitive to hospital nursing care. This study focused on the maintenance or improvement of functional status as a higher level outcome of hospital nursing care. In addition, intermediate outcomes which are sensitive to hospital nursing care and which affect the achievement of the higher level outcome were examined. By focusing on higher level and intermediate outcomes a better understanding of the processes by which patient outcome achievement is affected by the quality of nursing care was generated.

Intermediate outcomes of hospital nursing care include pain control and secondary complications. Nurses have sole responsibility for analgesic administration, particularly opioids in managing pain. Regular opioid dosing has resulted in patients having fewer complications such as infection following surgery, shorter hospital stay, and less disability after discharge (Tuman et al., 1991; Wasylak, Abbott, English & Jeans, 1990; Yeager, Glass, Neff & Brinck-Johnses, 1987). *Secondary complications* include patient falls, medication errors, and nosocomial infections. While nurses are not solely responsible for preventing falls or preventing nosocomial infections, they are the only persons in the hospital close to the patient every hour of the day and night, only they can provide continuous, professional supervision with respect to fall risk and infection control (AHA, cited in Majesky et al., 1978). "The general control of infections in hospitals is influenced largely by techniques used in daily routines of patient care" (Majesky, Brewster & Nishio, 1978, p. 367).

(B) SYSTEM QUALITY AND COST OUTCOMES

System outcomes which can be influenced by changes to the staff mix configuration employed include *costs* of care and the *quality* of care. Changes in staff mix and nursing roles can affect the nature of interprofessional *communication and coordination*,

which in turn, has been shown to affect outcomes such as risk adjusted *length of stay* (Shortell et al., 1994), risk adjusted *mortality rates* (Knaus, Draper, Wagner & Zimmerman, 1986), *excess home care costs following discharge* (Brooten et al., 1994), *unplanned visits to the physician or emergency department*, and *unplanned re-hospitalization* (Naylor et al., 1994). Other cost variables associated with nurse staffing include *length of stay, direct and total inpatient care costs, total home care charges*, and *unplanned re-hospitalization*. Family *caregiver burden* is an indirect social cost which is sensitive to nursing interventions (Lang & Marek, 1990; Naylor, Munro & Brooten, 1991). Nurses are often the primary health professionals who teach family members about the care of the dependent patient, including the principles of asepsis and how to safely perform therapeutic procedures such as injections and dressing changes. The promotion of optimal functional recovery and the prevention of disability or complications ultimately reduce the burden of care for informal caregivers in the home.

As well, the effectiveness or quality of the care provided by the unit staff can be affected during times of organizational change. Some authors suggest that staff report no change in quality of care on the unit although measures for ascertaining these reports were largely descriptive (Abts, Hofer & Leafgreen, 1994).

(C) NURSE OUTCOMES

System change can impact on the quality of work relations, the quality of working conditions, and the quality of supervisory relations, all of which have been shown to influence staff outcomes such as job satisfaction, stress, absenteeism, and turnover (Blegen, 1993, Irvine & Evans, 1995). Layoffs and unit mergers and some of the changes implemented as a result of the organization's change strategy, have resulted in decreased numbers of RNs and/or RPNs employed, the need for the nurses remaining on the unit to assume extra tasks, and an overall threat to job security and job stress. Job satisfaction is one of the most prevalent outcomes examined when changes are made to staff mix (Eriksen et al., 1992; Lengacher et al., 1996b; Neidlinger et al., 1993). Job satisfaction is an important hospital indicator of quality and can have an impact on turnover and absenteeism (Irvine & Evans, 1995). Much of the literature related to changes in staff mix models provides evidence of role confusion and lack of role clarity between the mix of care providers involved in the provision of care (Eriksen et al., 1992; Neidlinger et al., 1993; Salmond, 1995; Zimmerman, 1995). Thus, the role tension experienced by nurses in response to work-related factors is an important variable to examine.

SUMMARY

The literature indicates the need for a description and evaluation of the changes in organizational structure, staff mix models and care delivery processes that have been undertaken in Ontario teaching hospitals. While it is widely recognized that a great deal of change has occurred within the context of hospital restructuring, there has been little systematic description of the scope of these changes, and no evaluation of the impact of change in health human resources on patient and system quality and cost outcomes. Recent changes in the structure and composition of the nursing work-force as a result of hospital downsizing and restructuring have prompted concern in the nursing community regarding the quality of care provided to patients. This study was the first large scale attempt in the province to systematically examine the process and impact of changes to the nursing staff mix in the hospital health care delivery system.

Study Purpose

The Nursing Staff Mix Outcomes Study (NSMOS) had two primary purposes. These were to:

- describe the nature of the changes in staff mix, and
- evaluate the impact of changes in staff mix on patient, system and nurse outcomes.

In addition, it described the nature of organizational change and restructuring within the OCOTH hospitals, using the topology proposed by Leatt et al. (1997). A secondary purpose of the study was the examination of the effect of the change model on a select number of patient and nurse outcomes.

Objectives

The objectives of this study were to:

- describe nursing staff mix models and organizational changes that have been implemented in patient care settings in the OCOTH hospitals;
- evaluate the impact of nursing staff mix models and care delivery models on the system, patient and/or nurse in these hospitals;
- evaluate the impact of staff models and care delivery models on outcomes following hospitalization, including family caregiver burden, and patient outcome; and
- develop recommendations for hospital management, health care planners and policy analysts concerning the implications of different staff mix models for different practice settings.

Research Questions

The specific research questions that were explored were:

1. What are the predominant models of staff mix within the Ontario academic health science centres/OCOTH hospitals?
2. What are the predominant models of organizational change undertaken by OCOTH hospitals?
3. Is there a relationship between the professional mix of staff on inpatient units (e.g. proportion of RN & RPN to unregulated worker) and patient outcome achievement (at the time of hospital discharge and at six weeks post discharge), cost outcomes, and nurse outcomes?
4. Does the influence of staffing model on patient, cost and nurse outcomes vary with the type of care delivery model (e.g. team nursing or total patient care)?
5. Do nurse staffing variables such as the average nurse educational preparation, and average nurse experience level explain variation in patient, cost, and nurse outcomes beyond what is explained by differences in case mix, patient complexity, patient age, surgical risk, and functional status at admission?
6. Does the organizational change model explain variation in patient, cost, and nurse outcomes beyond what is accounted for by differences in case mix, patient complexity, patient age, surgical risk, functional status at admission, and the nursing variables?

T W O

METHODS & PROCEDURES

Methods

DESIGN

A descriptive repeated measures design was used to determine the association between organizational change, staffing model components and patient, nurse and system outcomes. Data describing the structure variables were acquired through interviews (organizational change model), administrative records (unit census, operating beds), questionnaires (nurse staffing patterns, care delivery model, unit communication, baseline measures for patient outcomes), and chart abstraction (baseline patient characteristics). Process data were acquired through chart abstraction and outcome data through administrative records (LOS, readmission, cost) and questionnaire (subjective patient outcomes, subjective nurse outcomes).

SETTING

The sample comprised hospitals, selected patients within those hospitals and nurses providing care to the sampled patients. To control for hospital level factors known to influence patient and system outcomes, such as bed size, teaching status and geographic location (urban, non-urban), data were collected from patients admitted to 19 urban teaching hospitals in Ontario (OCOTH hospitals). Limiting participation to these sites reduced any variation in patient, nurse and system outcome that may be due to hospital level factors.

PATIENT SAMPLE

To control for variation due to disease processes, patients from specific Case Mix Groups (CMGs) were selected on the basis of volume, variable outcome, and probable sensitivity to nursing intervention. As an initial screening for conditions with varied responses to management patterns, for high volume CMGs currently admitted to OCOTH hospitals, a set of CMGs were selected that demonstrated substantial variation in length of stay. Some additional CMGs were also included where evidence demonstrated varied post-discharge outcomes. From these groupings, the final set of study CMGs were selected if they represented conditions that involved a high degree of nursing intervention, or where nursing interventions related directly to expected outcomes (eg. where education of the patient is key to positive outcome). The CMGs selected include:

- simple pneumonia,
- chronic obstructive pulmonary disease,
- major intestinal and rectal surgical procedures,
- major non-cancer related gynaecological and uterine procedures,
- vaginal deliveries,
- pediatric asthma and bronchitis.

Patients were eligible for participation if they were admitted to an inpatient unit with one of these diagnoses, and they consented to participate.

The patient sample size was estimated on the basis of expected effect size, use of hierarchical and repeated measures regression, and expected attrition rate. Effect size was estimated on the basis of prior research with the selected outcomes measures (Irvine et al., 1999) and with related outcomes (O'Brien Pallas et al., 1997). R2 values from .16 to .22 in prior research for the patient outcomes of interest suggest a moderate effect size. Based on the lowest effect size (.19), a maximum of 25 predictor variables used in hierarchical regression, and separate analysis of each CMG, a minimum sample size of 142 cases per CMG were required to achieve a power of .80 at an alpha of .05. An attrition rate of 30% was expected during follow-up data collection. In addition, a 20% adjustment was added to account for the increased variation expected due to the use of multiple hospitals from which the patients were drawn. Therefore, a minimum sample of 240 cases per CMG was sought across the hospitals.

NURSE SAMPLE

Nursing personnel (i.e. Registered Nurses, Registered Practical Nurses) were recruited if they (1) worked at least 20 hours a week, (2) had been employed on the unit for 6 months, and (3) agreed to participate in the study. The nurse sample required was based on a different analysis structure. Analysis of nurse outcomes does not include individual patient characteristics from the selected CMGs because nurses look after a mix of patients in any given shift. Therefore, a measure of overall patient complexity on the nurse's unit was used to control for the effects of the patient population. Nurse outcomes were measured at a single point in time and related to workplace variables. Previous analysis suggested a moderate effect size for the outcomes of interest (Irvine et al., 1999). Based on a moderate effect size (eta =.10), power of .80 and an alpha of .05, a sample size of approximately 12 nurses per unit was required for these analyses.

Data Elements

Data requirements comprised system inputs (organizational, unit, nurse and patient characteristics), process (patient care, organizational unit management) and outcomes (patient, nurse and patient-related system outcomes). "System inputs" included the organizational change model(s) utilized by each hospital and the approximate time since initiation. Possible models were downsizing, restructuring, and reengineering (Leatt, et al., 1997). It is recognized that these models can co-exist within the same hospital and may have been initiated at the same or different points in time. The model(s) currently in use at each hospital were determined through interviews with senior executives and were based on the criteria defined by Leatt et al. (1997). Care delivery model were determined through questionnaires completed by the unit managers, based on the criteria for care delivery model defined by McGillis Hall (1999). Staff mix and staffing level (nurse to bed ratio, nurse to patient ratio) for each study day and shift were determined from administrative data obtained from the unit manager. System outcomes included caregiver burden (Caregiving Burden Scale-Oberst, Thomas, Gass & Ward, 1989) and cost of patient care (nursing personnel hours and costs). "Patient input" data included age, gender, education, primary diagnosis, secondary diagnoses acquired through abstraction of the patient record, and measurement of baseline health outcome status and demographics (questionnaire). Patient outcome data includes several subjective

outcomes with previously established sensitivity to illness and patient care. These included symptom control (Brief Pain Inventory - Cleeland, 1991) functional status (Functional Independence Measure - Hamilton, Granger, Sherwin, Zielezny & Tashman, 1987; Inventory of Functional Status After Childbirth - Fawcett, Tulman & Meyers, 1988); patient satisfaction (Patient Satisfaction Scale-La Monica, Oberst, Madea & Wolfe, 1986), and patient costs (Time away from work). Patient and patient-related outcomes were measured at baseline (admission), discharge and six weeks following discharge using self administered questionnaires. The follow-up questionnaire was administered by mail with telephone follow-up for non-respondents. "Nurse input" data included the nurse's age, gender, years in practice, years on the study unit and with the hospital, and education. Nurse outcomes included stress (Stress in General Scale; Smith et al., 1992), job satisfaction (Job in General Scale; Ironson, Smith, Brannick, Gibson & Paul, 1989), and role tension (Role Tension Index; Lyons, 1971). These data were measured by questionnaire at a single point in time, at the beginning of the study.

Procedure for Data Collection

The study received ethical approval from the Human Subjects Committee of the University of Toronto in June, 1998. Following the development of the contract agreement with OCOTH in August, 1998 the researchers were able to begin the process of approaching the study hospitals for permission to conduct the research. The sites were asked to identify a contact person or "site coordinator" who would act as a liaison with the research team. Once these site contacts were identified, the research coordinator, hired in mid-August, 1998, began the process of contacting each site to determine the process for obtaining ethical approval to conduct the research.

RESEARCH ETHICS APPROVAL PROCESS

Ethical approval also had to be obtained from each of the study sites. The process for obtaining approval to conduct the research proved to be quite complex, varied substantially among the study hospitals, and took place over a period of eleven months. For example, despite having ethical approval from the Human Subjects Committee of the University of Toronto, the researchers were required to obtain this same approval from each of the other academic centres in the study (e.g. University of Western Ontario in London, Queen's University in Kingston, and McMaster University in Hamilton). Only three hospitals accepted the university review and provided an expedited review of the study. In the other sites, it was necessary for the researchers to submit the research study protocol to the individual research ethics boards of each of the hospitals for a full ethical review process.

Also, in some settings, it was necessary to receive approval from a Nursing Research Review Committee or a Patient Care Program within the hospital, prior to consideration by the hospital ethical review board. This process resulted in substantial delays to the project since the ethics review committees often meet monthly or less frequently. As well, for the majority of sites, the research team was required to address specific questions identified by the reviewers. Following submission of these responses, the researchers were required to wait for final approval from the research ethics board to begin the study. Each of the hospitals required that a hospital-

specific research ethics board form be completed by the researchers along with obtaining a number of accompanying signatures. As well, most of the hospitals required that the "letters of information" for the study, and the "consent forms" be adjusted to meet the specific requirements of that study hospital, often on their own hospital stationary. This also contributed to considerable delay in getting the project started.

Finally, substantial unexpected costs were incurred related to photocopying, postage, and translation for this process. All of the hospitals required multiple copies of the entire study protocol, their hospital-specific REB form, and the consents/letters on their institutional letterhead. As well, one of the sites required French translation of the letters of information, patient consents, and some of the study questionnaires.

ESTABLISHING ON-SITE DATA COLLECTORS

As part of the agreement with each of the individual hospitals, on-site data collectors were provided by each site for a seventeen week time period. The research team provided guidelines related to the skill requirements needed in these roles, and each of the hospitals in the study selected the individuals. These on-site data collectors represent the "in-kind" support for the study provided by each of the hospitals. Each hospital made individual arrangements for these data collectors based on the (a) sample size requirements for data collection for the study site, (b) number of units that the data collectors were required to go to, and (c) the number of geographical hospital campuses that the data collectors have to access. Thus, employment arrangements for the data collectors varied among sites.

ORIENTATION OF DATA COLLECTORS

Prior to beginning the research study in each of the hospitals, the site coordinators and on-site data collectors were brought together for a two-day orientation session on January 7 and 8, 1999. Representatives from all but one hospital attended the workshop. Participants were welcomed by Jean Reeder, PhD, who at that time was Chairperson of the OCOTH Chief Nurse Executive Council and a member of the Advisory Working Group for the study, and Patricia Petryshen PhD, Co-Chair of the Advisory Working Group for the study. As well, Elizabeth Carlton from the Ontario Hospital Association greeted the participants. The principal investigators and research coordinator provided an overview of the development of the research study and the process involved in the data collection for the study. The orientation session involved "hands-on" experience with the surveys and questionnaires to be administered as part of the research process, and opportunities for group problem-solving on situational examples. A session on problem-solving focussed on specific scenarios that the data collectors might encounter in the process of data collection.

Feedback from the on-site coordinators and data collectors about the session was positive:

"good working group, a lot of excellent questions and concerns";
"this meeting will help facilitate a much more successful study result and outcome";
"this was excellent. Thank you for the organization of the program. I felt this was very helpful and I am pleased to be part of such a dynamic, professional process".

As follow up to the workshop, a more detailed "Data Collection Manual" was developed and sent to each of the sites.

SITE VISITS BY RESEARCH COORDINATOR

One of the first stages in the research process involved the research coordinator visiting each of the study hospitals to meet with the unit managers of the participating study units. This process was usually planned with the site coordinators who also participated in the meetings, along with the on-site data collectors. At the site visit, the research coordinator reviewed the steps in the research process and the data collection plan for each hospital. Opportunity was provided for response to any questions raised at these meetings. A mechanism for communication with the research coordinator and research team was also identified.

Staff from each site who attended these meetings varied at each hospital but included the Senior Nursing Officer, Unit Managers, Care Coordinators, Clinical Nurse Specialists, and Nurse Educators. Attendance varied from 4 to approximately 15. If a hospital has multiple sites, they were all invited to the same meeting to ensure consistent communication. The purpose of the meeting was to share information about the study and its operationalization. It provided an opportunity for dialogue about the research, role clarification, and next steps to enable data collection to begin.

Information shared at the site meetings included:

- confirmation of units involved in study
- confirmation of sample size required
- determination of concurrent research underway at the sites
- discussion of unit-specific situations which might impact patient or nurse recruitment (e.g. plans for closure or relocation of unit during study period, changes in number of beds, changes in leadership, etc.)
- identification of processes to minimize the burden of participation on unit staff and acknowledge their contribution to the study

CONCURRENT RESEARCH STUDIES

All hospitals involved in this study had concurrent research underway during the data collection period for this research. In most situations, the research team was able to negotiate start dates on each unit which would minimize the confounding effect on staff or patients. However, in one case the research team was unable to include an appropriate study unit because of another research study. In this situation, the sample was recruited from other units in that hospital.

Data Collection Process

NURSES AND PATIENTS

Timing of the data collection varied among the hospitals since each site started at a different time depending upon the (a) notification by the individual research ethics board of approval to conduct the study, (b) hiring of the on-site data collector, and (c) site visit by the research coordinator.

Nurses in the hospitals selected were asked to complete a survey to determine their perceptions of the organizational change strategy employed by the hospital, the processes utilized to support or facilitate the implementation of the organizational change strategy, and outcomes of these change strategies.

To enable the research team to monitor the progress of each individual hospital towards achieving the sample size requirements for the study, the on-site data collectors submitted a bi-weekly progress report to the research coordinator. These reports are reviewed by the principal investigators and the research coordinator and problem-solving approaches developed to assist in achieving the desired sample. Potential problem areas were also discussed with the project advisory committee. For example, early in the data collection process all of the hospitals identified difficulty in obtaining the sample requirements for the pediatric patient population selected for inclusion in this study. A number of factors appear to have contributed to this: (a) a change in treatment protocol for pediatric asthma patients from the time that the study was designed, from in-patient to ambulatory care, resulting in fewer admissions; (b) dramatic warmer weather over the winter which led to less need for pediatric asthma admissions to hospitals; and (c) greater specificity in the diagnostic labels given to children admitted with respiratory diseases (e.g. respiratory distress, reactive airway disease, wheeze). This indicated that the sample size requirements for the pediatric asthma population may not be achievable for this study and that the findings related to this patient group may be limited. On discussion with the advisory committee, it was decided the pediatric component of this study may not be feasible.

UNIT MANAGERS

Unit managers in the hospitals selected were asked to complete a survey to determine the unit level structural and system processes employed to support or facilitate the implementation of the organizational change strategy, and the distribution and care responsibilities of the staff mix employed on patient care units within these hospitals. The data provided on the organizational change strategies were used to categorize the change model as described above. The data on the distribution and responsibilities of staff were used to categorize the *patient care delivery model* according to the defining criteria of a substitution or complementary model of patient care (McGillis Hall, 1997). Data pertaining to the characteristics of the patient care unit: (1) the overall mix of staff employed; (2) the mix of staff by shift of work; (3) the staff to patient ratios by shift; (4) unit bed capacity; (5) average census during the data collection period; (6) average percentage occupancy during the data collection period; (7) average patient length of stay; (8) case mix of patients housed on the unit; and (9) the nursing care delivery model, was also requested. Some of these data were obtainable from the middle managers and others were obtainable from hospital medical records (i.e., average resource intensity weights (RIW) by patient unit for the study days).

SENIOR EXECUTIVES

Senior executive personnel including chief executive officers (CEO), chief nursing officers (CNO), and Human Resources department executives within each hospital were interviewed to create a chronology of the hospitals restructuring initiatives and to gather data on the implementation of these initiatives. The interview included open ended questions about the goals and tools of the strategies. In addition, a number of close ended questions were asked of these senior leaders to assess the similarities and differences in views about strategies between different teaching hospitals. Items for these questions come from a review of literature on downsizing strategies that was undertaken by two of the co-investigators (Leatt et al., 1997). In addition to interviews, these strategies were cross referenced to various organizational documentation which have been reviewed, including strategic and operational plans and documents on specific change initiatives. Rather than ask hospital leaders to identify the change strategy adopted by their organization, data were collected on the extent to which different behaviors and changes provide evidence of different types of change strategies (e.g., downsizing, re-engineering or restructuring). Each hospital's change strategy was then categorized according to the defining characteristics proposed by Leatt et al. (1997). The interview process related to the organizational change strategies that are used by each of the hospitals was pilot tested in April, 1999 at two community hospitals and refined following completion of that pilot. The study interviews with the senior executives were conducted during the late spring and summer of 1999.

NURSING WORKLOAD

To provide information regarding nurse costing for the study, each site was asked to provide individual patient and unit-level nursing workload data. The two components of workload data utilized are comprised of:

- a daily calculation of the "total nursing workload" for the entire nursing unit (which included all patients on the unit), and
- the "individual patient nursing workload" scores for each of the patients included in the study.

The "total nursing workload" score was to be computed by summing the nursing workload scores for all of the patients on the unit on a given day; while the "individual patient nursing workload"score was obtained from the nursing workload measurement system employed on the unit. These nursing workload data were to be collected for every day of the study. Since nursing workload measurement systems may differ among hospitals making comparability of these data a challenge, the specific nursing workload measurement system utilized in each site was also identified.

NURSING COSTS

Once the patient-specific sample had been determined, all hospitals participating in the study were asked to provide individual patient case cost data and unit-level nurse costing data for the patients and patient care units included in the study.

Hospital sites that were able to provide patient-specific case costs (i.e., case costing hospitals), were asked to provide

- the total hours and costs of unit producing personnel (UPP) and management and operating support (MOS) personnel for each patient who participated in the study.

As well, all hospitals were asked to provide

- total hours and cost for registered nurses, and registered practical nurses for units participating in the study.

Initial written requests were made in February, 2000, followed by a second request in June, 2000 and final telephone followup in September, 2000.

HOME CARE COSTS

Data collection of home care costs proved to be a challenge for the research team. Specifically, the tracking of home care costs is not being done consistently across the province at this time. Originally the research team planned to obtain these data from the Community Care Access Centres. However, major issues have been noted recently with the accuracy and validity of the data that are available. Although the Ontario government is developing a standardized reporting format for home care data, this will not be available during the life of this research study. Therefore the research team decided on the option of asking patients additional information in the follow-up phone calls, which included four additional phone calls to patients. However, this mechanism did not elicit a large enough sample to determine any assessment of home care costs.

Ongoing Study Communication

A number of communication mechanisms were developed for this study to address communication among the study sites, as well as dissemination of information about the study to stakeholders and interested parties within the health care community as the study progressed. First, all of the on-site data collectors and site coordinators had access to e-mail and telephones, and were encouraged to use these to communicate with the research coordinator or principal investigators as desired. The e-mail addresses and telephone numbers were included in the newsletter to facilitate linkage among the study sites. The e-mail mechanism became so popular that the research coordinator developed an ongoing "questions" and "answers" forum where commonly asked questions were shared with the group, to help them problem-solve issues that may arise throughout the progress of the study.

Second, a newsletter was developed for distribution to the study hospital sites and to interested stakeholders. The newsletter provided an overview of the study and the progress achieved at different points in time throughout the study time frame. The content for the newsletter was developed by the research team and provided to the Public Relations Department of the OHA. As part of the in-kind support for the study provided by the OHA, the Public Relations staff formatted the newsletters and provided editorial advice, prior to each publication.

Finally, the research team established a mechanism for ongoing communication with the advisory committee for the study. In association with a liaison person from the Ontario Hospital Association, regular meetings and conference calls were held to discuss progress on the study as well as specific issues that had emerged throughout the study process. The advisory group designated one member to deal with specific day-to-day study issues with the research team (e.g. inability to meet pediatric sample size requirements), and another to manage any issues that are of a broader nature (e.g. desire for new sites that had become part of OCOTH to join the study once the study was already underway).

On-site Data Collectors conducted two or three inservice sessions on each unit to familiarize staff with the study prior to contacting randomly selected nurses individually about participating in the study. A thank-you/reminder note was sent by the Data Collectors to all nurses who had received a questionnaire one week after the initial distribution, and a duplicate questionnaire one week later. The survey was pilot tested prior to going to the field.

Pilot Study

The pilot study was conducted for the purposes of (a) establishing the feasibility of the data collection methods, and (b) clarifying the procedure for extracting secondary data from the participating units. The pilot study sample consisted of 3 Unit Managers, 25 patients and 25 nurses who met the study inclusion criteria. Respondents were asked to complete the questionnaires in the presence of the Research Coordinator who monitored (a) difficulties encountered by the participants in responding to any of the questionnaire items; (b) reasons for the reported difficulties; (c) clarity of instructions and appropriateness of the wording; (d) omissions, and (e) extent of effort required to complete the questionnaire.

There appeared to be very few difficulties with completion of the questionnaire items on the part of the unit managers. Registered nurses found the questionnaire very long to complete. For that reason, the research team decided to separate the questions on the patient care process and organization of nursing services from the multi-item scales assessing communication, coordination, unit effectiveness, job satisfaction, job stress, and perceived role tension. In the main study, the patient care process and organization of nursing services questions were completed in a unit meeting with representation from eligible RNs and RPNs. Individual nurses who had been randomly selected to participate in the study were then given a questionnaire package for completion of the multi-item scales. This change was intended to reduce the response burden among staff nurses and promote optimal participation among the nurse sample.

For the most part, the research team was satisfied with the performance of the study instruments in this small pilot test. The following revisions to the data collection plan were made following the results of the pilot study.

- Because of very little variability on the social-cognitive items for the FIM, it was decided to only include the motor items in the main study.
- Because of respondent burden during the first 24 hours of admission and/or surgery, the baseline assessment was extended from 24-48 hours to 24-72 hours.
- Because obstetrical patients felt it important to differentiate their satisfaction with nursing care during labour from their satisfaction with nursing care during the post-partum experience, two separate sets of questions for women to respond to concerning these hospital experiences were developed.

Instruments

PATIENT OUTCOMES

Demographic data was collected on patients' age, gender, education, income, primary diagnosis, and secondary medical diagnoses.

FUNCTIONAL HEALTH OUTCOMES

Multiple measures of *functional status* were used for the following reasons. A "condition specific" measure was used to assess functional status for the vaginal delivery subjects (Inventory of Functional Status after Childbirth) and the pediatric subjects (Functional Status IIR). In order to enhance the internal validity of the research findings, two measures and two sources of data collection were used in order to collect the data on the functional health outcomes of the adult medical/surgical patients. This enhanced our confidence in the findings and enabled an evaluation of the feasibility and validity of the different measurement approaches. While not a primary objective of the study, these data may provide useful information for the development of an outcomes monitoring tool that could be used by provider agencies for ongoing quality assessment.

Change in the patient's functional health outcomes were assessed with the *Functional Independence Measure (FIM)* (Hamilton et al., 1987), which was completed by the data collector, and the Medical Outcome Study SF-36 (Stewart & Kamberg, 1992), which was completed by the patient. The FIM and SF-36 were completed by the adult medical-surgical subjects within the first 72 hours of admission, five to seven days later, and again after 6 weeks. At the six week follow-up, the FIM and SF-36 were administered by a telephone interview.

The *FIM* is a rating scale applicable to patients of all ages and diagnoses (McDowell & Newell, 1996). It consists of 18 items, measuring activities of daily living (e.g., eating, grooming, bathing, dressing), sphincter control, transfers (e.g. bed to chair, toilet), and locomotion (e.g. walking). The researchers expected the self-care and mobility subscales would be more relevant for the patient populations in this study and more applicable to nursing interventions than the communication and social cognition subscales. With the exception of the locomotion subscale, internal consistency reliability coefficients have been reported as above 0.90 (Dodds, Martin, Stolov & Deyo, 1993). The validity of the FIM has been established, including its ability to reliably detect and measure changes in functional status over an acute hospital stay (Emhoff, McCarthy, Cushman, Garb & Valenziano, 1991; Mortifee, Busser & Anton, 1996).

The *SF-36* (acute form) is a 36 item scale measuring eight health domains: physical functioning, vitality, role limitations due to physical health, role limitations due to emotional problems, social functioning, bodily pain, mental health, and general health perceptions. It measures both ends of the health continuum. The SF-36 was originally developed for use among ambulatory adults with medical problems and all scales have been shown to be sensitive to minor versus major medical problems and to psychiatric problems (McHorney, Ware, Rogers, Raczek & Lu, 1992; Ware & Sherbourne, 1992; Ware, Snow, Kosinski & Gandek, 1993; Wu, 1991). Internal consistencies were reported by Ware et al. (1993) as ranging from .93 to .78. O'Brien Pallas et al. (1997) used the physical function scale in a study of patients receiving home nursing services in the Metropolitan Toronto area and reported internal consistency reliabilities of 0.92 and 0.94 at admission and discharge respectively. The MOS instrument was sensitive to a change in the physical function of home care patients over a four week period (O'Brien-Pallas et al., 1997). In their review of the instrument, McDowell and Newell (1996) concluded that the MOS instrument should be considered for use in relatively healthy populations, such as the patient populations in this study.

Vaginal delivery patients completed the *Inventory of Functional Status After Childbirth (IFSAC)* (Fawcett et al., 1988). The IFSAC contains 5 subscales designed to measure the mothers' readiness to assume infant care and to resume self care, household, social, community, and occupational activities following childbirth. Internal consistency reliability as measured by Cronbach's alpha ranged from 0.51 to 0.78 for the five subscales. The IFSAC was completed by the mothers at 6 weeks post discharge.

The *Functional Status II(R)* (FS II(R)) was modeled on the Sickness Impact Profile (Bergner, Bobbitt, Carter & Gilson, 1976; Gilson et al., 1975). The inventories measure behavioural manifestations of illness that interfere with social role performance in three sites (home, neighborhood, and school) (Stein & Jessop, 1990), with locomotion, and with age-appropriate activities of daily living. Behavioural statements for the FS II(R) were created for one of four age categories: infants (0-9 months), toddlers (9-23 months), preschoolers (2-5 years), and school age children (>5 years). In this study, we used the 14 item version of the FS II(R) which is composed of a group of core items that are applicable across the entire age range. Stein & Jessop (1990) reported a Cronbach alpha of 0.87 for all age ranges. Evidence of discriminant validity of the longer 43 item version was demonstrated by significant differences in FS II(R) dimension scores between well children and children with a health condition (Stein & Jessop, 1990). Significant correlations were reported between the FS II(R) 14 item scale and days in bed over the past two weeks, days absent from school, and days hospitalized in the last 6 months.

PAIN

Pain was assessed with the *Brief Pain Inventory - Short Form (BPI-SF)* (Cleeland, 1991). The BPI-SF measures the severity of pain and its impact on the patient's functioning. Reliability for English, French, and Chinese versions of the BPI have consistently been above .85 (McDowell & Newell, 1996). Components of the BPI were recently adopted by the American Pain Society Quality of Care committee as one of the outcome indicators for monitoring the quality of pain management (American Pain Society Quality of Care Committee, 1995). Pain was assessed within the first 48 hours of admission (approximately 8 hours postpartum for the obstetrical patients), five to seven days later, and after 6 weeks.

System Outcomes

QUALITY OUTCOMES

(A) Patients - Patient Perceptions of the Quality of Nursing Care

Patients' perceptions of the quality of nursing care was measured with the nursing care quality subscale of the Patient Judgement of Hospital Quality Questionnaire (PJHQ) (Rubin, Ware & Hayes, 1990). The nursing care quality subscale of PJHQ consists of 5 items in which patients are asked to rate on a 5 point scale the quality of care received from nurses during their hospital stay. The subscale was found to be highly reliable (alpha 0.94) in a study of in-patients from a large tertiary care teaching hospital in southern Ontario (Irvine et al., 1999). Support for construct validity was demonstrated by significant correlations between the patient's judgement of the quality of nursing care and the number of patients assigned to the nurses' care, the proportion of RN staffing, the quality of unit communications and patient education (Irvine et al., 1999). Patients were asked to complete the PJHQ on the day prior to discharge from hospital.

(B) Patients - Secondary Outcomes

Unit-level data were collected on patient falls, medication errors, wound infections and urinary tract infections. Consistent definitions for each of these variables were developed with the input of the on-site study coordinators, prior to these data being abstracted by the hospital Health Records Departments.

(C) Nurses - Perceived Effectiveness of Care

A measure of nurses' perceptions of the effectiveness of the care provided on the unit and the capability of the unit to meet the needs of the family members was obtained using the *Perceived Effectiveness of Care Questionnaire (PECQ)*, a scale developed by Shortell, Rousseau, Gillies, Devers & Simons (1991). Cronbach's alpha reliability estimates for this scale among a sample of nurses was 0.85 (Irvine et al., 1999). Construct validity for the scale was supported through factor analysis (Shortell et al., 1991). In a study of nurses in southern Ontario, Irvine et al. (1999) reported a significant negative relationship between the effectiveness of care measure and nurses' experience of role tension.

(D) Nurses - Unit Communication and Coordination

Unit communication and coordination was measured with an instrument developed by Shortell et al. (1991). Unit communication was measured along a number of dimensions including openness, accuracy, timeliness, understanding and satisfaction. Shortell et al. (1991) reported reliability based on Cronbach's alpha ranging from .64 to .88. Irvine et al. (1999) found a Cronbach alpha of .85 for the total scale. The quality of unit communications was related to the proportion of RN staffing, job autonomy and role tension (Irvine et al., 1999). Unit coordination is measured by five items related to written plans and schedules, treatment protocols, policies and procedures, unit director's efforts, and face-to-face interaction. Shortell et al. (1991) reported a Cronbach alpha of .80 while Irvine et al. (1999) reported a Cronbach alpha of .77. Unit coordination was positively related to job autonomy and negatively related to the nurses' role tension (Irvine et al., 1999).

COST OUTCOMES

(A) Nurse - Costs

Patient specific nursing costs were to be determined by utilizing hospital-based nursing workload data and unit-level cost data related to nursing hours expenditures. Nursing workload measurement data was intended to reflect the nursing resources required to accomplish all tasks performed by nursing personnel in a given functional centre (JPPC, 1997). Nursing workload and cost data for unit producing personnel on the selected nursing inpatient units which house the case mix employed in this study were examined for comparability with each hospital.

(B) Patient - Costs to the Patient

Data were collected on the following indirect social costs: length of time taken to return to gainful employment (if employed outside of the home), days lost from work over the six week period post discharge (if work has been resumed), and caregiver burden.

(C) Patient - Length of Time to Return to Usual Employment

At the six week follow-up patients were asked if they have returned to their usual level of employment. If they indicated yes, the exact date of return to employment was noted. If individuals resumed employment either through modified work or part-time, instead of full-time work when full-time was their pre-illness pattern, then this was noted. If patients had not yet returned to full employment, they were contacted again in 4 weeks time and asked the same questions concerning if and when they resumed employment outside of the home.

(D) Patient - Caregiver Burden

Oberst et al. (1989) developed the *Caregiver Load Scale (CLS)* to measure care giving demands for chronically ill populations. The CLS is a self-report measure developed to quantify the time and energy family members expend in caregiving activities (e.g. personal care, assistance with mobility, additional household tasks). Coefficient alpha for the total scale was 0.87 (Oberst et al., 1989). Evidence of construct validity was provided by significant correlations with the degree of patient dependence ($r=0.53$, $p=0.001$) and length of time the patient received radiation ($r=0.35$, $p=0.016$). The CLS has been used in a study of family caregivers in cases of hip fracture and demonstrated good reliability (.78, .82, .85 for repeated administrations) and sensitivity to change over an 8 week period (Williams, Oberst, Bjorkland & Hughes, 1996).

Nurse Outcomes

Nurses recruited into the study were asked to complete a demographic profile, the Stress in General Scale, the Role Tension Scale and a measure of job satisfaction. As well, data related to the number of work-related injuries on a patient care unit were obtained (e.g. needle sticks, etc.) Registered Nurse participants were asked to provide the following information: age, current marital status, gender, work status, position title, length of time employed in nursing, length of time employed at present hospital, length of time employed in present role, highest level of education obtained, and average hours worked per week.

NURSING JOB STRESS

A measure of nurse's job stress was obtained using the *Stress in General Scale (SIG)* (Smith et al., 1992). This instrument is comprised of 18 items that measure global judgments of job stress. Cronbach's alpha over four study samples was reported as ranging from .91 to .92. Convergent and discriminant validity have also been reported.

NURSING ROLE TENSION

The strain or tension experienced by nursing staff in response to their work was measured by the nine item Tension Index developed by Lyons (1971). This instrument had demonstrated internal consistency (split-half correlation coefficient: .70) and construct validity as evidenced by negative correlations between role strain and job turnover, propensity to leave, and perceived role clarity (Lyons, 1971).

NURSING JOB SATISFACTION

Registered Nurse perceptions of overall job satisfaction were obtained using the global satisfaction measure from the Job Descriptive Index (JDI), the *Job in General (JIG) Questionnaire* (Ironson et al., 1989). This scale is comprised of 18 items for which the respondents are asked to indicate how they would describe their job in general. The JDI had been widely used in studies of satisfaction with Cronbach's alpha reliabilities of .88 across six recent studies. Convergent validity was acceptable when this scale was correlated with four other general scales of job satisfaction (Ironson et al., 1989). McGillis Hall (1999) reported Cronbach's alpha of .94 on a sample of 306 nurses.

Data Analysis

Several preliminary steps were undertaken before conducting the statistical analyses on this large data set, obtained from different sites (i.e., 77 wards/units located in 19 hospitals across the province) and from different sources (i.e., patients, nurses, and unit managers), on multiple variables of interest. The purposes of the preliminary steps were to maintain the accuracy of the data and to address effectively the issues of missing data and measurement error, which may adversely influence the results. The preliminary steps are presented in sequential order.

DATA ENTRY ERROR

Data entry error could occur for several reasons, such as unclear response (for example, circling two response options for the same item) and human mistake in transcribing the coded data. Such error can adversely affect the accuracy of the data set and potentially, the validity of the study conclusions. The potential for data entry error was minimized by: 1) developing decision-rules for addressing unclear responses, 2) following the coding scheme to maintain consistency of the data upon entry, 3) reviewing the raw data (i.e., forms completed by respondents) when inconsistency was suspected and correcting the questionable value accordingly.

HANDLING MISSING DATA

The issue of missing data (i.e., cases with incomplete data or responses) is problematic in multivariate analyses, particularly when different subgroups of cases have incomplete data on different subsets of variables. The number of cases available for analysis is reduced, which decreases the statistical power to detect significant effects or correlations; this, in turn, potentially leads to type II error (Ward & Clark, 1991).

The percentage of missing data varied from 0% up to 6%, for the variables of interest in this study. Although these percentages are usually considered relatively low for any one variable, they could be additive across all variables to the used in the multivariate analyses, potentially lowering the sample size and the statistical power. To minimize the likelihood of this potential problem, three strategies were used to handle missing data at different levels of analysis.

First, missing values on items comprising a multi-item scale were replaced by imputing the person's mean score on the remaining scale items with non-missing data, or by imputing the value representing a "neutral" response option. The selection of the strategy to use for a particular scale was based on the recommendations given by the tool developer in the scale scoring manual. For instance, the individual mean score imputation was used to handle missing data on the MOS SF-36 scale.

Second, missing values for the total scale were addressed by a strategy which consisted of computing the total scale score as the sum or the mean of the items with complete responses. This strategy is based on the theory of measurement stating that all items are equal and interchangeable indicators of the concept being measured (Figueredo, McKnight, McKnight & Sidani, 2000). This strategy was used for most multi-item scales, since computing the total scale score as the mean or sum of the items comprising it was the formula recommended by the tool developer.

RECODING OF ITEMS

Some multi-item scales incorporate negatively worded items in order to reduce acquiescence or response bias. These items should be recoded in a way that would maintain consistency in the scoring scheme across all items comprising the scale. Consistency in scoring scheme is essential for avoiding measurement error (i.e., low internal consistency reliability) and for facilitating the interpretation of the total scale scores and subsequently the accuracy of the study conclusions. Items were recoded, using the scheme recommended in the scale scoring manual. The accuracy of the recoding was checked by comparing the frequency distribution of the scores on the initial and the recoded items.

ASSESSING THE RELIABILITY OF MEASURES

Measurement error or unreliability of measures presents a major threat to the validity of statistical conclusions. It increases random or error variance, which decreases the statistical power for detecting significant effects or correlation, potentially leading to type II error (Cook & Campbell, 1979). In this study, unreliability of measures could results in attenuation of the parameter estimates (i.e., correlation coefficients or b-weights) (Cohen, 1982).

The reliability of measures used in this study was enhanced in two ways. First, the instruments selected to measure the variables of interest were well-established; they have demonstrated reliability and validity in previous studies involving various patient populations that are similar to those sampled in this study. Second, the internal consistency reliability of multi-item measures was assessed. The mean inter-item correlation, the item-to-total correlation coefficients, and the Cronbach's alpha coefficient were examined and compared to the criterion/standard values.

All multi-item measures showed acceptable internal consistency reliability (see Tables 1 and 2). Thus, the extent of error/measurement variance was considered minimal and the validity of the statistical conclusions was enhanced. The reliability results enabled us to proceed to the next preliminary step (i.e., computing total scale scores based on the scores of the individual items comprising the scale) with confidence. It should be also noted that the content of multi-item measures was acceptable to the various patient populations represented in this study sample, as evidenced by the relatively low percentage of missing data.

RELIABILITY OF THE PATIENT OUTCOME MEASURES

Table 1

MEANS, STANDARD DEVIATIONS, AND CRONBACH ALPHAS FOR MULTI-ITEM MEASURES

Scale/Subscale	Time 1 Mean, (Standard Deviation) Cronbach Alpha	Time 2 Mean, (Standard Deviation) Cronbach Alpha	Time 3 Mean, (Standard Deviation) Cronbach Alpha
		Medical Surgical Sample	
		Medical-Short Form (SF-36)	
Physical functioning	34.21 (33.81) 0.95	26.57 (21.29) 0.87	61.49 (27.38) 0.90
Role-physical	37.27 (43.23) 0.91	6.48 (18.20) 0.73	43.09 (41.64) 0.87
Bodily pain	50.07 (31.82) 0.99	40.37 (26.37) 0.99	67.99 (24.87) 0.99
General health	65.80 (24.08) 0.79	67.31 (23.60) 0.81	68.31 (24.58) 0.80
Vitality	39.49 (27.06) 0.84	29.40 (20.50) 0.78	50.77 (24.26) 0.85
Social functioning	58.47 (34.21) 0.82	37.24 (30.05) 0.76	74.37 (28.79) 0.86
Role-emotional	62.51 (43.17) 0.88	67.71 (43.48) 0.92	80.20 (35.96) 0.89
Mental health	68.39 (20.69) 0.80	73.80 (19.60) 0.81	78.73 (18.94) 0.84
		Brief Pain Inventory	
Pain Intensity	4.56 (2.03) 0.87	3.40 (1.91) 0.90	2.79 (1.96) 0.92
		Functional Independence Measure	
FIM Total Score	48.12 (17.07) 0.87	76.26 (13.85) 0.88	86.47 (7.97) 0.87
		Caregiver Burden	
Caregiver demand			31.14 (10.59) 0.90
Caregiver difficulty			24.99 (10.41) 0.92
		Obstetrical Sample	
Brief Pain Inventory	4.53 (1.53) 0.75	3.34 (2.03) 0.90	2.67 (2.16) 0.90
Inventory of Functional Status After Child Birth		3.37 (.37) 0.93	
Satisfaction with Nursing Care	4.78 (.67) 0.88		
		Pediatric Sample	
Functional Status II(R)	19.64 (11.83) 0.86	21.71 (17.73) 0.99	

RELIABILITY OF THE NURSE OUTCOME MEASURES

Table 2

MEANS, STANDARD DEVIATIONS, AND CRONBACH ALPHAS FOR MULTI-ITEM MEASURES

Questionnaire	Mean (standard deviation)	Cronbach alpha
Nurses Work Satisfaction	36.09 (12.50)	0.91
Nurses Job Stress	29.46 (10.89)	0.88
Pressure	15.65 (4.72)	0.76
Threat	12.62 (7.06)	0.83
Nurses Role Tension	24.33 (5.88)	0.84
Communication Overall	48.88 (7.08)	0.86
Openness	15.88 (2.70)	0.83
Accuracy	17.66 (3.55)	0.78
Timeliness	15.35 (2.24)	0.66
Nursing leadership	27.18 (6.46)	0.9
Unit relations	14.24 (3.19)	0.84
Effectiveness of technical quality	23.29 (3.49)	0.83
Conflict management		
Problem solving	13.64 (2.79)	0.84
Avoidance	7.70 (2.21)	0.76
Effectiveness of coordination within unit		
Programming approaches	11.21 (2.29)	0.79
Individual approaches	16.28 (3.66)	0.75
Effectiveness of coordination between unit		
Programming approaches	10.39 (2.57)	0.87
Individual approaches	14.95 (4.22)	0.86

COMPUTING TOTAL SCALE SCORES

In this step, total scale or subscale scores were computed to quantify the variables of interest. The total scores were calculated based on the scores of the individual items comprising each scale or subscale, as recommended by the tool developer in the respective scale scoring manual. The subscales represented the different domains of the concept being measured.

The formulae for computing the total scores were those provided in the respective scale scoring manual. The formulae usually consisted of taking either the sum or the mean of the items' scores. The MOS SF-36 and the Caregiver Burden Scale required additional steps for computing total scores.

1) For the MOS SF-36, a transformed score was calculated for each subscale, based on the raw score for each subscale. The actual raw score was the simple algebraic sum of the scores on all the items comprising the subscale. The transformed score was then computed using the following formula:

Transformed score =
[actual raw score – lowest possible raw score/possible raw score range] x 100.

The actual raw score is the respondent's raw score obtained for the subscale (as described above). The lowest possible raw score and the possible raw score range were provided for each subscale, in the scoring manual.

2) For the Caregiver Burden Scale, a total burden score was computed by multiplying the total scores on the demand and the difficulty subscales scores, and then taking the square root value of the multiplicative term.

Once these preliminary steps were completed and the total scale scores for the multiple variables of interest were obtained for all subgroups of participants (i.e., patients, nurses, nurse managers), the data set was prepared for the multi-level analyses planned to address the study purposes.

MULTI-LEVEL ANALYSES

Multi-level analyses were appropriate for this study because the data were collected at different levels or unit of analysis, and one level was nested in the other (Bryk & Raudenbush, 1992). The levels of analysis represented in this study were: 1) individual level, where data were obtained from patients, caregivers, and nurses assigned to various hospital wards/units; and 2) hospital ward/unit level, where some data, representing the ward/unit characteristics, were obtained from the unit manager or other administrative bases in the hospitals. Thus, the individual patients and nurses were nested within the hospital ward/unit. Accounting for this "nesting" or multi-level effect is essential for improving the estimation of the effects of the hypothesized effects of variables measured on one level on outcome variables measured on another level (Bryk & Raudenbush, 1992).

This study was designed to determine the effects of changes in staff mix on patient, nurse, and system outcomes. The variables representing changes in staff mix were: the proportion of regulated to unregulated staff, an RN/RPN staff mix, and all RN staff mix, and a RN/RPN/URW staff mix. All of these variables were measured at the ward/unit level. In contrast, the patient, nurse, and system outcomes were measured at the individual level.

To enable the conduct of the multi-level analyses, it was important to maintain the outcome variables at the individual level of analysis. This necessitated the assignment of a value for each hospital ward/unit variable, for each individual patient and nurse, whereby individual cases assigned to the same ward/unit would receive the same value reflecting the actual value for their respective ward/unit. For instance, if the proportion of regulated staff on ward/unit A was 5, then the value 5 was assigned to all cases (patients, nurses) in that particular unit. The ward/unit value was of two types, depending on how the variable of interest was measured. The first type included a single item variable that could assume only one value provided by the unit manager. Staff mix and nursing care delivery model are examples of this type of variable. The one value obtained for the ward/unit was imputed for individual cases assigned to that unit. The second type included single- or multiple-item variables to which the staff on each unit responded. Thus, multiple values were available for each unit. Nurses' age, education, and experience are examples of this type of variable, and were controlled for statistically, before examining the effects of staff mix variables on the outcomes of interest. The multiple values were aggregated, using the mean function (i.e., mean of the values obtained across all staff assigned to the same ward/unit), in order to have a single value on these variables for each ward/unit. The ward/unit single value was then imputed for individual cases assigned to that unit. A comprehensive data set, including all variables with values maintained at the individual level, was generated for use in the multi-level analyses.

STATISTICAL TECHNIQUES

Different statistical tests/techniques were used to address the study questions. These are presented in relation to each research question.

- *Question 1:* What are the predominant models of staff mix within the Ontario academic health science centres/OCOTH hospitals?

Descriptive statistics were used to address this question. The frequency distribution was examined to identify the most commonly reported model of staff mix.

- *Question 3:* Is there are relationship between the professional mix of staff on inpatient units (i.e., proportion of regulated to unregulated staff) and patient outcome achievement (at the time of hospital discharge and at 6-weeks post discharge) cost and nurse outcomes?

- *Question 4:* Does the influence of staffing model on patient, costs, and nurse outcomes vary with the type of care delivery model (e.g. team nursing or total patient care)?

- *Question 5:* Do nurse staffing variables, such as the average nurse educational preparation, and average nurse experience level, explain variation in patient cost, and nurse outcomes beyond what is explained by differences in case mix, patient complexity, patient age, and functional health status at admission?

Questions 4 to 5 listed above are interrelated, hierarchical, building on each other, and involve variables that have been measured at different levels of analysis.

They were addressed simultaneously, using the HLM approach to data analysis (Bryk & Raudenbush, 1992). As mentioned previously, HLM is the most appropriate approach for analyzing multi-level models, particularly in organizational research, where dependence among individual responses within the same ward/unit and/or organization is present and should be accounted for. HLM involves pre-specifying two or more level models and conducting the analyses accordingly, typically using regression-type analyses. The regression parameters can be estimated for relations occurring within each level and across levels.

The HLM models specified here involved two levels: 1) the individual respondent level, and 2) the hospital ward/unit level. The two levels accurately represented the relationships to be investigated, based on the research questions. The individual respondent level included the patient, nurse, and system outcomes. The ward/unit level included variables reflecting the characteristics of the unit that could influence outcome achievement; these were: staffing variables, professional mix of staff, and staffing model, as specified in the research questions. The variables reflecting communication, coordination, nursing leadership, and perceptions of the quality of care were handled in two ways. When examining the effect of these system variables on nurse outcomes (e.g. job satisfaction), the analyses included a variable for each predictor measured at the individual nurse level as well as a variable that represented the average view within the unit for all nurses. These second variables more accurately represent the environment in which nurses practice because they include the perceptions of all nurses.

The HLM models varied slightly across the subgroups of participants (i.e., patient and nurses).

Hierarchical Linear Model for Patients

Outcome data were obtained from patients at three occasions of measurement: 1) time 1 or baseline data were collected upon admission to the ward/unit; 2) time 2 data were obtained at the time of discharge from the hospital; and 3) time 3 data were collected at six weeks post-discharge. The individual pattern of change in the outcome over time was of interest. Examining the individual patterns of change in outcomes is very informative in terms of determining whether individual patients achieved the expected, desired outcomes identifying the direction and rate of change, and identifying factors that could affect the pattern of change. The latter factors are related to individual characteristics and/or to the ward/unit characteristics. Consequently, a multi-level HLM model was specified to analyze the patient outcome data.

In the first level of the HLM model, the influence of individual patient characteristics on the outcome variable at time 2 and time 3 were examined. These patient characteristics were considered risk factors that determine, partially, variability in outcome achievement and their effects on the outcome were controlled for. They included the patient's baseline value on the outcome, and the patient's case mix, comlexity, age, gender, and functional health status at admission. The effects of these variables on the outcome variables at time 1 and time 2 were estimated using multiple regression analysis with forced entry. Three of the health status variables measured at time 1 were entered as control variables because they were relatively orthogonal and provided a control for the patients' baseline health status. These were the baseline FIM and the SF-36 vitality and general health subscales.

In the second level of the HLM model, the influence of the ward/unit characteristics on the patients' outcome achievement at time 2 and time 3 was examined, using multiple regression analysis. The ward/unit characteristics were: average nurse education and experience, nurse-to-patient ratio, proportion of regulated-to-unregulated staff, model of nursing care delivery.

In the third level of the HLM model, the influence of the work environment variables (e.g. communication, coordination, perception of the quality of care, nurse leadership) and the nurse outcomes (e.g. job satisfaction, role tension, job pressure, and job security) were examined.

Heirarchical Linear Model for Nurses

Outcome data were obtained from nurses at one point in time (i.e., cross-sectional). A two level HLM model was specified to examine the effects of individual and ward/unit variables on the nurse outcomes. The first level involved individual level analysis, where the nurse outcome was regressed on the individual nurse characteristics. The latter were: nurse's age, education, and experience. The second level consisted of examining the effects of the ward/unit variables on the outcome variables. Some of these variables were measured at the unit level (e.g. proportion of regulated staff, professional mix model, care delivery model) and some were measured at both the individual nurse level and unit level (e.g. work environment variables).

Hierarchical Linear Model for System Quality and Cost Outcomes

The outcomes included: length of hospital stay, hospital and home care costs, and caregiver burden. These were measured at the individual patient level. The quality outcomes were of two types: 1) patient's perception of the quality of nursing care, hereafter referred to as patient satisfaction, measured at the individual patient's level, and 2) quality assurance variables, namely rate of medication error and patient fall, measured at the ward/unit level. A two level HLM model was specified and tested for the cost outcomes and the satisfaction with nursing care outcome. In the first level, the outcome variable, measured at one point in time, was regressed on to the patient's characteristics of case mix, complexity, age, education, and gender. In the second level, the effects of the ward/unit variables (i.e., bed size, average nurse education and experience, nurse-to-patient ratio, proportion of regulated staff, nursing care delivery model, and the interaction between proportion of regulated staff and care delivery model) on the outcomes were examined, using hierarchical linear modelling. The effects of the ward/unit characteristics (same as mentioned above) on the rate of medication error and patient fall were examined using multiple regression. Regression analysis, with stepwise method of variable entry was used. This analysis was appropriate as all the independent and dependent variables included here were measured at the ward/unit level. Thus, the sample size for this analysis was 77.

ANALYSIS OF ORGANIZATIONAL CHANGE

- *Question 2:* What are the predominant models of organizational change undertaken by OCOTH hospitals?

- *Question 6:* Does the organizational change model explain variation in patient, cost, and nurse outcomes beyond what is accounted for by differences in case mix, patient complexity, patient age, surgical risk, functional status at admission, and the nursing variables?

The data relevant to the models of organizational change were elicited through the interviews conducted with the hospitals' administrators (e.g. CEO, Chief of Nursing Officer, Vice President of Patient Care, and/or Vice President of Human Resources). The responses to the open-ended questions posed during the interviews were content analyzed, while the responses to the close-ended questions were tallied.

Analysis of the interviews indicated that most, if not all, hospitals pursued a variety of different strategies at different times during the study period. Most often, these strategies involved elements of downsizing, reengineering and restructuring. In many cases, hospitals were pursuing two or more of the three strategies concurrently. For example, while many hospitals were clearly engaged in hospital-wide reengineering or restructuring through merger, they were at the same time downsizing beds and closing units. In addition, the form and depth of their implementation varied widely. The three strategies were, therefore, not strictly mutually exclusive.

On a smaller scale, all hospitals implemented tens, if not hundreds, of initiatives aimed at both quality improvement and cost reduction. These ranged from reducing use of paper cups to redesigning emergency room triage.

All of these initiatives, both macro and micro, potentially impact the cost, patient and nursing outcomes examined in this study. However, interviewees identified the following strategies as having the most significant impact on the clinical side of hospital operations. Each of these will be discussed separately in a detailed report on organizational strategies to be prepared separately:

Restructuring
- Merger
- Focus on Priority Programs
- Program Consolidations

Reengineering
- Hospital-wide Reengineering
- Skill Mix Changes
- Program Management
- Care Process Changes

Downsizing
- Unit Consolidations and Bed Closures
- Management De-layering/Consolidation

Revenue generation strategies, while frequently discussed by interviewees, were not identified as significant during the study period. Other strategies, including consolidation and outsourcing, were identified as significant, however, since these were not the focus of the interviews, they will not be extensively discussed in this report.

As indicated, each of these strategies have been grouped according to the strategic category they are most closely associated: downsizing, reengineering or restructuring. However, these strategies also can cut across categories. In fact, many of these strategies are intimately inter-connected, either by their inherent implications or by deliberate hospital design. For example, management consolidation can occur with or without restructuring, although mergers often prompt such consolidation. Interviewees commented that accurately identifying the impacts of each separately was a difficult, if not impossible, task.

Finally, despite this mix of strategies and the tremendous activity that they generated, it must be noted that several factors in the hospital environment constrained the choice of strategy available to hospitals. Most significantly, the directions of the Health Services Restructuring Commission substantially dictated hospital strategy in many cases. It is reasonable to assume that such externally imposed restructuring would have a different impact on outcomes than that which is internally generated.

In summary, what happened in OCOTH hospitals during the period of this study is clearly a cumulative, multi-factorial result of both complex environmental factors and hospital responses across a number of dimensions.

As indicated above, Ontario teaching hospitals engaged in a wide variety of strategies, often currently. The analysis of which organizational changes might have been more effective in influencing outcomes will require further specification and analysis of the types of organizational changes. Since many strategies were used with overlapping time frames it may not be possible to discretely categorize these efforts. Additional data analysis is being pursed to assess this question, and, in particular, to focus on the perceived benefits and liabilities of each strategy. Presentation and analysis of these findings in a way that will illuminate this research question is not possible for this report.

NURSING WORKLOAD DATA

In the original research design, patient classification/workload data was to be collected on each patient each day of the patient's stay. In addition units were asked to provide the research team with the total unit workload and census on a daily basis. Although several attempts were made to ensure the sites were clear on the data requirements for this portion of the study, some difficulties were experienced. Some facilities were not able to provide patient classification data for the units selected for the study because the data were not routinely collected on the unit. Others reported that daily patient classification workload data was collected but automatically downloaded to an information system which summarized unit data as a whole but deleted patient specific data daily or after a specified period of time (after 7 days). As a result of these circumstances, at the completion of the study, nursing workload data was obtained from 4 hospitals.

Data were entered into an Excel spreadsheet by patient for each day of their stay. The admission and discharge date, nursing unit, the total workload and the daily census on the unit were also entered. Three hospitals (19 units) used the GRASP methodology and 1 hospital with two campuses and 11 units used the Medicus methodology for measuring nursing workload. The daily workload estimates for all patients classified on the GRASP system were taken from the hospital submissions. When patients were classified using the Medicus system the relative value for the patient's level of classification was multiplied by the "target hours" for that unit. No attempt was made to convert GRASP and Medicus workload measures to a common basis of estimating hours of nursing care for the present study. Although this is a potential source of error in the nursing hours of care estimates, it was considered to be small because O'Brien-Pallas, Leatt, Deber & Till (1989) and O'Brien-Pallas, Cockerill & Leatt (1992) found an average difference between the two tools of less than ten minutes per patient day.

A total of 6,137 patient days of workload data were collected . When examined across patient episodes of care, there were approximately 2,385 (39%) days of workload data missing from the data set. Most data was missing on the first and/or last day of patient stay. With shorter length of stay (LOS) and increased acuity of patient's admitted to hospitals, nursing workload is no longer reduced on the first and last day of stay as may have been the case in previous years. Therefore the mean daily value of workload for the patient's LOS was substituted for missing days of workload data.

More than one study patient may have been on a unit on any day of the study, yet the total unit workload was reported for each individual patient. In some instances the total unit workload and census reported to the research team differed between these patients. In order to minimize the impact of this variation, the highest unit workload and census reported for that day of stay was substituted. This minimized the proportion of the workload that were associated with study patients on days on which data were missing. Thus, this approach was conservative and underestimated the potential workload of any patient, minimizing the impact of error associated with missing values.

The study patient workload total by length of stay was calculated by summing all days of stay including the estimated days, to provide a total by study patient. The study patient daily average workload was calculated by dividing the total study workload by the number of available length of stay days.

The total unit workload by calendar month was calculated by summing the workload by nursing unit for each calendar month, including the estimated unit workload values. The study patient total workload by calendar month was calculated by summing all study patient workload within the calendar month, including the estimated study patient values.

The nursing workload data were intended to be used as a comparison with the nursing case costs data at select sites, if such a comparison could be made. Considering the data challenges described above, it was determined that nursing case cost hours be used in the analysis for the purposes of this report.

NURSING HOURS COST DATA

In common economic terms, the total acute inpatient cost of a hospital (TC) is the sum of the product of the unit cost (C_i) and the quantity (Q_i) of the i^{th} hospital factor input used for acute inpatients:

$$TC = \sum_{i=1}^{n} C_i Q_i$$

Factor inputs include capital, labour, and supplies.

The total inpatient cost of a hospital can also be defined as the sum of the costs of each patient treated by the hospital (the so-called "case costs"). The total acute inpatient cost of patient j can be defined as:

$$TC_j = \sum_{i=1}^{n} C_i Q_{ij}$$

Unit quantity has a subscript for patient j and the unit cost does not. Unit costs are standard across patients – a nurse caring for patient j is paid the same hourly wage when he cares for patient k, a syringe used for patient j costs the same as a syringe used for patient k, and so on. However, patients may vary substantially in the quantity of factor inputs consumed during their hospital stay. Although a nurse earns the same hourly wage no matter which patient he cares for, he may spend much more time with patient j in comparison with patient k, patient j may require twice the number of syringes, and so on. Therefore, variation in case costs reflects primarily variations in the quantity of factor inputs.

In recent years, many hospitals have implemented case cost systems to better manage resources. As implied above, most systems use a standard unit cost for each factor input and an actual or estimated quantity of factor inputs used for each case. If the cost is above a specific threshold and directly observable, the actual amount is included in the case cost – for example, the cost of a prosthetic hip (+ $1000). If the cost is below a specific threshold or not directly observable, an estimated amount is included in the case cost – for example, aspirin or utilities. The estimate is usually derived from a cost allocation exercise in which some numerical base is used to allocate the total costs of a group of patients to each specific patient. For example, the base may be the number of cases (if each patient stay does not vary substantially in the use of the input) or it may be patient days (if each patient does not vary substantially in the use of the input per day).

The largest single component of an acute inpatient case cost is usually nursing. A nursing case cost is usually above a specific threshold but is not directly observable and, consequently, must be estimated. Simple cost allocation bases such as cases or patient days are clearly not appropriate for allocating nursing costs because there is substantial variation in the amount of daily and total nursing care that patients require. To allow for this variation, most case cost systems use nursing workload measurement systems (WMS) to allocate nursing costs. The usual process is as follows: using GRASP, Medicus or other standardized instrument, a nurse assesses

each patient on a nursing ward every day. The daily nursing workload for each patient (WMS_i) on a nursing ward is recorded and then aggregated for a standard reporting period (two weeks or one month, for example). The aggregate number (Σ WMS_i) represents the total nursing workload of the nursing ward over the standard reporting period that includes the patient's stay. The proportion of the total nursing workload consumed by patient j (α_j) is estimated to be:

$$\alpha_j = WMS_j / \sum_{i=1}^{n} WMS_i$$

The estimated nursing hours consumed by patient j (Q_{nj}) is:

$$Q_{nj} = \alpha_j \Sigma Q_n$$

where Σ Q_n is the total nursing hours of the nursing ward. The estimated nursing case cost of patient j is:

$$TC_{nj} = C_n Q_{nj}$$

where C_n is the standard unit cost for nursing (the average collective agreement wage rate weighted by staff mix of the nursing ward).

For this study, hospital sites with case cost systems were asked to submit case nursing cost and hour data for the participating 668 patients in our sample. Seven hospitals provided these data. One hospital site was unable to provide any case nursing data for the 71 study patients from that site, and another hospital site was unable to provide the case nursing data on 14 of its study patients. A data quality review of the case costs and hours data received by the research team required the removal of another patient, bringing the potential participants in the cost analysis of the study to 582.

A first step in determining the reliability, validity and comparability of the case cost and hours data involved a simple calculation of the cost per hour amount, or the standard unit cost for nursing (C_n). A range of $22.00 to $69.00 per hour was found. Consultations with the hospitals determined that the data submitted reflected a misinterpretation of the data request. In some cases, hospitals submitted a pure nursing case cost, whereas in other cases, they submitted a 'burdened' or a 'total product' cost, meaning the submitted cost included other non-nursing costs, such as hospital overhead. A per hour calculation therefore varies not only by hospital, but also by nursing unit depending on the resource intensity of the nursing unit. The consultations with hospital sites also verified that the case hours provided were relatively comparable. Two hospital sites submitted the actual paid hours of nursing staff from the payroll system. The other four sites provided workload hours from the workload system. To test for validity and comparability of these data, hours per patient day were calculated and reviewed for reasonableness. Hours per patient day ranged from 0.2 to 24.9. One outlier with a calculated 68 hours per patient day was removed.

For these reasons, case nursing hours was used as a measure of nursing resource use. Under MIS Guidelines, there are two types of nursing staff who work on inpatient nursing units: Unit Producing Personnel (UPP) and Management and Support (M&S). UPP nursing staff are defined as "those personnel whose primary function is to carry out the activities that contribute directly to the fulfilment of the mandate of the service for the specific functional centre" and M&S staff are defined as "the personnel whose primary function is the management and support of the operation of the functional centre" (JPPC, 1997). Typically, the hours of UPP nursing staff are allocated to individual patients using workload measurement tools and the hours of M&S are allocated as an overhead rate. In this study, the case UPP paid hours was used as the measure of nursing resource use. This includes the paid hours, worked and benefit, of all registered nurses and registered practical nurses allocated to a specific patient. Table 3 describes the dataset by CMG type.

Table 3

NURSING HOURS COST DATA ORGANIZED IN CASE MIX GROUPS

CMG Type	Number of Patients	Mean	Standard Deviation	Range
Medical				
Chronic Obstructive Pulmonary Disease	13	58.51	100.32	7.00-384.00
Simple Pneumonia	32	25.03	15.74	5.00-63.84
Surgical				
Major Intestinal & Rectal Procedures	109	61.62	70.29	7.00-669.29
Major Gynecological/Uterine Procedures	83	21.39	11.78	5.00-68.82
Obstetrics				
Vaginal Delivery	341	16.56	8.59	0.80-68.81
Pediatrics				
Asthma & Bronchitis	1	84.84	N/A	N/A
Unclassified Patients	3	21.14	8.77	13.00-30.42
Total	**582**	**27.23**	**39.04**	**0.80-669.29**

The average number of nursing hours per patient is just over 27 hours. There is a wide range of values and this varies across CMG types. Three hundred and seventy patients either had no complexity level assigned or where considered level 1 complexity. Thirty-three patients were considered level 2, 17 considered level 3, and 10 considered complexity level 4 – life threatening. These more complex patients could be the case of the wide variation in these data.

The use of case nursing hours instead of case nursing cost was disappointing but not deemed to be a significant limitation to the analysis because, as stated above, there was no basis to expect significant inter-hospital variation in nursing unit costs. The compensation schedule of acute inpatient nursing staff in most hospitals is determined through bargaining between the Ontario Nurses Association and the Ontario Hospital Association. Collective agreements set out standard hourly wages for different types of nursing staff, by level of experience, education, and other factors. The nursing compensation schedules of the few non-union hospitals usually pattern ONA/OHA agreements. Therefore, it is reasonable to assume, for example, that a registered nurse who has baccalaureate training and ten years' seniority will earn approximately the same hourly wage regardless of which Ontario hospital is the place of employment. Any variation in nursing unit costs would be due primarily to variations in staff mix, either the mix of RNs and RPNs or the mix of staff at different seniority levels.

One potential source of error in the calculation of case nursing hours is the known inter-hospital, intra-hospital, and inter-nurse variation in the assignment of GRASP or Medicus units to similar patients. Furthermore, GRASP and Medicus have different scales and classification properties that, if applied to the same patient, could result in different case nursing hours. This may limit comparison of case nursing hours that are calculated using these workload measurement tools (Cockerill, O'Brien Pallas, Bolley & Pink, 1993).

Nursing

T H R E E

STUDY RESULTS

Description of the Study Sample

The sample consisted of over 50 senior administrative staff, 74 unit managers, 1,116 nurses and 2,046 patients who met the study inclusion criteria. This included patients diagnosed with COPD/pneumonia, admitted for a major gynaecological surgical procedure (non-cancer), admitted for major intestinal or rectal surgical procedure, women who experienced vaginal deliveries, and children with asthma and/or bronchitis. Eligible patients were identified by either the Unit Manager or the Charge Nurse, as negotiated on each unit.

REGISTERED NURSES/REGISTERED PRACTICAL NURSES

A stratified random sampling process was used to recruit the unit quota of nurses (n=12 per unit), required to provide an adequate sample of 921 nurse respondents for the study. A total of 1,116 nurses who met the eligibility criteria for the study returned completed questionnaires. The sampling requirements for the study overall were met and the sample is fairly representative of all hospital sites in the study. As there was a concern that some of the units in the study may have insufficient staff numbers to achieve the necessary sample, similar units in other hospital sites over-sampled to ensure the study sampling requirements were met. Twenty-six nurses formally declined to participate in the study.

Demographic data examined included general biographical data, and data pertaining to educational preparation and work arrangements. Overall (n=1085), 1041 (96%) were female, and 44 (4%) were male. The majority of study respondents (68%) ranged in age from 31 to 50 years (n=686), while (n=188) 19% were thirty years of age or younger, and (n=127) 13% were over the age of fifty years (see Table 4).

Table 4

AGE OF NURSE RESPONDENTS IN STUDY

Age (Years)	Number	Percent	X	SD
≤ 30	188	18.8	39.42	8.94
31-50	686	68.5		
≥ 51	127	12.7		
Total	**1001**	**100**		

The majority (68%) of respondents (n=727) were married, while (21%) were single (n=220), with (10%) separated or divorced (n=103), and (1%) widowed (n=14). Respondents in this study (n=994) were predominately registered nurses (93%), with only (n=72) registered practical nurses (7%) participants.

Table 5 demonstrates that the majority of nurses (78%) participating in this study (n=847) were prepared at the level of diploma Registered Nurse or hospital-based certificate. Approximately (22%) had baccalaureate education (n=239), while less than (1%) were prepared at the Masters level (n=4). Some of the participants (10%) identified that they were enrolled in a university program (n=107), with over half of these (63.7%) indicating the program was a baccalaureate (n=70).

Table 5

EDUCATIONAL PREPARATION OF NURSE RESPONDENTS IN STUDY

Education	Number	Percent
Hospital-based certificate/diploma	847	77.7
Baccalaureate degree	239	21.9
Masters degree	4	0.4
Total	**1090**	**100**

Table 6 indicates that for the study respondents overall, the number of years employed in nursing is fairly evenly distributed over the decades. This indicates that the overall sample of this study is representative of nurses with all levels of employment experience. While a small majority of nurses (n=192) have been employed between eleven and fifteen years in nursing (17.2%), almost as many respondents (n=196) have between sixteen and twenty years of nursing experience (16.6%), as do respondents (n=180) with between six and ten years of nursing experience (16.2%), and those (n=171) who only have up to five years of such experience (15.4%). A relatively large number of respondents (n=128) have between twenty-five and thirty years of experience (11.5%), and it is not until after reaching thirty years of experience (n=55) that the percentage of nurses employed (5.0%) at this level begins to show any real decline.

Table 6

NUMBER OF YEARS NURSE RESPONDENTS EMPLOYED IN NURSING

Years	Number	Percent	X	SD
< 5	171	15.4	16.34	9.47
6 - 10	180	16.2		
11 - 15	192	17.2		
16 - 20	186	16.6		
21 - 25	151	13.5		
26 - 30	128	11.5		
31 - 35	55	5		
36 - 40	19	1.7		
Total	**1082**	**100**		

Data related to the number of years employed by respondents at their present hospital is presented in Table 7. A relatively equal distribution is evident for nurses (n=227) who have been employed at their present hospital between one and five years (20.4%),with those (n=246) employed between six and ten years (22.1%), and those (n=227) with eleven to fifteen years of employment experience at the current hospital (20.4%). The percentage of nurses employed at their present hospital begins to show a decline with nurses who have sixteen or more years of on-site experience.

Table 7

NUMBER OF YEARS NURSE RESPONDENTS EMPLOYED IN PRESENT HOSPITAL

Years	Number	Percent	X	SD
< 5	227	20.4	12.75	7.87
6 - 10	246	22.1		
11 - 15	227	20.4		
16 - 20	185	16.6		
21 - 25	122	10.9		
26 - 30	53	4.8		
≥ 31	9	0.8		
Total	**1069**	**100**		

The majority of nurses in this study (n=475) have been employed for five years or less on their present work unit (42.5%), with the greatest proportion of these (n=285) within their first two years of employment (25.5%) (see Table 8). Nurses with six to ten years of experience on their unit (n=281) represent one quarter (25.3%) of respondents in this study, followed by those (n=145) with between eleven and fifteen years of unit work experience (13%). Only (n=41) nurses in this study had been employed on their unit for more than fifteen years (12.7%).

These patterns of employment both across the profession, and within hospitals and hospital units are indicative of the tremendous organizational changes that took place in Ontario.

Table 8

NUMBER OF YEARS NURSE RESPONDENTS EMPLOYED ON PRESENT UNIT

Years	Number	Percent	X	SD
1 - 2	285	25.5	7.98	6.57
3 - 5	190	17		
6 - 10	281	25.3		
11 - 15	145	13		
16 - 20	87	7.9		
21 - 25	39	3.4		
26 - 30	15	1.4		
31	1	0.1		
Total	**1043**	**100**		

Table 9 indicates that the majority of nurses participating in this study (63%) were employed full-time (n=687) , while approximately one third (33%) were employed part-time (n=355), and (5%) held casual positions (n=49).

Table 9

EMPLOYMENT STATUS OF NURSE RESPONDENTS

Status	Number	Percent
Full-time	687	63
Part-time	355	32.5
Casual	49	4.5
Total	**1091**	**100**

The majority of respondents (89%) indicated their work status had been chosen by them (n=980) (see Table 10).

Table 10

CHOICE OF EMPLOYMENT STATUS OF NURSE RESPONDENTS

Status	Number	Percent
Nurses choice	980	89.2
Not nurses choice	119	10.8
Total	**1099**	**100**

Of the nurses (11%) who indicated their current work status was not their choice (n=119), approximately half of these (6.1%) identified that they would like to work more (n=68).

UNIT MANAGERS

Managers of patient care units included in this study were invited to participate in this study. Although all agreed to participate, three of these were responsible for the management of more than one study unit resulting in the unit manager sample size of (n=74) for 77 patient care units. As Table 11 demonstrates, the majority of unit managers were over the age of 40 years.

Table 11

AGE OF UNIT MANAGER RESPONDENTS IN STUDY

Age (Years)	Number	Percent
30-34	8	10.4
35-39	12	15.6
40-44	18	23.4
45-49	20	26
50-54	12	15.6
≥ 55	4	5.2
Total	**74**	**96.2**

Overall (n=74), 55 (71.4%) were married, 11 (14.3%) were separated or divorced, and 10 (13%) were single. All but one of the unit managers was female.

Table 12 indicates that for the unit manager study respondents overall, most have over ten years of experience in nursing. A small number of unit managers (n=4) have been employed less than ten years in nursing (5.4%). The majority of unit managers (n=69) have more than ten years of experience (93.5%), with a fairly even distribution of experience across the decades. This indicates that the overall sample of this study is representative of unit managers who have greater than ten years of nursing experience.

Table 12

NUMBER OF YEARS UNIT MANAGER EMPLOYED IN NURSING

Years	Number	Percent
< 10	4	5.4
11 - 15	17	22.9
16 - 20	14	18.9
21 - 25	16	21.6
26 - 30	18	24.3
≥ 31	5	6.7
Total	**74**	**100**

It is apparent that many of the unit managers in this study are relatively new to the unit that they are managing. Table 13 demonstrates that 43 (67.1%) of the unit managers have been employed on their unit for less than five years.

Table 13

NUMBER OF YEARS UNIT MANAGER EMPLOYED ON PRESENT UNIT

Years	Number	Percent
< 3	25	39
3 - 5	18	28.1
6 - 10	10	15.6
11 - 15	5	7.8
16 - 20	1	1.6
21 - 25	39	1.6
26 - 30	4	6.3
Total	**64**	**100**

Table 14 demonstrates that the majority of unit managers (67.5%) participating in this study (n=50) had baccalaureate educational preparation. Approximately (16.2%) had diploma education (n=12), while another (16.2%) were prepared at the Masters level (n=12). Many of the participants (40.3%) identified that they were enrolled in a university program (n=31), with over half of these (20%) indicating the program was a Masters (n=20).

Table 14

EDUCATIONAL PREPARATION OF UNIT MANAGER RESPONDENTS IN STUDY

Education	Number	Percent
Hospital-based certificate/diploma	12	16.2
Baccalaureate degree	50	67.5
Masters degree	12	16.2
Total	**74**	**100**

The majority of unit managers (57.7%) identified that they worked more than a regular 40-hour work week (n=41). The majority of these (45%) worked between 40 and 50 hours (n=32), while the remaining group (12.6%) identified working more than 50 hours a week (n=9).

PATIENTS

Table 15 provides a summary of the patient accrual and attrition rates for medical-surgical patients, obstetrical patients, and pediatric patients over the three waves of data collection. Seven hundred and forty two medical-surgical patients participated in all three phases of data collection resulting in an attrition rate of approximately 22%. Seven hundred and forty one obstetrical women participated over the three phases of data collection resulting in an attrition rate of 24%.

We were not able to recruit the pediatric sample as planned. Early in the data collection process all of the hospitals identified difficulty in obtaining the sample requirements for the pediatric patient population selected for inclusion in this study. A number of factors appear to have contributed to this: (a) a change in treatment protocol for pediatric asthma patients from the time that the study was designed, from in-patient to ambulatory care, resulting in fewer admissions; (b) dramatic warmer weather over the winter which led to less need for pediatric asthma admissions to hospitals; and (c) greater specificity in the diagnostic labels given to children admitted with respiratory diseases (e.g. respiratory distress, reactive airway disease, wheeze). A total of eighty six pediatric patients were recruited into the study, with seventy five participating at time 2 for an attrition rate of 13%.

There were four hundred and twenty three caregivers of medical surgical patients recruited into the study and fifty three caregivers of pediatric patients.

Table 15

PATIENT/CAREGIVER RECRUITMENT AND ATTRITION RATE

Patient Group	Recruitment at T1	Response at T2 (Attrition)	Response at T3 (Attrition)
Medical-Surgical	905	835 (12.11%)	742 (21.90%)
Obstetrical	970	901 (7.1%)	741 (23.61%)
Pediatric	86	75 (12.8%)	
Caregiver Medical-Surgical	423		
Caregiver Pediatric	53		

A total of two thousand and forty six patients were recruited into the study. One thousand, eight hundred and eleven patients participated at time 2 (RR=89%) and one thousand, four hundred and eighty three eligible patients participated at time 3 (RR=79%). Therefore the overall response rate for all three phases of data collection was seventy-nine percent. The data collectors at each hospital site kept records of why patients declined to participate and/or reasons for patient attrition. The following reasons were recorded for patient refusal/attrition: too ill to bother, too tired, not interested, weak, too much work, unable to speak English well enough, does not like doing surveys, too symptomatic (e.g. short of breath, pain), difficulty concentrating, hard of hearing, and already involved in research. Four hundred and twenty three caregivers of medical surgical patients were recruited into the study.

Table 16

DEMOGRAPHICS OF PATIENTS ADMITTED TO MEDICAL-SURGICAL UNITS

Characteristic	Frequency	Percent
Age	Mean age 55 years (sd = 16) Range 16-98 years	
Gender		
Female	676	75
Male	225	25
Education		
Less than high school	208	23.4
High school graduate	185	20.8
On-the-job training	39	4.4
Formal technical training	43	4.8
Some college	259	28.6
Bachelor's degree	110	12.4
Graduate degree	44	5.0
Ethnic background		
Caucasian	802	88.9
Aboriginal	9	0.9
Black	25	2.8
East Indian	8	0.9
Asian/Pacific Islander	10	1.1
Hispanic	4	0.4
Other	44	4.9
Marital status		
Single/engaged	87	9.7
Married/co-habitating	593	66.0
Separated/divorced	89	9.9
Widowed	129	14.4
Current living arrangements		
Owned/rented residence	837	93.0
Family member's residence	53	5.9
Assisted living	4	0.4
Other	6	0.7
Living condition		
Alone	186	17.8
Spouse/significant other	590	56.4
Family member	245	23.4
Friend	10	0.9
Paid help	3	0.3
Other	11	1.0

The average age of the medical surgical patients was 55 years. The majority were female (75%) with high school education or less (44%), Caucasian (89%), married/co-habitating (66%), and owned/rented their place of residence (93%).

Table 17

DEMOGRAPHICS OF PATIENTS ADMITTED TO OBSTETRICAL UNITS

Characteristic	Frequency	Percent
Age	Mean 30.51 years (sd = 5)	
	Range 16-52 years	
Education		
Less than high school	49	7.7
High school graduate	79	12.5
On-the-job training	6	0.9
Formal technical training	12	1.9
Some college	231	36.5
Bachelor's degree	205	32.4
Graduate degree	51	8.0
Ethnic background		
Caucasian	439	69.9
Aboriginal	7	1.1
Black	28	4.4
East Indian	5	0.8
Asian/Pacific Islander	27	4.3
Hispanic	16	2.55
Other	106	16.9
Marital status		
Single/engaged	52	8.2
Married/co-habitating	580	91
Separated/divorced	5	0.78
Current living arrangements		
Owned/rented residence	601	94.35
Family member's residence	33	5.2
Assisted living	3	0.47

The average age of the obstetrical sample was 30 years. The majority had completed some college education/graduate (76.9), were Caucasian (70%), were married/co-habitating (91%), and owned/rented their residence (94%).

Table 18

CASE MIX GROUPS, COMPLEXITY RATING, AND SECONDARY COMPLICATIONS FOR PATIENT SAMPLE

Characteristic	Frequency	Percent
CMG		
Intestinal/rectal surgery	264	13.7
COPD	55	2.9
Pneumonia	230	11.7
Gynecological surgery	414	21.4
Vaginal delivery	962	49
Complexity rating		
No complexity	728	37.0
Complexity regarding chronic condition	138	7.0
Complexity regarding serious condition	64	3.3
Potentially life threatening	30	1.5
Complexity not applicable to CMG	974	49.6
Type 2 wound infection		
No	1907	99.8
Yes	4	0.2
Type 2 urinary tract infection		
No	1906	99.7
Yes	5	0.3
Type 2 pneumonia		
No	1910	99.9
Yes	1	0.1
Type 2 other infection		
No	1907	99.8
Yes	4	0.2

The majority of the medical-surgical sample consisted of patients undergoing intestinal/rectal surgery (27%) or major gynecological surgery (43%). The majority of the medical patients had been admitted for treatment of pneumonia (24%). The majority of the patient sample had minimal complexity (score of 1 or 9 in Table 18). The occurrence of secondary complications such urinary tract infection, pneumonia, and 'other' infections were found to be minimal among the patients in this study.

STAFF MIX RESULTS

Introduction

This chapter provides the results of the following research questions:

1. What are the predominant models of staff mix within the Ontario academic health science centres/OCOTH hospitals?

3. Is there a relationship between the professional mix of staff on inpatient units (e.g. proportion of RN & RPN to unregulated worker), cost outcomes, and nurse outcomes?

4. Does the influence of staffing model on cost and nurse outcomes vary with the type of care delivery model (e.g. team nursing or total patient care)?

5. Do nurse staffing variables such as the average nurse educational preparation, and average nurse experience level explain variation in cost, and nurse outcomes beyond what is explained by patient complexity?

Staff Mix Models

The first research question examines what the staff mix models were within study hospitals. Unit managers were asked to provide information on the composition or "mix" of staff employed on patient care units in this study. *Regulated staff mix models* can include two staffing combinations: (1) a staff mix comprised of registered nurses (RNs) and registered practical nurses (RPNs), or (2) a staff mix comprised of registered nurses only (all-RN staff). Regulated staff mixes include nursing personnel whose practice is regulated within scope of the Standards of Practice outlined by the College of Nurses of Ontario. *Regulated and unregulated staff mix models* also include two distinct staffing combinations: (1) a staff mix comprised of registered nurses (RNs), registered practical nurses (RPNs), and unregulated workers (URWs), or (2) a staff mix comprised of registered nurses (RNs) and unregulated workers (URWs). The practice of URWs is managed and monitored by the individual organization in which they are employed, with no linkages to the College of Nurses of Ontario. As outlined in Table 19, the majority of hospital units (63.7%) utilize a staff mix comprised of both *regulated and unregulated staff* (n=49). Most of these (42.9%) are units that employ RNs and URWs (n=33), while only (20.8%) employ all three types of staff, RNs, RPNs, and URWs (n=16). In contrast, *regulated staff* mix models are employed on (36.4%) of the study units (n=28). Of these, RNs and RPNs comprise the mix on (20.8%) of the units (n=16), while all-RN staffing occurred on (15.7%) of the units (n=12).

Table 19

COMPOSITION OF THE NURSING STAFF MIX IN STUDY

Staff Mix Model	Number	Percent	X	SD
Regulated and Unregulated Staff Mix	49	63.7	2.09	1.12
RN/URW	33	42.9		
RN/RPN/URW	16	20.8		
Regulated Staff Mix	28	36.4		
RN/RPN	16	20.8		
RN only	12	15.6		
Total	**77**	**100**		

Further examination of the nature and configuration of the combined *regulated and unregulated* staff mix models was also conducted. Using the framework developed by McGillis Hall (1997) which categorizes units into groups based on the responsibilities of the staff, the staff mix model utilized by each of the study units was determined. This framework includes two nurse staffing models: (1) *substitution*, and (2) *complementary.*

- A *substitution* staff mix model is comprised of a regulated and unregulated staff mix where the URW performs some direct and indirect patient care activities;
- A *complementary* staff mix model is comprised of a regulated and unregulated staff mix where the URW performs non-nursing care activities.

Table 20 indicates that the majority of *regulated and unregulated* staff mix units in this study (38.9%) utilize a *substitution* model (n=30), while another (24.6%) utilize a *complementary* model (n=19). The remaining units (36.3%) employ regulated staff who perform all of the patient care activities (n=28).

Table 20

NURSING STAFF MIX MODELS IN STUDY

Staff Mix Model	Number	Percent
Regulated and Unregulated Staff Mix	49	63.5
Substitution	30	38.9
Complementary	19	24.6
Regulated Staff Mix		
Regulated only	28	36.3
Total	**77**	**100**

While it is of interest to know the configurations associated with different staff mix models, the phenomena of greatest importance to nursing is the actual proportion of the staff mix that is comprised of registered nurses (RNs), or of regulated nursing staff (RNs & RPNs). The *proportion of registered nurses* in the staff mix is derived by dividing the number of RNs on the unit by the total number of staff on the unit, and multiplying this by 100.

$$\text{Proportion of Registered Nurses (RNs)} = \frac{\#\ \text{RNs on Unit}}{\#\ \text{Total Nursing Personnel on Unit}} \times 100$$

The *proportion of regulated staff* (RNs & RPNs) in the staff mix is derived by dividing the number of RNs + RPNs on the unit by the total number of staff on the unit, and multiplying this by 100.

$$\text{Proportion of Regulated Staff (RNs \& RPNs)} = \frac{\#\ \text{RNs \& RPNs on Unit}}{\#\ \text{Total Nursing Personnel on Unit}} \times 100$$

As outlined in Table 21, the majority of hospital units (71.4%) have between 60 and 89% of their staff mix comprised of registered nurses (n=55), while only (14.3%) have over 90 percent of their staff made up of RNs (n=11). In contrast, another (14.3%) have less than 60 percent of their staff made up of RNs (n=11).

Table 21

PROPORTION OF REGISTERED NURSES IN THE STAFF MIX

% RNs in Staff Mix	Number Units	Percent
100	2	2.6
90 - 99	9	11.7
80 - 89	16	20.7
70 - 79	22	28.6
60 - 69	17	22.1
50 - 59	6	7.8
40 - 49	5	6.5
Total	**77**	**100**

A similar pattern is evident in Table 22 where the majority of hospital units (71.4%) have between 70 and 99% of their staff mix comprised of regulated staff (n=55), while (10.4%) have over 90 percent of their staff made up of regulated staff (n=8). In contrast, another (18.2%) have less than 70 percent of their staff made up of regulated staff (n=14).

Table 22

PROPORTION OF REGULATED STAFF IN THE STAFF MIX

% RNs & RPNs in Staff Mix	Number Units	Percent
100	8	10.4
90 - 99	19	24.6
80 - 89	18	23.4
70 - 79	18	23.4
60 - 69	11	14.3
50 - 59	3	3.9
Total	**77**	**100**

Nursing Care Delivery Models

The third research question asked whether the nursing care delivery model causes variation in the influence of staff mix on nurse and cost outcomes in this study. In order to answer this research question, a description of the care delivery model was required. Unit managers were asked to provide information on the type of care delivery model employed on patient care units in this study. *Total patient care* delivery occurs when a staff member is "assigned" to a patient and is responsible for the organization and coordination of all aspects of the patient's care for a designated shift of duty. This staff member may or may not be reassigned to the patient on their next shift of duty. *Team nursing* occurs when a group of patients are assigned to a group of nursing staff on the unit, for a designated shift of duty. The staff work as a group and each may be responsible for different aspects of patient care (e.g. the RN may provide medications only while the URW may be responsible for assisting the RPN with the patient's bath and ambulation). *Primary nursing* implies that the nurse has 24-hour accountability for specific patients from hospital admission through discharge. Table 23 demonstrates that the majority of hospital units (83.1%) utilize a total patient care delivery model (n=64).

Table 23

NURSING CARE DELIVERY MODELS IN STUDY

Nursing Care Delivery Model	Number	Percent
Total Patient Care (TPC)	64	83.1
Team	9	11.6
Primary	4	5.3
Total	**77**	**100**

Further exploratory analyses related to the continuity of nursing care delivery were also conducted. Unit managers were asked to provide information on the assignment patterns and management of the mix of staff employed on patient care units in this study. *Continuity of patient assignment* was determined through an assessment of whether nursing staff were "assigned" to a patient on admission and consistently assigned to that patient throughout the hospital stay on that unit, or whether the patient assignment was changed in such a manner that nurses cared for patients who were located in close geographic proximity with one another. Table 24 indicates that continuity of patient assignment was evident on (14.3%) of the units (n=11).

Table 24

CONTINUITY OF PATIENT ASSIGNMENT IN STUDY

Continuity of Patient Assignment	Number	Percent
Continuity of Patient Assignment	11	14.3
Geographic Proximity of Patient Assignment	66	85.7
Total	**77**	**100**

The Relationship of Staff Mix, Care Delivery Model, System Quality, and Patient Complexity on Nurse Outcomes

STAFF MIX AND NURSE OUTCOMES

The research questions addressed whether nursing staff mix models and nursing demographic variables, explain variation in nurse outcomes; and whether the influence of staff mix on nurse outcomes varied with the type of nursing care delivery model. Multilevel hierarchical linear modelling was used to determine whether different staff mix models were predictive of the nurse outcomes of job satisfaction, job stress and role tension. While staff mix was originally categorized into four models in this study, for the purposes of the data analysis, the following staff mix categories emerged as the most robust when testing for the study results for each of the research questions: (1) RNs & RPNs, (2) all-RN staff, (3) the proportion of regulated staff in the mix, and (4) RNs, RPNs, & URWs. Table 24 presents the results of these analyses which indicate that nurse staffing was not predictive of the nurse outcomes examined in this study.

STAFF MIX, CARE DELIVERY MODEL AND NURSE OUTCOMES

In order to address the research question examining whether the influence of staff mix on nurse outcomes varied with the type of nursing care delivery model, additional variables were entered into the model (see Table 25). These variables were "total patient care" and "continuity of care". *Total patient care* was found to have a statistically significant negative influence on nurses perceptions of job pressure (t= -3.81; p= 0.0007), suggesting that nursing care delivery models that did not utilize total patient care contributed to nurse's job pressure. Similarly, *geographic proximity of patient assignment* was found to have a statistically significant negative influence on nurses perceptions of job pressure (t= -2.53; p= 0.017); and a statistically

significant positive influence on job satisfaction (t= 3.06; p= 0.005). These findings suggest that assigning patients in close geographic proximity to one another contributed to nurse's job satisfaction in this study, while a continuity of assignment contributed to perceptions of job pressure.

STAFF MIX, SYSTEM QUALITY AND NURSE OUTCOMES

Further exploratory analysis were conducted to determine if any of the system quality variables were predictive of the nurse outcomes in this study. System quality variables emerge from data collected from registered nurses that measure the nurses perceptions of the effectiveness of the technical care provided on the unit, overall communication on the unit, the approaches used for the overall coordination of patient care on the unit, and the nursing leadership on the unit. These variables were entered into the hierarchical linear model as predictors of the nurse outcomes (see Table 25). For each of the system quality variables, two variables were created to represent: (1) individual level data $_{i}$, and (2) data that had been aggregated to the unit level $_{u}$. The congruence or "equality of effect" of these variables for each of the models was assessed using a "likelihood ratio test" to determine whether both variables were required, or whether they could be combined for the analysis. In instances where there was no significant difference between the effects of the two variables, they were not combined and data from individuals were used. The effect of the aggregated variable is reported as N/A in the tables.

Almost all of the system quality variables were found to be predictors of the nurse outcomes in this study. *Technical quality of care* at the unit level was found to have a statistically significant positive influence on nurses perceptions of job satisfaction (t= 5.71; p= 0.0001), and a statistically significant negative influence on nurses perceptions of job pressure (t= -3.78; p= 0.0008), and job threat (t= -3.72; p= 0.0009). This indicates that the higher the nurses' perception of the technical quality of the care provided on the unit, the higher their level of job satisfaction. In contrast, the lower the nurses' perception of the technical quality of the care provided on the unit, the higher their level of job pressure and job threat. Similar findings were found with the technical quality of care from the data analyzed at the individual level. Technical quality of care at the individual level was found to have a statistically significant positive influence on nurses perceptions of job satisfaction (t= 7.25; p= 0.0001), and a statistically significant negative influence on nurses perceptions of job pressure (t= -2.16; p= 0.03), job threat (t= -3.39; p= 0.0007), and role tension (t= -5.06; p= 0.0001).

At the unit level, *programming approaches for the coordination of care* had a statistically significant negative influence on nurses perceptions of job satisfaction (t= -2.16; p= 0.04), and a statistically significant positive influence on nurses perceptions of job pressure (t= 2.40; p= 0.02). However, at the individual level programming approaches had a statistically significant positive influence on nurses perceptions of job satisfaction (t= 3.77; p= 0.0002), and a statistically significant negative influence on nurses role tension (t= -3.57; p= 0.0004). This indicates that, at the unit level, the less that nurses were required to use programming approaches for coordinating patient care, the more satisfied they were. In contrast, at the individual level, nurses were more satisfied with using programming approaches for patient care, and reported higher levels of role tension if these approaches were not used.

Table 25

INFLUENCE OF NURSING STAFF MIX MODEL ON NURSING OUTCOMES

Control/Predictor Variables	Nurse Outcomes			
	Job Satisfaction t values (N=770)	Job Pressure t values (N=770)	Job Threat t values (N=770)	Role Tension t values (N=766)
Regulated Models				
RN/RPN	0.49	0.69	0.02	-1.00
RN only	0.33	-0.15	-0.32	0.76
Proportion of Regulated Staff	-1.63	-0.08	-0.028	.0.57
Regulated & Unregulated Models				
RN/RPN/URW	-1.06	0.86	0.52	-0.47
Nursing Care Delivery Model				
Total patient care	1.62	-3.81***	-1.54	-0.55
Continuity of care	3.06**	-2.53*	-1.35	-1.96
System Quality Variables				
Technical Quality of Care $_u$	5.71***	-3.78***	-3.72***	N/A
Technical Quality of Care $_i$	7.25***	-2.16*	-3.39***	-5.06***
Coordination of Care by Programming Approaches $_u$	-2.16*	2.40*	N/A	N/A
Coordination of Care by Programming Approaches $_i$	3.77***	0.15	-1.14	-3.57***
Coordination of Care by Individual Approaches $_u$	2.86**	-3.50**	-2.03*	N/A
Coordination of Care by Individual Approaches $_i$	1.16	-2.63**	-1.70	-1.19
Nursing Leadership $_u$	-0.61	N/A	N/A	N/A
Nursing Leadership $_i$	4.88***	-3.57***	-4.58***	-7.16***
Patient Variables				
Complexity	-3.17**	4.15**	3.12**	3.09**
Complexity $_9$	2.42*	-3.42**	-2.97**	-2.20*
Nursing Demographics				
Experience	1.5	-1.87	-0.7	-2.47**
Job Satisfaction				
Outlier	- 4.02***	1.89	2.96**	0.45

*** p< .001; ** p< .01; * p< .05; Data aggregated to unit level data = $_u$; Individual level data = $_i$

Individual approaches for the coordination of care were also explored in this study. At the unit level, *individual approaches for the coordination of care* had a statistically significant positive influence on nurses' perceptions of job satisfaction (t= 2.86; p= 0.008), and a statistically significant negative influence on nurses' perceptions of job pressure (t= - 3.50; p= 0.0016), and job threat (t= -2.03; p= 0.05). Using data collected at the level of the individual, *individual approaches for the coordination of care* had a statistically significant negative influence on nurses' perception of job pressure (t= - 2.63; p= 0.008). These findings suggest that for nurses grouped at the unit level, the more individualized the approaches were that nurses could employ for coordinating patient care, the more satisfied they were with their work and the less job pressure they experienced. This finding was also supported in the individual level data where nurses reported higher levels of job pressure when individual systems for patient coordination were not prevalent.

Finally, *nursing leadership* was examined to see if it was predictive of any of the nurse outcomes in this study. ANOVAs revealed that all of these analyses could be conducted using individual-level data. Nursing leadership was found to have a statistically significant positive influence on nurses perceptions of job satisfaction (t= 4.88; p< 0.0001), and a statistically significant negative influence on nurses perceptions of job pressure (t= - 3.57; p= 0.004), job threat (t= -4.58; p< 0.001), and role tension (t= - 7.16; p<0.0001). This indicates that nurses who had a positive perception of the nursing leadership on their units had higher job satisfaction, and lower perceptions of job pressure, job threat and role tension.

STAFF MIX, PATIENT COMPLEXITY, NURSING DEMOGRAPHICS AND NURSE OUTCOMES

In order to address the research question examining whether nursing demographic variables such as average nurse education level and average nurse experience level, explain variation in nurse outcomes beyond what is explained by patient complexity, additional variables were entered into the model. Patient complexity variables were entered first into the model to control for differences in the outcomes reported that may relate to the individual patient. Two complexity variables were created. The first variable, labelled as "complexity" was representative of patients who had complexity levels assigned to them in this study. The second variable, $complexity_9$ referred to patients who had no complexity.

Both *complexity* variables were found to be significant predictors of the nurse outcomes in this study. Patient complexity had a statistically significant negative influence on nurses perceptions of job satisfaction. The lower the average complexity of patients, the higher nursing job satisfaction (t= - 3.17; p=0.003) and the lower nursing job pressure (t= 4.15; p=0.0003), job threat (t= 3.12; p=0.004) and role tension (t= 3.09; p=0.004) . Similarly, patients that had no complexity had a statistically significant positive influence on nurses perceptions of job satisfaction (t= 2.42; p= 0.02), and a statistically significant negative influence on nurses perceptions of job pressure (t= - 3.42; p= 0.002), job threat (t= - 2.97; p= 0.005), and role tension (t= - 2.20; p=0.03). These findings indicate that nurses in this study experienced greater job satisfaction caring for less complex patients, while patients that were more complex created job pressure, job threat and role tension.

The variables nursing education and nursing experience were found to be highly correlated for this study sample, therefore only one variable, nursing experience was used in the analysis. The nursing experience was then entered into the model to determine whether nursing demographics explained variation in the nurse outcomes, beyond what had been explained by patient complexity. Nursing experience had a statistically significant negative influence on nurses role tension. Specifically, the lower the level of nursing experience the higher nurses job tension (t= - 2.47; p=0.01)

The Relationship of Staff Mix, Care Delivery Model, Patient Complexity and Nursing Demographics on System Quality and Nursing Hours Cost Outcomes

STAFF MIX AND SYSTEM QUALITY AND NURSING HOURS COST OUTCOMES

The research questions also examine whether nursing staff mix models and nursing demographic variables, explain variation in system quality and cost outcomes; and whether the influence of staff mix on system quality and cost outcomes varied with the type of nursing care delivery model. Similar hierarchical linear modelling was done to assess whether different staff mix models were predictive of the system outcomes related to quality of care such as nurses perceptions of the effectiveness of technical aspects of patient care, coordination approaches employed, overall communication, and the system costs associated with nursing. Table 26 presents the results of these analyses which indicate that staff mix was predictive of two of the quality outcomes and nursing hours costs.

Staff mix models comprised of both *regulated and unregulated workers* (RNs/RPNs/URWs) had a statistically significant positive influence on the use of individual approaches to patient care coordination (t= 2.89; p=0.006). This finding suggests that nursing staff employed within regulated and unregulated worker models were more likely to utilize individual approaches for the coordination of care. In contrast, staff mix models that utilized a *professional mix of staff comprised of RNs and RPNs* had a statistically significant negative influence on the use of individual approaches to patient care coordination (t= -2.25; p=0.03). This indicates that RN/RPN staffing models are less likely to utilize individual approaches for the coordination of care. Finally, *all RN staffing models* had a statistically significant positive influence on the technical quality of care provided to patients in this study (t= 2.43; p=0.02). This suggests that the nurses working in staff mix models comprised of an all RN staff perceive the effectiveness of the technical quality of care provided to patients to be higher.

Nursing staff mix was found to have a statistically significant negative influence on nursing hours costs. Specifically, staff mix models that include a *lower proportion of regulated staff* were related to the utilization of more nursing hours (t= -2.09; p=0.05).

STAFF MIX, CARE DELIVERY MODEL AND SYSTEM QUALITY OUTCOMES

In order to address the research question examining whether the influence of staff mix on system quality outcomes varied with the type of nursing care delivery model, additional variables were entered into the model (see Table 26). These variables were "total patient care" and "continuity of care". *Total patient care* was found to have a statistically significant negative influence on nurses perceptions of the technical quality of care provided to patients (t= -3.04; p= 0.004), and on individual approaches to the coordination of patient care (t= -2.75; p= 0.009). This suggests that nursing care delivery models that did not utilize total patient care, such as primary or team nursing, contribute to the technical quality of care and to individual approaches to the coordination of care. Continuity of care was not found to have an influence on these system quality outcomes.

Table 26

INFLUENCE OF NURSING STAFF MIX MODEL ON SYSTEM (QUALITY AND COST) OUTCOMES

Control/Predictor Variables	System (Quality and Cost) Outcomes				
	Technical Quality of Care t values (N=837)	Coordination of Care by Programming Approaches t values (N=785)	Coordination of Care by Individual Approaches t values (N=783)	Overall Unit Communication t values (N= 785)	Nurse Cost Hours t values (N= 203)
Regulated Models					
RN/RPN	-0.14	-1.96	-2.25*	-2.25*	0.52
RN only	2.43*	1.22	1.87	1.87	-0.70
Proportion of Regulated Staff	-0.29	-0.50	-1.29	-1.29	-2.09*
Regulated & Unregulated Models					
RN/RPN/URW	1.42	1.86	2.89**	2.89**	-1.39
Nursing Care Delivery Model					
Total patient care	-3.04**	-0.60	-2.75**		
Continuity of care	-1.81	-1.10	-1.32		
Patient Variables					
Complexity	-0.94	0.92	-1.31		2.94**
Complexity $_9$	1.03	-0.56	0.69		-1.14
Nursing Demographics					
Education					1.4

*** p< .001; ** p< .01; * p< .05; Data aggregated to unit level data = $_u$; Individual level data = $_i$

STAFF MIX, NURSING DEMOGRAPHICS, PATIENT COMPLEXITY AND SYSTEM QUALITY AND NURSING HOURS COST OUTCOMES

In order to address the research question examining whether nursing demographic variables such as average nurse education level and average nurse experience level, explain variation in system quality and cost outcomes beyond what is explained by patient complexity, additional variables were entered into the model. Patient complexity variables were entered first to control for differences in the outcomes reported that may relate to the individual patient. The nursing demographic variable utilized in these analyses -nursing experience, was then entered into the model. Nursing experience was not predictive of the nursing cost hours outcomes examined in this study.

Table 26 indicates that patient complexity was not found to be a significant predictor of the system quality outcomes in this study, although it did have an influence on nursing hours costs. Patients that were more complex had a statistically significant positive influence on nursing hours utilization (t= 2.94; p= 0.003). This finding suggests that more complex patients utilize more nursing care resources.

Influence of Nursing Staff Mix on Medical Surgical Patients Nurse Hours Cost Utilization

Since patient complexity had proved to be a predictor of nursing hours utilization, further exploratory analysis of the nursing hours cost data in relation to specific patient groups from this study was conducted. Table 27 shows that the proportion of regulated staff in the staff mix model had a statistically significant negative influence on the nursing hours utilized for medical surgical patients (t= -3.37; p=0.003). This finding suggests that staff mix models comprised of a lower proportion of regulated nursing staff, actually utilize more nursing hours.

Table 27

INFLUENCE OF NURSING STAFF MIX MODEL ON MEDICAL SURGICAL PATIENTS NURSE HOURS COST UTILIZATION

Control/Predictor Variables	Nurse Hours Costs t values; (N= 203)
Patient Variables	
Age	2.65**
Complexity	2.53**
Complexity $_9$	-0.89
Regulated Models	
Proportion of Regulated Staff	-3.37**

** p< .01

As well, patient age and complexity were also found to be predictors of nursing hours utilization within the medical-surgical patient population in this study. Specifically, both patient age (t= 2.65; p=0.008) and complexity (t= 2.53; p=0.01) had a statistically significant positive influence on the nursing hours utilized for medical surgical patients. This indicates, not surprisingly, that for medical-surgical patients in this study, more nursing hours were utilized for patients that were older and for patients with higher complexity levels.

Influence of Nursing Staff Mix on Secondary Patient Outcomes

Further exploratory analysis was conducted on the secondary patient data that were collected as part of this study. The nursing staff mix and demographic variables such as average nurse experience level, were assessed to see if they were related to any of the secondary outcomes. Unit -level secondary data were collected on medication errors, patient falls, wound infections, pneumonia, and urinary tract infections. Table 28 presents the results of these analyses which indicate that nurse staffing was related to two of the secondary outcomes, medication errors and patient falls. On units where there was a lower proportion of RNs/RPNs there was a higher number of medication errors. Similarly, units with a lower proportion of RNs/RPNs and a less experienced staff, had higher rates of wound infection.

Table 28

INFLUENCE OF NURSING STAFF MIX MODEL ON SECONDARY OUTCOMES

Independent Variables	Medication Errors	Wound Infections	Falls	Urinary Tract Infections
	T	T	T	T
Proportion of Regulated Staff	-3.25*	-2.57**	-1.86	1.90
Average RIW	-.823	1.968	.87	1.01
Average LOS	-.919	-1.019	-1.76	-.37
Average Nursing Experience	-.87	-2.71	-1.61	-.23
	Adj R^2=.37;	Adj R^2=.49;	Adj R^2=.33;	Adj R^2=.01;
	df = (5, 17)	*df* = (5, 17)	*df* = (5, 17)	*df* = (5, 17)

** p< .01; * p< .05

Nursing

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PATIENT OUTCOMES RESULTS

Introduction

This chapter provides the results of the following research questions:

3. Is there a relationship between the professional mix of staff on inpatient units (e.g. proportion of RN & RPN to unregulated worker), and patient outcome achievement (at the time of hospital discharge and at six weeks post discharge), and cost outcomes?

4. Does the influence of staffing model on patient and cost outcomes vary with the type of care delivery model (e.g. team nursing or total patient care)?

5. Do nurse staffing variables such as the average nurse educational preparation, and average nurse experience level explain variation in cost outcomes beyond what is explained by differences in case mix, patient complexity, patient age, surgical risk, functional status at admission, and the nursing variables?

Patient Outcomes

Prior to answering the research questions related to the patients' health and cost outcomes (questions 3, 4, and 5), we first assessed for evidence of change in the health outcomes over time; at baseline (time 1), at hospital discharge (time 2), and at 6 weeks following hospital discharge (time 3). Table 29 summarizes the average level of the outcome measures at the three points of data collection. The last column in Table 29 identifies whether the changes in mean level were significant, and if so, whether these were in a linear or non-linear direction (i.e., linear or quadratic).

It was not possible to examine the research questions for the pediatric sample because of small sample size and thus inadequate power. Thus the analyses focussed on outcomes for the medical-surgical patients and obstetrical patients.

Table 29

CHANGE IN PATIENT HEALTH OUTCOMES OVER TIME

Patient Outcome	Mean at baseline	Mean at discharge	Mean at 6 weeks post discharge	Significance	
		Medical-Surgical Patients			
SF-36 Physical Role	39.65	6.84	44.33	Linear Quadratic	0.028 0.000
SF-36 Pain	50.66	40.5	68.15	Linear Quadratic	0.000 0.000
SF-36 Physical Function	33.95	27.08	62.14	Linear Quadratic	0.000 0.000
SF-36 General Health	66.77	68.3	69.04	Linear Quadratic	0.001 NS
SF-36 Vitality	41.81	30.8	51.52	Linear Quadratic	0.000 0.000
SF-36 Social Function	60.09	38.15	74.84	Linear Quadratic	0.000 0.000
SF-36 Role Emotional	64.4	68.34	89.24	Linear Quadratic	0.000 0.017
SF-36 Mental Health	69.38	75.02	78.9	Linear Quadratic	0.000 NS
BPI - Pain Intensity	1.9	1.97	1.92	Linear Quadratic	0.000 NS
Functional Independence Measure	47.96	76.52	86.72	Linear Quadratic	0.000 0.000
		Obstetrical Patients			
Brief Pain Inventory	5.53	3.34	2.67	Linear Quadratic	0.000 NS

There were significant changes over time in all of the patient health outcomes for the medical-surgical patients and obstetrical patients. The change in outcomes was in the expected direction such that by 6 weeks post hospitalization patients reported better physical and social functional outcomes, more vitality, better pain levels, better general health, and better mental health. For seven of the outcomes there were significant non-linear effects which reflected a decrease in health outcomes at the time of hospital discharge. For the most part this is an expected trend reflecting the fact that patients, especially those who underwent surgery, came into the hospital with a level of healthy functioning that may have been compromised temporarily by surgery or other treatments they received. However, in all cases, the level of health outcomes at 6 week post-discharge was higher than the level reported at admission and discharge.

Table 30 provides a summary of the patient social and health utilization cost variables. Data were collected on caregiver burden, visits to the hospital emergency department following discharge, time lost from work following hospitalization, and whether a family member lost time from work because of the patient's illness and hospitalization. Data were also collected on the utilization of home care services following discharge through the use of a 'Health Care Event Diary". However, because only a small proportion of the sample received home care services and completed the Health Care Event Diary it was not possible to use this particular cost variable to address the research questions.

Table 30

PATIENT COST VARIABLES – MEDICAL-SURGICAL SAMPLE

Cost Variable	Frequency/ Mean (sd)	Percent
Emergency room visits post-discharge		
No	474	47.4
Yes	258	25.8
Missing data	269	26.9
Number of visits to the hospital emergency ward		
0	2	.2
1	84	8.4
2	16	1.6
3	9	.9
4	2	.2
Missing data	888	88.7
Weeks off work since hospitalization		
1 week or less	29	2.9
2 weeks	28	2.8
3 weeks	18	1.8
4 weeks	14	1.4
5 weeks	18	1.8
6 weeks	88	8.8
Missing data	806	80.5
Family member off work because of hospitalization		
No	479	47.9
Yes	234	23.4
Missing data	288	28.8
At six weeks return to usual employment		
No	193	19.3
Yes	135	13.5
Missing data	673	67.2

Twenty five percent of the patients utilized the hospital emergency department following discharge. Thirty two percent of the patients who responded indicated that a family member had lost work because of their illness, and approximately 59% of the patients had not returned to their usual employment by the six week follow-up.

The Effect of Nurse Staffing, Professional Mix, Work Environment and Nurse Outcomes on Patient Outcomes at Hospital Discharge

The first two research questions asked whether nurse staffing variables, such as the nurses' educational preparation and experience, and the professional mix of staff on the inpatient units explain variation in patient outcomes beyond what is explained by differences in the case mix, patient complexity, patient age, and functional health status at admission. Hierarchical linear modelling (HLM) was used to examine these research questions. The patient variables were entered first into the model to control for differences in outcome achievement because of individual patient factors. Three variables that were found to be relatively orthogonal were entered to control for baseline levels of perceived health status; vitality, general health perceptions, and functional independence (FIM) scores. In addition, the baseline level of the outcome variable was controlled for if this was different from one of the three variables identified above. For the time 2 outcomes, there was evidence of a significant interaction between case mix and age, so the interaction terms were entered into the HLM models. Following this, the nurse staffing variables and the professional mix variables were entered into the HLM models.

The fifth research question asked whether the influence of the staffing mix on patient outcomes varied with the type of care delivery model. This question was explored by entering two variables into the hierarchical linear model; total patient care was entered to represent the type of care delivery model on the inpatient unit and a variable representing the continuity of care was entered to represent the extent to which the nursing care provided on the unit provided continuity over the patients' length stay.

Two other sets of analyses were conducted of an exploratory nature. The nature of inter-professional communication and coordination of care on inpatient units has been shown to influence patient outcomes and costs such as risk adjusted length of stay (Shortell et al., 1994), risk adjusted mortality rates (Knaus et al., 1986), excess home care costs following discharge (Brooten et al., 1994), unplanned visits to the physician or emergency department, and unplanned re-hospitalization (Naylor et al., 1994). Because data had been collected on unit communication, coordination, perceived effectiveness of care, effectiveness of head nurse leadership, and problem-solving, it was possible to examine the influence of the work environment on patient outcomes at discharge and on follow-up. In addition, based on the theoretical and empirical work of Weisman and Nathanson (1985), we expected that nurse outcomes such as nurse job satisfaction, might influence patient outcome achievement. Therefore the hierarchical linear models were run with the work environment variables and nurse outcome variables entered as between unit predictors of patient outcome achievement at time 2 and time 3. The results of the HLM analyses for the patient outcomes at time 2 are summarized in Table 31.

Table 31

PREDICTORS OF PATIENT HEALTH OUTCOME ACHIEVEMENT AT HOSPITAL DISCHARGE

Control/Predictor Variables	FIM t values (n=572)	SF-36 Pain t values (n=604)	SF-36 Physical Function t values (n=581)	General Health t values (n=608)	SF-36 Vitality t values (n=607)	SF-36 Social Function t values (n=601)	Mental Health t values (n=605)
Medical-Surgical Patients							
Control Variables							
Days in hospital	4.07***	3.93***	5.66***	-0.04	2.78**	3.78**	2.33*
Vitality Baseline	1.47	0.08	2.09*	2.75**	6.58***	0.79	-0.73
General Health Baseline	0.95	2.69**	2.03*	24.04***	2.71**	1.17	5.18***
FIM Baseline	8.83***	3.31***	6.42***	1.15	3.41***	2.83**	-1.17
Baseline of outcome		5.61***	4.35***			3.69***	13.51***
Gender	1.93	1.32	3.44***	-0.48	3.01**	0.25	2.15*
Gyne surgery vs. others	1.07	-4.21***	-3.30***	1.81	-1.40	-0.32	0.90
Respiratory vs. others	2.49**	2.93**	1.58	-1.43	1.22	1.73	1.25
Simple pneumonia/copd	0.14	0.92	-1.82	-0.83	1.16	-0.33	0.45
Gyn. recont./major uterine	-0.13	1.03	-0.68	-0.43	1.85	-0.68	-0.68
Copd vs. COPD other	-1.57	-2.44*	-0.23	-1.27	-0.29	0.79	1.01
Bronchitis ve. COPD	0.26	1.84	-0.77	-0.25	0.74	-0.13	0.97
Intestinal/colost/gastro	3.69***	-1.07	1.20	1.17	1.87	2.22*	1.46
Patient Age	-6.28***	1.57	-5.56***	-1.04	-1.33	0.08	-0.78
Illness complexity	-6.12	-2.30*	-2.23*	0.39	-0.30	0.58	-0.65
Complexity not pr. Dx	-0.88	0.45	-2.72**	-0.91	-3.42***	1.17	-2.26*
CMG GVO*age	3.55***	-0.13	2.90**	1.60	1.96*	0.98	2.00*
CMG RvGI*age	-2.31*	-1.27	-1.94	-0.31	-0.47	0.91	-0.93
CMG RwCvA*age	3.73***	-2.00*	-0.67	-0.80	-2.28*	-1,38	-1,51
CMG GW1*age	-0.12	-0.89	0.65	-0.25	0.75	-0.46	-0.38
CMG Rw1*age	0.72	2.53**	0.28	-0.32	-0.86	-0.55	-2.27*
CMG Rw2*age	1.88	-1.31	1.39	0.60	0.21	0.53	-1.05
CMG G1W1*age	1.09	-2.66	0.002	1.34	-0.12	0.44	-0.48

Table 31 continued

Control/Predictor Variables	FIM t values (n=572)	SF-36 Pain t values (n=604)	SF-36 Physical Function t values (n=581)	General Health t values (n=608)	SF-36 Vitality t values (n=607)	SF-36 Social Function t values (n=601)	Mental Health t values (n=605)
Nurse Staffing Variables							
Education	NS	NS	NS	NS	NS	NS	NS
Experience	NS	NS	NS	NS	NS	NS	NS
Professional Mix Staffing Variables							
Proportion of regulated staff	2.90**	0.43	1.71	0.75	1.44	3.78***	-1.28
Staff Mix Model							
Mix 3&4 versus 1&2	-1.26	-0.11	-0.88	-1.28	-1.08	-0.28	-1.00
Mix 4-3	0.58	-1.03	0.27	-0.92	-0.08	1.06	0.71
Mix 2-1	-0.14	2.28*	-0.33	1.47	-1.44	-0.81	0.19
Care delivery model							
Continuity of care	NS	NS	NS	NS	NS	2.60**	NS
Total patient care	NS	NS	NS	NS	NS	NS	NS
Work environment variables							
Unit communication	2.85**						
Technical quality of care							
Coordination/programming							
Individual coordination							
Head nurse effectiveness							

Table 31 continued

Control/Predictor Variables	FIM t values (n=572)	SF-36 Pain t values (n=604)	SF-36 Physical Function t values (n=581)	General Health t values (n=608)	SF-36 Vitality t values (n=607)	SF-36 Social Function t values (n=601)	Mental Health t values (n=605)
Nurse Outcome Variables							
Job satisfaction							
Role tension							2.61**
Job pressure						2.13*	
Job threat							

Obstetrical Patients

	Pain at Time 1 t values (n=749)	Pain at Time 2 t values (n=836)
Vaginal birth/complication	-1.66	-0.71
Vaginal birth after caesarean	0.97	1.86
Patient age	-2.82**	1.32
Proportion of regulated staff	-2.179*	NS
Mix of professional staff	NS	NS
Nurse education	NS	NS
Nurse experience	NS	NS
Technical quality of care		-2.85**
Nurse job satisfaction		-2.41*

*p<.05 **p<.01 ***p<.001

MEDICAL-SURGICAL SAMPLE

It was not possible to examine the effect of the nurse variables on two of the SF-36 subscales for Time 2; role physical and role emotional; because there was very little variability on these two subscales. Therefore the analyses was done excluding these two outcome variables.

Many of the variables that were entered to control for individual patient variability on outcome achievement were significant for all outcomes that were examined. A positive relationship was found between hospital length of stay and patient outcome achievement indicating that patients who stayed in hospital longer tended to report better health outcomes at the time of discharge. The baseline health status variables were significant predictors of most of the health outcomes at discharge, as was complexity of the illness condition.

The first research question asked whether the educational preparation and experience level of nurses on inpatient units explained variation in patient outcome achievement at hospital discharge. The educational preparation of nurses and experience level, measured at the unit level, were not significant predictors of the discharge FIM, pain, physical function, general health, vitality, social function, and mental health scores. Therefore there was no evidence that the educational preparation of nurses and their experience in nursing influenced patient outcomes at hospital discharge.

The second research question asked whether the professional mix of nurses on the inpatient units explained variation in patient outcomes at discharge. The proportion of regulated staff on the unit was associated with better FIM scores and better social function scores at hospital discharge. In addition, a mix of staff that involved RNs and unregulated workers was associated with better pain outcomes at discharge than a mix that involved RNs/RPNs and unregulated workers. Therefore, for three of the patient outcomes, a higher mix of regulated staff was associated with better outcome achievement at discharge. In addition, in the HLM analysis for physical function (SF-36), the proportion of regulated staff approached significance ($t=1.71$, $p=0.09$), lending further support to the finding that the proportion of regulated staff in medical-surgical units influence the health outcomes patient achieve at hospital discharge.

The fifth research question asked whether the influence of the staff mix on patient outcomes varied with the care delivery model. With the exception of social functioning, the variables representing total patient care and continuity of care were not significant predictors of any of the patients' outcomes at discharge. Neither were the interaction terms between these variables and the staff mix variable significant for any of the outcomes. Therefore there was no evidence that the influence of the staff mix on patient outcome achievement varied with the type of care delivery model. In the case of social function, the results suggested that when nurses were assigned by geographic location (i.e., low continuity of care assignment), patients achieved better social health outcomes. Because continuity was found to be significant for only one of the patient outcomes, we should interpret this result with caution.

In the exploratory analyses, there was limited support for the influence of the work environment variables and nurse outcome variables on patient outcome achievement. For most of the models involving outcomes at discharge, these variables were not significant. Unit communication was positively associated with better FIM scores at discharge, while nurse role tension was found to be positively associated with better mental health scores at hospital discharge.

OBSTETRICAL SAMPLE

For the obstetrical sample, the baseline assessment of pain occurred within the first twenty four hours of vaginal delivery, which is a time when we would expect pain to be present because the women is still recovering from the birth experience. It is a time when effective nursing care could be important to the women's level of comfort. It therefore was important to examine the impact of the nurse staffing variables on the pain outcome at this point in measurement.

We controlled for case mix group and patient age prior to testing the effect of the staffing variables on obstetrical pain. Age was a significant predictor such that younger women reported higher pain than older women. The other significant predictor of obstetrical pain was the proportion of regulated staff on the unit, although this effect was marginally significant ($p<.06$). Because of the limited degrees of freedom to test the staffing variable in the obstetrical sample (i.e., there were only eight obstetrical units in the sample) we accepted a slightly higher significance level. The direction of the relationship suggests that patients report higher levels of pain following childbirth on units with lower proportions of regulated staff.

A second hierarchical linear analysis was conducted in order to assess the effect of the staffing variables on pain outcomes immediately following hospital discharge. None of the nurse staffing variables were significant predictors of the pain reported by women following discharge. However, a significant relationship was found between pain following discharge and nurses' work satisfaction and the quality of technical nursing care. The direction of the relationships suggested that patients reported lower levels of pain when they were discharged from units where nurses were more satisfied with their job and where nurses viewed the technical quality/effectiveness of care to be high.

The Effect of Nurse Staffing, Professional Mix, Work Environment and Nurse Outcomes on Patient Outcomes at Six Weeks Following Hospital Discharge

The same variables were entered to control for patient variability in time 3 outcomes as those entered at time 2, with two exceptions. FIM scores at discharge were found to be highly associated with most of the patients' health outcomes at 6 weeks following hospital discharge. Therefore FIM scores at discharge were entered as a control variable in the HLM analysis for some outcomes. None of the interactions between case mix and age were significant predictors of patient outcomes at time 3 and so these variables were dropped from the analysis. The results of the analyses examining the research questions for the post-discharge outcomes are summarized in Table 32.

Table 32

INFLUENCE OF THE PROFESSIONAL MIX OF STAFF ON INPATIENT UNITS AND PATIENT HEALTH OUTCOME ACHIEVEMENT AT SIX WEEKS POST DISCHARGE

Control/Predictor Variables	++FIM (n=384)	SF-36 Pain (n=464)	Physical Function (n=461)	General Health (n=466)	SF-36 Vitality (n=461)	Social Function (n=461)	Mental Health (n=462)
Medical-Surgical Patients							
Control Variables							
Days in hospital	-2.46*	-0.16	2.63**	-0.08	2.42*	2.02	0.17
Vitality Baseline	-1.09	-0.50	2.13*	1.56	6.55***	0.68	-0.85
General Health Baseline	4.04***	2.69**	3.87***	17.65***	5.55**	3.63***	5.80***
FIM Baseline	4.87***	0.65	0.95	-1.22	0.09	-0.40	-1.17
FIM 2			6.15***	0.98	2.36*	4.69***	0.42
Baseline of outcome		3.95***	6.24***			3.32***	9.93***
Gender	-1.62	1.35	1.42	-1.45	2.07*	-1.45	0.31
Gyne surgery vs. others	1.89	0.59	2.52**	3.14**	-0.56	-2.12	0.66
Respiratory vs. others	-4.01***	-0.63	-3.13**	-2.43*	-0.07	0.61	-1.14
Simple pneumonia/copd	0.19	-2.25*	-1.10	-2.17*	-0.82	-1.14	-2.49**
Gyn. recont./uterine	-3.33***	-0.70	-2.43*	-3.00**	-0.85	-0.86	-1.53
Copd vs. COPD other	0.60	-0.41	1.56	0.40	-0.37	0.25	-0.69
Bronchitis ve. COPD	0.34	-0.06	-3.04**	0.87	0.63	-1.16	-0.43
Intestinal vs. colost./gastro	2.81**	-0.50	0.40	0.62	0.08	-0.56	-0.78
Patient age	-3.74***	-0.19	-6.63***	-0.94	-4.82	-0.05	-0.68
Illness complexity	0.72	1.39	-0.56	2.41*	0.59	0.86	1.82
Complexity not related to primary diagnosis	-2.49**	-1.49	-1.67	0.43	-0.97	0.31	0.42

Table 32 continued

Control/Predictor Variables	++FIM (n=384)	SF-36 Pain (n=464)	Physical Function (n=461)	General Health (n=466)	SF-36 Vitality (n=461)	Social Function (n=461)	Mental Health (n=462)
Professional Mix Staffing Variables							
Proportion of regulated staff	-1.25	1.79	0.6	0.32	1.21	0.11	-0.32
Staff Mix Model							
Mix 3&4 versus 1&2	-0.51	-0.03	0.59	0.30	-0.65	1.69	-0.27
Mix 4-3	0.05	-1.07	-0.54	-0.98	-1.14	-1.29	-0.49
Mix 2-1	-1.12	-1.48	-1.28	-1.05	0.32	-0.83	0.42
Care delivery model							
Continuity of care	NS	NS	NS	NS	NS	NS	NS
Total patient care	NS	NS	NS	NS	NS	NS	NS
Work environment variables							
Unit communication		-3.38**	-3.88***				
Technical quality of care		1.95*					
Coordination-program			-2.14*				
Individual coordination			1.49				
Problem solving			2.66**				
Head nurse effectiveness							
Nurse Outcome Variables							
Job satisfaction							
Role tension	-2.18*						
Job pressure							
Job threat							

Table 32 continued

Control/Predictor Variables	++FIM (n=384)	SF-36 Pain (n=464)	Physical Function (n=461)	General Health (n=466)	SF-36 Vitality (n=461)	Social Function (n=461)	Mental Health (n=462)
Obstetrical Patients							
	Inventory of Functional Status following Childbirth						
Vaginal vs. complicated del.	2.38*						
Vaginal birth after caesarean	2.18*						
Patient age	2.29*						
Professional mix							
Proportion of regulated staff	-0.09						
Mix 3&4 vs. 1&2	0.60						
Mix 4 vs. 3	-1.85						
Mix 2 vs. 1	-1.71						
Work environment variables							
Nurse outcomes							
Nurse job satisfaction							
Role tension							
Job pressure							
Job threat							

*p<.05 **p<.01 ***p<.001; ++ Note, the analysis for FIM was done with logistic regression because of the distribution of scores

Questions 2 and 3 addressed the relationship between the nurse staffing variables and the professional mix of nurses on patient outcome achievement at 6 weeks following hospital discharge.

MEDICAL-SURGICAL PATIENTS

There was no evidence that the nurse staffing variables and staff mix variables influenced medical-surgical patient outcome achievement at six weeks post discharge. None of the variables were significant predictors of time 3 outcomes. Likewise there was no evidence that the type of care delivery model influenced patient outcome achievement at 6 weeks post discharge. Unit communication had a negative effect on pain at 6 weeks and on physical function at six weeks. This would suggest that on units where communication was perceived by the nursing staff to be effective, patients reported lower pain and functional health outcomes post-discharge than on units where nurses rated communication low. However, patients reported better pain outcomes on units where nurses rated the technical quality of care high. Coordination of care was negatively related to patients' physical function scores post-discharge. On units where staff resolved problems openly, patients reported better functional health outcomes. In addition, on unit where nurses reported greater role tension, patients reported lower functional independence scores at 6 weeks following discharge.

OBSTETRICAL PATIENTS

Data were collected on obstetrical patients' pain level and functional status at 6 weeks following discharge from hospital. The nurse staffing variables, professional mix, and care delivery variables were not significant predictors of obstetrical patients' functional status post-discharge. Functional status was positively related to patient age. Therefore there was no evidence that the nursing variables influenced functional adjustment after vaginal delivery.

There were too few obstetrical patients who reported pain at 6 weeks to enable HLM analysis of the pain outcome. Therefore it was not possible to examine the effect of the nurse staffing variables on pain at time 3.

The Effect of Nurse Staffing, Professional Mix, Work Environment and Nurse Outcomes on Patients' Quality and Social Cost Outcomes

The effect of the nurse staffing variables and professional mix on patient quality outcomes were assessed by testing the influence of these variables on the patients' perception of the quality of nursing care/patient satisfaction with nursing care. A separate hierarchical linear model was run for the medical-surgical sample and the obstetrical sample because of the need to control for different variables at the patient level (see Table 33). For the medical-surgical sample, we controlled for days in hospital, baseline health status scores, gender, case mix group, patient age, severity of illness, and the interactions between case mix group and age. In the obstetrical group we controlled for age and case mix group.

Table 33

INFLUENCE OF THE PROFESSIONAL MIX OF STAFF ON INPATIENT UNITS AND PATIENT QUALITY AND COST OUTCOMES

Control/Predictor Variables	Patient satisfaction with nursing care (n=604)	Care burden demand (n=220)	Care burden difficulty (n=220)	Emergency room visits (n=481)
Medical-Surgical				
Control Variables				
Days in hospital	0.33	-0.80	-0.72	0.20
Vitality Baseline	3.01**	-1.33	-1.17	-1.23
General Health Baseline	0.70	-3.76***	-4.15***	-1.72
FIM Baseline	-0.03	0.54	1.18	0.10
FIM T2		3.73***	-2.17*	-1.26
Gender	0.73	0.33	0.74	0.59
Gyne surgery vs. others	-1.27	2.50**	1.85	0.56
Respiratory vs. others	0.08	-1.65	-0.65	-1.11
Simple pneumonia vs. copd	-0.51	0.03	0.25	0.70
Gyn. recont. vs. major uterine	0.30	0.64	1.63	2.82**
Copd vs. COPD other	0.11	0.26	-0.38	-1.01
Bronchitis vs. COPD	-0.83	1.90	1.61	0.18
Intestinal vs. colostomy/gastro	0.51	-0.52	0.77	0.60
Patient age	-0.07	-2.04*	-1.09	-2.00*
Illness complexity	0.53	0.81	1.02	-0.73
Complexity not related to primary diagnosis	1.88	1.15	0.88	-0.18
CMG GVO*age	-0.22			
CMG RvGI*age	1.11			
CMG RwCvA*age	0.86			
CMG GW1*age	0.45			
CMG Rw1*age	-0.64			
CMG Rw2*age	1.52			
CMG G1W1*age	0.74			

Obstetrical Patients	Satisfaction with nursing care (n=673)
Control Variables	
CMGc	-1.61
CMG610	0.57
Age	-1.02

Table 33 continued

Control/Predictor Variables	Patient satisfaction with nursing care (n=604)	Care burden demand (n=220)	Care burden difficulty (n=220)	Emergency room visits (n=481)	Obstetrical Patients	Satisfaction with nursing care (n=673)
Medical-Surgical						
Professional Mix Staffing Variables						
Proportion of regulated staff	0.42	-0.57	-0.93	0.88		2.55*
Staff Mix Model						
Mix 3&4 versus 1&2	0.45	-1.16	-0.26	0.64		0.47
Mix 4-3	-0.95	-0.76	-1.24	0.03		-3.17*
Mix 2-1	-0.42	0.38	-0.16	-0.46		0.88
Care delivery model						
Continuity of care	NS	NS	NS	NS		
Total patient care	NS	NS	NS	NS		
Work environment variables						
Unit communication	1.56			3.18**		
Technical quality of care				-2.86**		
Coordination of care by programming						
Individual approach to coordination of care						
Head nurse effectiveness				0.32		
Nurse Outcome Variables						
Job satisfaction	2.69**					
Role tension						
Job pressure						
Job threat						

p<.05 **p<.01 ***p<.001

PATIENT QUALITY OUTCOMES

First with regard to the medical-surgical sample; none of the nurse staffing variables and professional mix variables were related to patient satisfaction with nursing care. The effectiveness of unit communication was a significant predictor of patient satisfaction ($t=2.40$; $P< .05$), but this effect disappeared when nurse job satisfaction entered the model. The results suggest that nurse job satisfaction has a direct effect on patient satisfaction. The effect of unit communication is mediated through nurse job satisfaction.

With regard to the obstetrical sample; the professional mix of nurses had a significant effect on patient satisfaction. Patients were more satisfied with their obstetrical nursing care on units where there was a higher proportion of regulated staff. The contrast between an all RN mix compared to a RN/RPN mix indicated patients were more satisfied on units that employed an RN/RPN mix.

PATIENT SOCIAL COSTS

Data were collected on caregiver demand and caregiver difficulty from family members of patients. The caregiver sample was smaller than the patient sample which resulted in less power to answer the research questions among this sample. None of the nurse staffing variables and professional mix variables predicted caregiver demand or caregiver difficulty. Neither did the work environment variables or nurse outcome variables predict caregiver demand and difficulty.

Data were collected on patient visits to an emergency department following hospital discharge. Approximately twenty six percent of the sample of medical-surgical patients made one or more visits to a hospital emergency department in the six weeks post discharge. A logistic regression analysis was used to explore the influence of the nurse staffing variables, professional mix, work environment, and nurse outcomes on the likelihood of making an emergency room visit post discharge. The significant predictors of emergency room visits were unit communication and the quality of nursing care. The direction of the relationships suggest that patients were more likely to visit an emergency room post-discharge when they were discharged from units were nurses perceived the quality of communication to be high and where they perceived the quality of nursing care to be low.

Summary of Results Concerning the Staff Mix Variables

Tables 34 - 36 summarize the results of the HLM analyses testing the effect of nurse staffing, unit communication and nurse outcomes on patient health/ quality outcomes. Nurse staffing had a significant effect on five of the patient health/quality outcomes. In each case, the direction of the relationship suggests that outcome achievement is higher on units that employ a higher skill mix, that is, a higher proportion of RNs and RPNs.

Table 34

PATIENT HEALTH AND QUALITY OUTCOMES THAT WERE INFLUENCED BY THE PROFESSIONAL MIX OF NURSES ON THE INPATIENT UNITS

Professional Mix	FIM T2	Pain T2 (MS)*	Social function T2	Pain T2 OBS*	Satisfaction with nursing care (OBS)
Effect	positive	negative	positive	negative	positive

* MS = medical surgical; OBS = obstetrical

Table 35

PATIENT HEALTH AND QUALITY OUTCOMES THAT WERE INFLUENCED BY THE WORK ENVIRONMENT OF NURSES ON THE INPATIENT UNITS

Effect	FIM T2	Pain T3 (MS)	Physical function T3 (MS)	Pain T2 OBS	Satisfaction with nursing care (OBS)	ER visits
Communication	positive	negative	negative		positive	positive
Technical quality		positive		negative		negative
Coordination			negative			
Problem-solving			positive			

* MS = medical surgical; OBS = obstetrical

Four work environment variables were associated with patient health/quality outcomes; unit communication, technical quality of care, coordination of care, and problem-solving. In the case of technical quality of care and problem-solving, the results were in the expected direction. Patient outcomes were better on units where there was higher technical quality of nursing care and where problems among unit staff were resolved openly. The results regarding unit communication were not consistent. Effective communication was associated with better functional independence scores for medical-surgical patients and higher satisfaction with obstetrical care at discharge. However, effective communication was associated with worse pain and physical function scores for medical-surgical patients at 6 weeks following discharge and greater likelihood of making an emergency room visit post discharge. Coordination of care using a programming approach was associated with worse physical function scores at six weeks following discharge.

Table 36

PATIENT HEALTH AND QUALITY OUTCOMES THAT WERE INFLUENCED BY THE NURSE OUTCOMES

Effect	Social function T2	FIM T3	Mental health T2	Satisfaction nursing care (MS)	Pain T2 OBS
Job satisfaction				positive	negative
Role tension		negative	positive		
Job pressure	positive				
Job threat					

* MS = medical surgical; OBS = obstetrical

Three of the nurse outcomes were associated with patients' health/ quality outcomes. Patients were more satisfied with nursing care and reported lower obstetrical pain on units were nurses were more satisfied with their job. The effect of role tension varied depending on the outcome. Medical-surgical patients discharged from units where nurses reported lower levels of role tension were found to have better functional independence scores at six weeks following discharge than those discharged from units where nurses reported higher levels of role tension. However higher levels of role tension were positively associated with better mental health scores at hospital discharge. Likewise, on units where nurses reported high job pressure, patients reported better social function scores at discharge.

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ORGANIZATIONAL CHANGE

Introduction

This chapter was to provide the results of the following research questions:

2. What are the predominant models of organizational change undertaken by OCOTH hospitals?

6. Does the organizational change model explain variation in patient, cost, and nurse outcomes beyond what is accounted for by differences in case mix, patient complexity, patient age, surgical risk, functional status at admission, and the nursing variables?

Organizational Change

Interviews were conducted throughout the late spring and summer of 1999. These interviews were tape-recorded and transcribed for analysis. The analysis has focused on understanding the different types of strategies used at OCOTH hospitals, and the perceived benefits and drawbacks of these strategies.

Analysis of the interviews indicates a number of conclusions on the overall hospital/nursing environments and their impacts on strategies and outcomes. These conclusions included the almost unanimous recognition that, on an individual basis and collectively, nurses engaged in heroic measures to preserve the quality of patient care, driven solely by a deep professionalism and commitment to their patients. Without this commitment, the patient outcomes measured in this study would very likely have been worse.

Other findings are:

- A primary goal of the strategy of most, if not all, hospitals was to maintain patient volumes while addressing funding reductions. Hospitals did not engaged in the type of downsizing that dramatically reduces services overall or involved withdrawal from a number of program areas. However, a few hospitals noted that future funding problems are now more likely to result in volume reductions.

- While individually hospitals followed their own unique paths, in aggregate, OCOTH hospitals generally followed strategic evolution.

- a movement from downsizing to reengineering as hospitals exhausted the ability to make small, across-the-board reductions without impacting patient care.

- a movement from reengineering to restructuring involving merger and, to a much lesser extent, program prioritization. This was prompted by both board and senior management leadership and the emerging directions of the Health Services Restructuring Commission (HSRC).

While this general evolution occurred, its timing, pace and extent varied considerably among hospitals. Some hospitals had already moved from downsizing to reengineering and/or merger by the beginning of the time period of the study, 1995. Merger was seen to relegate all other strategies to a distant second place.

Reengineering and restructuring are difficult, long-term strategies and were inappropriately perceived as part of the solution to short term fiscal pressures.

The time taken to reach restructuring decisions, both through District Health Council (DHC) and HSRC processes, introduced profound uncertainty and prompted counter-productive activity. At the same time, the short-time frame around Ministry of Health funding reductions reportedly compromised hospitals' abilities to formulate and implement optimal strategic responses.

In the light of funding pressures and HSRC directives, hospitals generally did not have the time, resources or management attention to properly implement, monitor and refine chosen strategies. Hospitals did not conduct formal, comprehensive assessment of strategy impacts beyond contribution to financial targets.

Due to the lack of funding for enabling infrastructure, hospitals, including those engaged in hospital-wide reengineering, were unable to "make the quantum leap" to radically reconfigured care processes brought closer to the patient. Without this investment, many hospitals felt that available opportunities for clinical efficiencies, including reduced length of stay and increased outpatient surgery, have been maximized.

In combination, reductions in the nursing workforce (and the attendant bumping) and, to a lesser extent, unit/program consolidations, skill mix changes and casual-ization, have generated significant displacement of nurses from the clinical areas in which they have both the most clinical expertise and the most interest. In short, nurses feel "reshuffled". This displacement is expected to have had a profound effect on both nursing and patient outcomes. In fact, the majority of interviewees identified this displacement as having the most negative impact on patient care of all the changes that have occurred. As one person stated, "taking apart the nursing family in the unit was the worse thing we have done". Further, although clinical skills and experience have been built by displaced nurses over time, the displacement had not been reversed.

Increasing acuity of hospital patients has had important effects on the desirability and use of nurses with different educational preparation. In general, the growing acuity of patients has increased the need for a skill mix that emphasizes advanced preparation, while the pressures of funding reductions have contributed to decisions to reduce nurse staffing and substitute less expensive nurses and unregulated workers for more advanced educated nurses.

There is an increasing recognition that many hospital nurses are overworked, psychologically stressed, physically suffering, and extremely dissatisfied with their worklife. Many nurses are distressed that they cannot do more for their patients. Both the inherent rewards and attractiveness of the profession were seriously damaged during the study period. In addition, although the last round of funding reductions is now two years in the past, stress levels have not eased.

Increased workload has shifted the role of nursing towards the completion of higher-priority clinical tasks and away from broader patient care activities. Patient education/counselling and discharge planning were most often identified as lacking.

Further analysis of these data and linkage of these data to the quantitative assessments are being undertaken.

DISCUSSION

Discussion

The ultimate purpose of this study was to contribute to the field of nursing administrative research by conducting one of the first research studies in Canada examining the relationships between changes in the nursing staff mix and patient, system (quality and cost), and nurse outcomes. While the literature provides examples of the development and implementation of different staff mix models, there is limited research relating these changes to outcomes. At the same time, a number of issues related to the development of new staff mix models were apparent (e.g. role tension, job dissatisfaction, job stress). The Nursing Staff Mix Outcomes Study (NSMOS) set out to (1) describe the nature of the changes in staff mix in acute-care teaching hospitals in Ontario, and (2) evaluate the impact of changes in staff mix on patient, system and nurse outcomes in these hospitals.

STAFF MIX

More than sixty percent of the hospital units in this study utilized a staff mix comprised of both *regulated and unregulated* staff, with most of these employing RNs and URWs in their staff mix. This appears to indicate that the utilization of RPNs is less apparent in acute care hospital units in Ontario, while the use of URWs as part of the staff mix is more evident. This is similar to findings reported in an earlier study of Toronto teaching hospitals (McGillis Hall, Pink, Johnson & Schraa, 2000).

The proportion of registered nurses employed as part of this staff mix varied across the hospital units examined, with the majority having between 60 and 89% of their staff mix comprised of registered nurses. Of these, 14.3% had over 90 percent of their staff made up of RNs, and close to half had between 70 and 89% of their staff mix comprised of RNs. The proportion of RNs in the staff mix at the time this study was conducted was higher than expected, given the level of restructuring and layoffs that occurred in these hospitals. No good comparitor of acute care staff mix proportions is evident in the literature although a report of nurse staffing from the U.S. health care environment cited staffing ratios in community hospitals as 67% (Wunderlich, Sloan & Davis, 1996).

STAFF MIX AND PATIENT CARE DELIVERY

Most units in this study utilized *total patient care* as the patient care delivery model. On units that did not utilize total patient care, nurse's perceptions of job pressure were higher. Contrary to our expectations, a patient care delivery model that was associated with lower *continuity of care* for patients contributed to nurse's job satisfaction, while a care delivery model that promoted continuity contributed to their perceptions of job pressure. The holistic design of total patient care may be more congruent with nurse's professional perceptions of the way that patient care should be delivered. However the ability to provide patient care continuity throughout the duration of the hospital stay may be taxing for nurses, at least in the situation where patients have high care needs. For this reason, units that assigned nurses to

patients based on geographic proximity had nurses who reported higher levels of job satisfaction and lower levels of role tension. It was also noted in this study that nursing staff who worked as part of *regulated and unregulated* staff mix models were more likely to utilize individual approaches to care. Ensuring that each patient is treated like an individual is one of the core principles of total patient care. Thus it is to be expected that nursing staff in this study, which was comprised primarily of units that utilized total patient care, would employ individualized approaches to care delivery.

STAFF MIX, SYSTEM QUALITY AND NURSE OUTCOMES

The majority of findings related to the staff mix and nurse outcomes in this study underscore the importance of the environment in which nurses work. Almost all of the system quality variables were found to be important predictors of the nurse outcomes. The higher the nurses' perception of the technical quality of the care provided on the unit, the higher their level of job satisfaction. In contrast, the lower the nurses' perception of the technical quality of the care provided on the unit, the higher their level of job pressure, job threat and role tension. This suggests that nurses are concerned about the quality of care they provide to patients, and the concerns perceived by nurse's can have an impact on their work. This finding is important to consider in the context of the restructuring that has occurred in hospitals and the nursing shortage that has developed since then. In efforts to recruit and retain nurses, it would seem essential that consideration be given to addressing the concerns nurses express regarding the quality of patient care. Nurses working in staff mix models comprised of an all RN staff perceive the effectiveness of the technical quality of care provided to patients to be higher.

At the unit level, the less that nurses were required to use programming approaches for coordinating patient care, the more satisfied they were. In contrast, at the individual level, nurses were more satisfied with using programming approaches for patient care, and reported higher levels of role tension if these approaches were not used. It is unclear why the effect of programming approaches to coordination varied depending on the level of analysis (i.e., unit level versus individual). The unit level represents the collective view of all the nurses on the unit who responded to the survey. For this reason, it is a more accurate representation of the environment on the unit. Individual nurses may vary in their expectations and perceptions of care but still be influenced by the environment in which they practice. Programming approaches to coordination include systems such as the utilization of care maps or clinical pathways for planning patient care. Nurses may use these systems as a guide for the overall plan of care, but may need to individualize them according to patient need. In the extreme case of coordination by programming, the systems in place to promote coordination of care may limit the ability to customize care and to make independent decisions about patient care. In this situation, coordination by programming may limit independent professional practice and may be a reason why units that had higher levels of coordination by programming had nurses who reported lower levels of job satisfaction and higher levels of role tension.

Nursing leadership was found to have an important influence on all of the nurse outcomes in this study. Nurses who had a positive perception of the nursing leadership on their unit had higher job satisfaction, and lower perceptions of job pressure, job threat and role tension.

STAFF MIX, PATIENT COMPLEXITY AND NURSE AND COST OUTCOMES

Patient complexity was found to have a strong influence on the nurse outcomes in this study. The lower the average complexity of patients, the higher nursing job satisfaction and the lower their perceptions of job pressure, job threat and role tension. These findings indicate that nurses in this study experienced greater job satisfaction caring for less complex patients, while patients who were more complex created job pressure, job threat and role tension.

As expected, patient complexity was also found to have an influence on *nursing hours cost*. Patients who were more complex utilized more nursing care resources.

STAFF MIX, PATIENT COMPLEXITY AND SECONDARY PATIENT OUTCOMES

Nurse staffing variables were also related to secondary complications experienced by patients in this study. The lower the proportion of regulated staff, the higher the number of medication errors and wound infections. As well, the less experienced the nurse, the higher the number of wound infections. Previous studies have identified a relationship between nurse staffing variables and adverse patient occurrences (ANA, 1997; Blegen et al., 1998).

STAFF MIX, NURSE AND COST OUTCOMES

Staff mix models that included a *lower proportion of regulated staff* utilized more nursing hours in this study. This may reflect the substitution of higher average wage "regulated" staff by lower average wage "unregulated" staff. As well, this finding may reflect the complex needs of the acute-care patient population, since patient age and complexity were found to be predictors of nursing hours utilization within the medical-surgical patient population. Additionally, for medical-surgical patients in this study, more nursing hours were utilized for patients that were older and for patients with higher complexity levels.

STAFF MIX AND PATIENT OUTCOMES

Patient outcomes were selected for study that were expected to be sensitive to nursing care. The outcomes selected focussed on patients' functional health outcomes, pain, social costs, and satisfaction with care. Significant improvements were found in the *health outcome* scores between admission and six weeks following discharge, although at the time of discharge patients actually experienced reductions in many of the health outcomes. This reduction in functional and pain outcomes at discharge is not unexpected because a large proportion of the sample were surgical patients who were recovering from the immediate insult of surgery and anaesthetic.

Nursing staff mix was found to be a significant predictor of five of the patient health and quality outcomes; *functional independence, pain, social functioning, and satisfaction with obstetrical care*. In all cases, higher proportions of RN/RPNs were associated with better health and satisfaction outcomes. It is important to note that the staff mix variable was significant, after controlling for other possible determinants of health outcomes such as case mix, baseline health status, patient age, and complexity of illness. This more rigorous test of the effect of the staff mix variable increases our confidence in the findings.

To the best of our knowledge, this is the first study to demonstrate an association between the professional mix of nurses and patients' self-reported health outcomes at hospital discharge. Previous research has found a relationship between nurse staffing and the occurrence of adverse occurrences such as medication errors, decubitus ulcers, pneumonia, postoperative infections, and urinary tract infections (ANA, 1997; Blegen et al., 1998). The latter were measured at the level of the inpatient unit or hospital, whereas, the outcomes in this study were measured at the individual patient level. The results offer further evidence of the importance of nurse staffing to high quality patient outcomes in acute and tertiary care hospitals.

It is noteworthy that the influence of the staff mix variable was evident at hospital discharge but not at the time of the six week follow-up. Outcomes at discharge are more proximal to the care received from nurses than those at six weeks. Furthermore, at six weeks, the patients' health outcomes are mediated by a number of other factors that we were unable to control for in this study, such as post-discharge care and the home environment.

The kinds of health outcomes that were influenced by nursing care were independence in personal care, pain, and social functioning. This confirms the role that nurses assume in assisting patients with functional recovery following an illness experience and in the management of symptoms such as pain. The fact that the functional independence score at discharge predicted health outcomes at 6 weeks post-discharge, underscores the importance of early functional recovery. For this reason, investment in nursing resources may have both short-term and long-term benefits for patients, although it is in the short-term outcomes that we see the immediate effect of the professional mix of staff.

STAFF MIX, PATIENT AND SYSTEM QUALITY OUTCOMES

The environment in which nurses practice also influenced patient outcome achievement. The *technical quality of care* on the inpatient unit was associated with better pain outcomes for medical-surgical patients and obstetrical patients. Furthermore, medical-surgical patients were less likely to make a visit to an emergency ward following discharge when they had been cared for on units of high quality. These findings offer further support for the importance of nursing resources in acute care and tertiary care hospitals. In this study, the technical quality of care reflected the degree to which the unit met its patient care treatment goals, met family members' needs, applied recent technology to meet patient needs, recruited the best nurses to the unit, and responded to emergency situations effectively.

The quality of *communication* among nurses and between nurses and other disciplines was associated with patients' functional independence scores at discharge and with obstetrical patients' satisfaction with nursing care. These results confirm the findings of previous research (Knaus et al., 1986; Shortell et al., 1994) suggesting that the quality of communication among disciplines is important to patient outcome achievement. However, in this study effective communication was also found to be associated with higher reports of pain and lower physical functioning at 6 weeks following discharge, and greater likelihood of making an emergency room visit after discharge. There is no obvious reason for this paradoxical finding concerning the role of communication and patient outcome achievement. The fact that the

negative effect was borne out for three different outcomes suggests the results are not simply a chance finding. It is of interest to note that the negative effects did not present until the post-discharge outcome assessment. One possible explanation that has been reported in the patient education literature is that communication for the purpose of patient education increases patients' awareness in a way that leads to increased reporting of symptoms and side-effects. If we extend this logic to the patients in this study, it is possible that on units where communication was open and timely among staff, patients were more informed and acted on this knowledge by reporting symptoms and visiting the emergency ward when they needed to following discharge.

The other two work environment variables that were significant predictors of patient outcome were *coordination* by programming and open *problem-solving* among unit staff. The former had a negative influence on physical functioning at 6 weeks post-discharge, whereas the latter had a positive effect. The negative effect of coordination by programming is consistent with the effect of coordination on nurse outcomes. In both cases, too much reliance on programming approaches appears to lead to compromised outcomes. These findings underscore the importance of further research that can inform the field about the best strategies for coordinating care in the complex environments of acute and tertiary care hospitals.

PATIENT AND NURSE OUTCOMES

Several nursing outcomes were associated with the patients' health and quality outcomes. There was a positive relationship between nurse job satisfaction and medical-surgical patients' satisfaction with nursing care. This finding is consistent with what Weisman and Nathanson (1985) found for family planning clinics. They theorized that in human service organizations the process of work relies on staff and client interactions. The job satisfaction of staff may affect client outcomes because it influences the quality of their interactions with clients. We also found that nurses' job satisfaction was associated with better pain outcomes for women after childbirth. Nurses' role tension had a negative effect on patients' functional independence outcomes at discharge, but a positive influence on patients' mental health outcomes. Role tension reflects the lack of clearly defined roles and responsibilities among staff and/or conflicting role responsibilities. Theoretically, one would expect the lack of role definition and role conflict would lead to care gaps if staff do not have a clear understanding of what is expected of them. For this reason, it is plausible that patients' functional health outcomes would be compromised on units where nurses experience high levels of role tension. It isn't clear however, why mental health outcomes were actually better on these units. We are unable offer a plausible explanation for this finding and suggest further research is needed to advance our understanding of how role design influences nursing practice and patient outcomes. Another paradoxical relationship was found between job pressure for unit staff and better social function outcomes for patients. Perhaps nurses are able to rise to the demands of care on their units despite an environment of job pressure and role tension. The qualitative findings support this conclusion, in that nurses 'engaged in heroic measures to preserve the quality of patient care" because of their professionalism and commitment to their patients.

Summary

In summary, the results of this study suggest that a higher proportion of RNs/RPNs on inpatient units in Ontario teaching hospitals is associated with better health and quality outcomes for patients at the time of hospital discharge and with lower rates of medication errors and wound infections. Thereafter, the effect of the staff mix variable is less evident. However, to the extent that nurses are able to contribute to the short-term functional recovery of patients, it appears that these patients will recover healthy functioning in the longer-term. Functional recovery at hospital discharge was predictive of health outcomes six-weeks later.

As well, the importance of the environment in which nurses work has been evidenced in this study. Patient complexity and system quality variables were found to be important predictors of the nurse and patient outcomes studied. These findings provide useful information for nurse executives, senior hospital personnel, and policy leaders about the linkages between nurse staffing and patient care, nurse, and system outcomes.

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Appendix A

ONTARIO TEACHING HOSPITALS PARTICIPATING IN THE STUDY (n=19)

City	Hospital	Campuses
Toronto	1. Hospital for Sick Children	
	2. Sunnybrook & Women's College Health Sciences Centre	- Women's College site - Sunnybrook site
	4. The Toronto Hospital	- General site - Western site
	6. Mount Sinai Hospital	
	7. St. Michael's Hospital	- Bond site - Wellesley site
Ottawa	9. Ottawa Hospital	- Civic Campus - General Campus
	11. Children's Hospital of Eastern Ontario	
Hamilton	12. Hamilton Health Sciences Corporation	- General Campus - Henderson Campus - University Campus
London	15. London Health Sciences Centre	- University Campus - Victoria South - Victoria West
	18. St. Joseph's	
Kingston	19. Kingston General Hospital	

Appendix B

PROJECT ADVISORY WORKING GROUP MEMBERSHIP

OCOTH Chief Nurse Executive Committee Representatives:
- Judith Shamian, VP, Nursing, Mount Sinai Hospital, Toronto (Chair)
- Karen Perkin, Professional Leader, Nursing, St. Joseph's Health Centre, London
- Peggy Goddard, Chief of Professional Practice, Hamilton Health Sciences Corporation
- Doris Doidge, Nursing Education, The Toronto Hospital
- Joan Tranmer, Director, Nursing Research, Kingston General Hospital
- Kathy Dunn, Chief, Nursing & Professional Practice, Ottawa Civic Hospital
- Wendy Nicklin, VP, Programs, Ottawa Civic Hospital

OCOTH Council Representative:
- Phil Hassen, CEO, St. Joseph's Health Centre, London

Community Nursing:
- Sue Munro, VP, Health Services, St. Elizabeth Health Care, Toronto

OHA Staff:
- Caroline Rafferty, Consultant, Hospital Relations
- Mary Beth McMahon, Consultant, Hospital Relations

Appendix C

STAKEHOLDER REPRESENTATIVES

Name	Organization	Position
Sandra Letton	St. Joseph's Health Centre, London	Vice President
Barbara Wahl	Ontario Nurses' Association	President
Leah Casselman	Ontario Public Service Employees Union	President
Michael Hurley	Ontario Council of Hospital Unions	President
Kenneth Brown	Service Employees International Union	International Vice President
Debra Simon	Ministry of Health	Provincial Nursing Coordinator
Claire Mallette	Council of University Programs in Nursing	Assistant Professor McMaster University
Barb Silverman	Council of University Programs in Nursing	Research Projects Coordinator
Gwen Villamere	Humber College	Chair, Nursing
Anne Bender	Humber College	Dean, School of Health Sciences
Charlotte Nosegaard	Registered Nurses' Association of Ontario	President
Doris Grinspun	Registered Nurses' Association of Ontario	Executive Director
Linda Lahay	Registered Practical Nurses' Association of Ontario	President
Margaret Risk	College of Nurses of Ontario	Executive Director

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