A Study of the Impact of Nursing Staff Mix Models and Organizational Change Strategies on Patient, System and Nurse Outcomes

- A Summary Report of the Nursing Staff Mix Outcomes Study -

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Summary Report

Background

The Nursing Staff Mix Outcomes Study (NSMOS) was a province-wide research project that was designed to assess the impact of the composition and mix of nursing care staff in acute care teaching hospitals on patient, nurse and system outcomes. This study was designed to address the imperative for reliable and valid data on the impact of different compositions 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 databases. Approximately 2,046 patients, 1,116 nurses, 63 unit managers, and over 50 senior executives participated in the study. The study had two primary purposes. These were to:

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

The study was generously funded by the Ontario Council of Teaching Hospitals (OCOTH) and the Canadian Health Services Research Foundation (CHSRF), a Federal health services research granting agency which focuses on partnerships between university researchers and the community.

Methodology

A descriptive repeated measures design was used to determine the association between nurse staffing 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, nursing bedside hours cost) and questionnaires (subjective patient outcomes, subjective nurse outcomes). Primary data collection took place throughout 1999 while secondary data linked to the patients in the study were collected in 2000.

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.

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 interventions. A set of CMGs were selected that demonstrated substantial variation in length of stay and were of sufficiently high volume to permit patient recruitment in a timely fashion. The final set of study CMGs was selected if they represented conditions that involved a high degree of nursing intervention, or where nursing interventions related directly to expected outcomes (eg. where nursing interventions focussed on patient education are key to positive outcomes). The CMGs selected included:

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

Patients were eligible for participation if they were admitted to an inpatient unit with one of these diagnoses, and they consented to participate. 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. Nurse outcomes were measured at a single point in time and related to workplace variables.

Multi-level hierarchical linear modeling (HLM) was used for the data analysis in 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).

Definitions and Measures

Nursing Staff Mix

Regulated staff mix = can include two staffing combinations: 1) units that employ registered nurses (RNs) and Registered Practical Nurses (RPNs) for patient care delivery; or 2) units that employ an all-RN staff

Proportion of regulated staff = $\frac{\text{\# RNs \& RPNs on unit}}{\text{\# total nursing personnel on unit}} \times 100$

Total patient care delivery = Individual nursing staff assigned to patient for the duration of the patient's hospital stay and is responsible for planning and coordinating all care.

Patient Outcomes

Patients' functional status = the level at which a person is functioning in a variety of areas, such as physical health, quality of self-maintenance, quality of role activities, social activity, and emotional status (Knight, 2000). A "condition specific" measure of self-reported functional status was used for vaginal delivery subjects (*Inventory of Functional Status after Childbirth (IFSAC)*, Fawcett et al., 1988). Cronbach's alpha for the IFSAC in this study was 0.93. Two methods were used to assess change in functional status for medical-surgical patients. Changes in the medical-surgical patient's functional health outcomes were assessed with the *Functional Independence Measure (FIM)*, Hamilton et al., 1987), and, the Medical Outcome Study *SF-36* (Stewart & Kamberg, 1992). The nurse data collectors used the FIM to assess patient's functional status. Patients self-reported their functional status using the SF-36. Cronbach's alpha for the FIM in this study was 0.87 at Time 1, 0.88 at Time 2, and 0.87 at Time 3. For the SF-36 subscales, Cronbach's alphas ranged from 0.79 to 0.95 at Time 1, followed by 0.73 to 0.99 at Time 2, and 0.80 to 0.99 at Time 3.

Patients perceptions of pain = The severity of pain and its impact on the patient's functioning (*Brief Pain Inventory- Short Form (BPI-SF)*, Cleeland, 1991). Cronbach's alpha for this study was 0.75 at Time 1, 0.90 at Time 2 and 0.90 at Time 3.

Patient satisfaction with nursing care = Patients' perceptions of the quality of nursing care (nursing care quality subscale) (*Patient Judgement of Hospital Quality Questionnaire (PJHQ)*,Rubin, Ware & Hayes, 1990). Cronbach's alpha for this study was 0.88.

Medication errors = Rate at which errors in the administration of medication occur within a given institution including: right medication given to the wrong patient, wrong medication give to the right patient, incorrect dose administered, medications given at wrong time, medications not given at all.

$$\frac{\text{Total number of medication errors x 1,000}}{\text{Total number of patient days for CMG}}$$

Wound infections = $\frac{\text{Number of wound infections}}{\text{Total number of patient days for CMG}}$

Nursing Work Environment

Nursing hours = Nursing hours data include the paid hours, worked and benefit, of registered nurses and registered practical nurses allocated to specific patients in the study. Nursing hours data per patient were obtained directly from hospital finance.

Nurses job satisfaction = Nurses' perceptions of overall or global job satisfaction (*Job in General Scale (JIG)*, Ironson et al., 1989). Cronbach's alpha for this study was 0.91.

Nurses job stress = Nurses' perceptions of job stress including job threat and job pressure (*Stress in General Scale (SIG)*, Smith et al., 1992). Cronbach's alpha for this study was 0.88.

Nurses role tension = Nurses' perceptions of job the strain or tension experienced in response to their work (*Tension Index*, Lyons (1971). Cronbach's alpha for this study was 0.84.

Nurses perceptions of quality of care = 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 (*Perceived Effectiveness of Care Questionnaire (PECQ)*,Shortell, Rousseau, Gillies, Devers & Simons (1991). Cronbach's alpha for this study was 0.83.

Nurses perceptions of the quality of nursing leadership = Nurses' perceptions of the characteristics of overall nursing leadership on the unit, emphasizing the degree to which unit nursing leadership sets and communicates clear goals and expectations and is responsive to changing needs and situations (a subscale of Shortell ,et al., 1991). Cronbach's alpha for this study was 0.90.

Nurses perceptions of coordination of care = Nurses' perceptions of unit communication and coordination processes along a number of dimensions including openness, accuracy, timeliness, understanding and satisfaction (subscales of Shortell et al.,1991). Cronbach's alpha for this study ranged from 0.66 to 0.87 on the subscales.

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Results and Discussion

Patient Outcomes and Nurse Staffing

Primary 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 was surgical patients who were recovering from the immediate effects of surgery and anaesthetic. The reduction in functional status at discharge was less when patients were cared for on units with higher proportions of regulated staff. Specifically, *nursing staff mix* was found to be a significant predictor of four of the patient health and quality outcomes at hospital discharge: *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, gender, and complexity of illness. This more rigorous test of the effect of the staff mix variable increases our confidence in the findings.

The effect of staff mix on patient outcomes 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.

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.

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.

The environment in which nurses practice also influenced patient outcome achievement. The *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. In this study, the 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 positively 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. The other two work environment variables that were significant predictors of patient outcome were *coordination* by structured- programmed means 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 may reflect too much reliance on pre-determined means to coordinate care, which may limit staffs' ability to respond to unforeseen circumstances in innovative ways. 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.

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. 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 positively 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 that 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 to 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.

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Secondary patient outcomes. Data were collected on unit rates of medication errors, patient falls, wound infections, urinary tract infection, and pneumonia. 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. As well, on units where there were less experienced nurses, there were higher rates of wound infections. Previous studies have identified a relationship between nurse staffing variables and adverse patient occurrences (ANA, 1997; Blegen et al., 1998).

Nursing Work Environment and Nurse Staffing

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. Assignment of patients in close geographic proximity to one another contributed to nurse's job satisfaction, while the inability to do so 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. The ability to provide continuity in patient assignment throughout the duration of the hospital stay when patients are located in various areas of the patient care unit may be taxing for nurses, given the complexity of in-patients in today's health care system. 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.

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 *quality of the care* provided on the unit, the higher their level of job satisfaction. In contrast, the lower the nurses' perception of the 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.

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. 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. 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 prefer to employ individualized approaches to care delivery.

Nursing leadership was also 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.

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. These findings suggest 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. However, there are a number of factors that are known to affect nurses' job satisfaction, many of which were not assessed in this study. It is possible that units where complexity was high may also have experienced work conditions unfavourable to nurses' job satisfaction. These issues require further examination in future studies.

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. This may reflect the utilization of fewer hours of the more "costly" regulated staff mix members, and the substitution of these with "less costly" workers. 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.

Conclusions

In summary, the results of this study suggest that a higher proportion of RNs/RPNs on inpatient medical/surgical and obstetrical units in Ontario teaching hospitals is associated with better health and quality outcomes for these 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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Summary of Key Findings

Patient Outcomes

- 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 four 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 *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 associated with better functional independence for medical-surgical patients at discharge and with obstetrical patients' satisfaction with nursing care

- *Nurses' job satisfaction* was associated with higher satisfaction with nursing care for medical-surgical patients, and with better pain outcomes for women after childbirth

- Nurses' *role tension* was associated with lower functional independence outcomes for medical-surgical patients at discharge

Nursing Work Environment

- 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 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

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