

Nurse Staffing and Patient Outcomes: Evolution of an International Study

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Des réformes effectuées aux États-Unis, au Canada et en Europe influant sur toute l'industrie du secteur de la santé ont donné lieu à une occasion unique, celle d'examiner les effets de la restructuration des hôpitaux sur les soins infirmiers auprès des malades hospitalisés et des résultats en regard de leur guérison, et ce dans un éventail de situations. Sept équipes de recherche interdisciplinaires, en provenance d'Alberta, de Colombie-Britannique, d'Angleterre, d'Allemagne, d'Ontario, d'Écosse et des États-Unis, ont formé un consortium international dont le but est d'étudier les effets d'une telle restructuration. Chaque équipe a recruté un grand nombre d'hôpitaux et d'infirmières pour cerner le rôle que joue l'organisation des soins infirmiers, ciblés par les mesures de restructuration hospitalière, en regard de la guérison des patients. L'étude vise à favoriser la compréhension de l'influence qu'exerce le personnel infirmier autant que l'environnement de la pratique professionnelle à l'égard d'une telle guérison. Une discussion sur la fondation théorique, la conception de l'étude et le processus de développement des méthodes et des instruments de mesure utilisés dans le cadre de l'étude illustre le déroulement du processus jusqu'à maintenant, en plus de la faisabilité d'un tel projet international et des occasions générées.

Industry-wide health sector reforms in the United States, Canada, and Europe have provided a unique opportunity to examine the effects of hospital restructuring on inpatient nursing care and patient outcomes across an array of settings. Seven interdisciplinary research teams — 1 each in Alberta, British Columbia, England, Germany, Ontario, Scotland, and the United States — have formed an international consortium whose aim is to study the effects of such restructuring. Each site has enrolled large numbers of hospitals and nurses to explicate the role that organization of nursing care, a target of hospital restructuring, plays in differential patient outcomes. The study seeks to understand more fully the influence of both nurse staffing and the nursing practice environment on patient outcomes. Discussion of the theoretical foundation, study design, and process of developing the study instruments and measures illustrates the process to date, as well as the feasibility of and opportunities inherent in such an international endeavour.

Widespread hospital reforms, undertaken during the 1990s in response to both marketplace and public policy initiatives to increase efficiency, have succeeded in transforming hospitals in the United States, Canada, and Europe (Anderson, 1997; Chan & Lynn, 1998; Office of Technology Assessment, U.S. Congress, 1995; Saltman & Figueras, 1998; Sochalski, Aiken, & Fagin, 1997). These reforms have left behind hospitals whose workforce and work-flows have been substantially reorganized (Decter, 1997; Harrison, 1997; Walston, Burns, & Kimberly, in press; Walston & Kimberly, 1997). In particular, many hospitals have altered their nursing

skill mix — employing fewer R.N.s to supervise growing numbers of lesser-trained assistive personnel — and have redefined the roles of nurses and other staff in the delivery of patient care (Bernreuter & Cardona, 1997; Brannon, 1996; Shamian & Lightstone, 1997; Shindul-Rothschild & Duffy, 1996; Siehoff, 1998; Vincent, 1997; Willmot, 1998).

In its recent report to the U.S. Congress on nurse staffing in hospitals, the Institute of Medicine (IOM) issued a call for empirical studies to determine if the quality of care in hospitals was being adversely affected by the reorganization of the nursing workforce (Wunderlich, Sloan, & Davis, 1996). Spurred by this call for research from the IOM, as well as by the international escalation of hospital reorganization and the growing number of reports from hospital nurses of deteriorating working conditions (Driedger, 1997; Gordon, 1997; Shindul-Rothschild, Berry, & Long-Middleton, 1996), researchers from the University of Pennsylvania convened a state-of-the-science conference on hospital workforce restructuring. With funding from the Rockefeller Foundation, the Penn team, led by Drs. Linda Aiken and Claire Fagin, invited experts from the hospital sector, public policy, health workforce, nursing and medicine, and health outcomes research in the U.S., Canada, the U.K., and Germany to the Rockefeller Conference Center in Bellagio, Italy, in November 1996 to participate in this conference (Sochalski, Boulis, Shamian, Buchan, & Müller-Mundt, 1997). The purpose of the conference was to determine the extent and nature of hospital workforce restructuring across countries with differently organized and financed health-care systems, and to assess the feasibility of an international study on the outcomes of hospital restructuring. Within 1 year, participants in the Bellagio conference had organized interdisciplinary research teams in seven sites — Alberta, British Columbia, England, Germany, Ontario, Scotland, and the U.S. (Pennsylvania) — each of which procured funding from broad-based government and private foundation sources to support their participation in a large international study to assess the impact of hospital reorganization on patient outcomes (Sochalski & Aiken, 1999).

The study asks whether changes in the numbers of nurses and the practice environment in hospitals resulting from workforce restructuring have affected patient outcomes (McKee, Aiken, Rafferty, & Sochalski, 1998; White, 1997). Each site is treated as an “independent replication” of a common study design, with the goal of determining the strength and consistency with which the organization of nursing care explains differences in patient outcomes across sites. A multinational study affords the opportunity to capture a greater degree of variation in levels of nurse staffing, characteristics of the nursing practice

environment, and patient outcomes than one would get from studying any one country, thus providing a stronger test of the relationship among these factors.

In this paper we present an overview of the study and its theoretical framework, focusing on the efforts undertaken to create robust measures of the organization of nursing care in each site by adapting instruments and methods developed in the U.S. We illustrate the steps taken to incorporate important site-specific features of nursing practice and the health-care system, and we describe the activities involved in the preparation of the study data for data-sharing and cross-site analysis. Finally, we discuss the implications of this international research initiative for the future of health services and nursing research.

Study Aims and Design

This multi-site study poses the question: *Does the organization of nursing care in hospitals contribute substantively to differences in patient outcomes independent of other organizational features that have been shown empirically to be associated with outcomes?* Specifically, we are endeavouring to explicate the *direct* and *indirect* effects of both nurse staffing *and* the nursing practice environment on outcomes, while controlling for other contributing organizational characteristics of hospitals (Aiken, Sochalski, & Lake, 1997). The impetus for this line of inquiry comes from a U.S. study that found lower mortality rates in "magnet" hospitals — hospitals identified through a reputational study as having superior professional nursing practice environments (Gleason-Scott, Sochalski, & Aiken, 1999; Kramer & Schmalenberg, 1988a, 1988b) — than in a comparison group of non-magnet hospitals matched on organizational characteristics associated with patient outcomes, such as size, teaching status, qualifications of physicians, and technology (Aiken, Smith, & Lake, 1994). These lower mortality rates persisted even after controlling for differences in nurse staffing. The Aiken et al. (1994) study established an important link between magnet hospitals and better patient outcomes, but left unanswered the question as to whether it was the professional nursing practice environment in these hospitals that was substantively responsible for these outcomes or some other unspecified feature of the hospital. This research initiative takes up that question by employing, in a single study, data on the characteristics of the nursing practice environment and nurse staffing for a large number of institutions that vary on key organizational features.

The theoretical framework guiding this investigation is drawn from the fields of nursing, sociology, and organizational theory and articu-

lates the role that the organization of nursing care plays in effecting patient outcomes. The study model defines the organization of nursing care as comprising two elements: nurse staffing levels and attributes of the nursing practice environment. Nurse staffing levels have been linked with patient outcomes in studies conducted in the U.S. and the U.K. (Aiken, Sloane, Lake, Sochalski, & Weber, 1999; Blegen, Goode, & Reed, 1998; Czaplinski & Diers, 1998; al-Haider & Wan, 1991; Hartz et al., 1989; Hunt, 1997; Kovner & Gergen, 1998; Shortell & Hughes, 1988), as have a number of other hospital organizational characteristics, such as teaching status and the availability of state-of-the art technology. There is little theory explaining *how* these characteristics influence patient outcomes, a noted shortcoming of most organizational research in health care (Flood, 1994). This study seeks to address that shortcoming, proposing that organizational attributes that characterize the hospital's nursing practice environment, in addition to nurse staffing and other hospital characteristics, not only play an important role in differential patient outcomes and but may in fact serve to explain in part why these features have been associated with outcomes in previous studies. Indeed, Rosenthal, Harper, Quinn, and Cooper (1997), who found better patient outcomes in major teaching hospitals in the U.S. as compared with teaching-affiliated and non-teaching hospitals, speculated that the "teaching effect" may actually be a proxy for such features as the organization of nursing care, and emphasized the need for outcomes studies that examine more fully the organizational features of hospitals.

To that end, this study links both primary data from hospital staff nurse surveys and administrative data on patient outcomes and organizational characteristics of hospitals in a nested study design — that is, the responses of nurses are "nested" within hospitals and hierarchical regression models are used to assess the effects of both hospital-level characteristics and nurse-level characteristics within hospitals on patient outcomes. The hospitals included in the sampling frame were determined by the availability of patient outcomes data. In the U.S., the state of Pennsylvania has a particularly rich public-use hospital discharge data set that is available annually for the full census of acute-care hospitals and admissions. Furthermore, these hospitals are representative of hospitals throughout the U.S. on a number of organizational features (e.g., size, urban/rural location, teaching status). Consequently, the full census of acute-care hospitals in Pennsylvania make up the U.S. component of the study. For all three participating provinces in Canada and for Scotland, comparable hospital discharge data exist for the full census of acute hospitals within their borders, thus allowing for their inclusion in the study sample. In England and Germany, the sample includes a subset of hospitals for whom data on patient outcomes and hospital

characteristics are available through a private firm contracted to manage their information systems (see Table 1).

Registered nurses working in each of the study sample hospitals were the sampling frame for a staff nurse survey that would provide information on the nursing practice environment and other features of the workplace at each of these institutions. Staff nurses work across all patient-care departments within hospitals, and consequently they are well positioned to assess critical features of an institution affecting patient care and its outcomes. Uniform criteria for drawing the staff nurse sample were developed and applied in each site. In Canada and the U.S., the nurse registry lists served as the data source for the sampling frame; sampled nurses were asked on the survey to identify the hospital where they worked, which would allow their responses to be assigned to the appropriate hospital. In England, Scotland, and Germany, lists of eligible staff nurses were obtained directly from the hospitals enrolled in the study, making up their sampling frame. As seen in Table 1, the final sample included thousands of nurses in each site, whose responses are nested within large numbers of hospitals. The scale of this survey effort, while ambitious, was dictated by the nested study design, which requires that a representative sample of nurses be obtained for each hospital.

Table 1 *Hospital and Staff Nurse Study Samples*

Number of:	Alberta	British Columbia	England	Germany*	Ontario	Scotland	U.S.
Hospitals	109	97	32	30	209	27	210
Nurses	6,558	2,838	5,006	4,000	8,778	5,238	14,145
* The number of nurses in the study sample for Germany is an estimate; in the fall of 1999 the study was to commence.							

Outcome Measures

The study design rests on patient outcome measures that (a) are sensitive and reliable indicators of quality of care and nursing practice (Strickland, 1997), and (b) could be derived from secondary data sources in each country. To that end, two key measures have been selected: hospital mortality rates, which as noted earlier have a well-documented empirical record of association with nursing, and a new and empirically promising outcome measure developed in the U.S. and using data from secondary or administrative sources — the failure-to-rescue rate (Silber, Rosenbaum, & Ross, 1995; Silber, Rosenbaum, Schwartz, Ross, & Williams, 1995; Silber, Rosenbaum, Williams, Ross, &

Schwartz, 1997). The failure-to-rescue rate is defined as the rate of death among patients experiencing complications, and can be thought of as the probability that a hospital fails to rescue patients who experience complications. The ability to rescue patients from complications is a function of nursing vigilance, of which surveillance is a large component. Nurse staffing levels determine the amount and quality of the interaction between nurses and patients and thus the effectiveness of the surveillance system in detecting early signs of complications. Furthermore, the nursing practice environment enhances or impedes nurses' timely interventions once complications are detected. Early detection of complications and a rapid response are related to survival, hence the conceptual link between nurse staffing, the practice environment, and patient outcomes.

Measures of the Organization of Nursing Care

In each study site, administrative or secondary data sources are available that contain at least rudimentary information from which commonly used aggregate measures of nurse staffing and nursing workload can be readily calculated, such as nurse-to-patient ratios and nursing skill mix. Procuring information on the nursing practice environment of hospitals, however, required the collection of primary data from the staff registered nurses in the study hospitals. A staff nurse survey used in a previous study in the U.S. (Aiken, Lake, Sochalski, & Sloane, 1997) served as the basis for development of the international nurse survey that would be used to obtain measures of the nursing practice environment and other features that characterized the work setting and nurses' work. The survey contained both study instruments and groups of items capturing features of the workplace: (1) the Revised Nursing Work Index (NWI-R), a 49-item inventory of work-environment features that nurses report as being important to delivering high-quality patient care (see Table 2), which had been adapted from Kramer and Hafner's (1989) original 65-item Nursing Work Index from their work with magnet hospitals; (2) the Maslach Burnout Inventory (Maslach & Jackson, 1982; Maslach, Jackson, & Leitner, 1997), a well-established instrument measuring domains of job stress and burnout; (3) reported incidence of needle-stick injury, risk factors, and prevention measures available (Aiken, Sloane, & Klocinski, 1997) that had been used to assess workplace safety; (4) a series of questions describing the nursing workload on a typical shift; and (5) questions about their work experience and level of expertise, characteristics of their current position (e.g., full-time, shifts worked), their job satisfaction, and demographic information.

Table 2 *Revised Nursing Work Index (NWI-R)*

For each item, the respondent indicates on a 4-point scale (strongly agree, somewhat agree, somewhat disagree, strongly disagree) the extent to which the item is present in their current job.

1. Adequate support services allow me to spend time with my patients.
2. Physicians and nurses have good working relationships.
3. A good orientation program for newly employed nurses.
4. A supervisory staff that is supportive of nurses.
5. A satisfactory salary.
6. Nursing controls its own practice.
7. Active staff development or continuing education programs for nurses.
8. Career development/clinical ladder opportunity.
9. Opportunity for staff nurses to participate in policy decisions.
10. Support for new and innovative ideas about patient care.
11. Enough time and opportunity to discuss patient care problems with other nurses.
12. Enough registered nurses on staff to provide quality patient care.
13. A nurse manager who is a good manager and leader.
14. A chief nursing officer who is highly visible and accessible to staff.
15. Flexible or modified work schedules are available.
16. Enough staff to get the work done.
17. Freedom to make important patient care and work decisions.
18. Praise and recognition for a job well done.
19. The opportunity for staff nurses to consult with clinical nurse specialists or expert nurse clinicians.
20. Good working relationships with other hospital departments.
21. Not being placed in a position of having to do things that are against my nursing judgment.
22. High standards of nursing care are expected by the administration.
23. A chief nursing officer equal in power and authority to other top level hospital executives.
24. A lot of team work between nurses and physicians.

Table 2 (cont'd)

25. Physicians give high quality medical care.
26. Opportunities for advancement.
27. Nursing staff are supported in pursuing degrees in nursing.
28. A clear philosophy of nursing that pervades the patient care environment.
29. Nurses actively participate in efforts to control costs.
30. Working with nurses who are clinically competent.
31. The nursing staff participate in selecting new equipment.
32. A nurse manager who backs up the nursing staff in decision making, even if the conflict is with a physician.
33. Administration that listens and responds to employee concerns.
34. An active quality assurance program.
35. Staff nurses are involved in the internal governance of the hospital (e.g., practice and policy committees).
36. Collaboration between nurses and physicians.
37. A preceptor program for newly hired RNs.
38. Nursing care is based on a nursing rather than a medical model.
39. Staff nurses have the opportunity to serve on hospital and nursing committees.
40. The contributions that nurses make to patient care are publicly acknowledged.
41. Nurse managers consult with staff on daily problems and procedures.
42. A work environment that is pleasant, attractive, and comfortable.
43. Opportunity to work on a highly specialized patient care unit.
44. Written, up-to-date nursing care plans for all patients.
45. Patient care assignments that foster continuity of care, i.e., the same nurse cares for the patient from one day to the next.
46. Staff nurses do not have to float from their designated unit.
47. Staff nurses actively participate in developing their own work schedules (i.e., what days they work; days off; etc.).
48. Each patient care unit determines its own policies and procedures.
49. Working with experienced nurses who "know" the hospital system.

Previous studies in the U.S. using the NWI-R have linked attributes of the nursing practice environment derived from its items with patient outcomes. In one study, nurses working in a sample of magnet hospitals were much more likely to report having access to sufficient patient-care resources than nurses working in a comparative group of non-magnet hospitals (Sochalski, Boulis, et al., 1997). These findings suggest that nursing practice environment attributes derived from the NWI-R may be able to distinguish hospitals with better patient outcomes, in this case magnet hospitals, offering support for an empirical link between the practice environment and patient outcomes. This link is underscored by the findings of a study by members of the Penn team evaluating the outcomes of organizational innovations in inpatient AIDS care in the U.S. (Aiken et al., 1999). Higher levels of patient satisfaction were found on units where nurses reported better access to patient-care resources, after controlling for patient and hospital characteristics as well as nurse staffing levels. These findings suggest that the nursing practice environment can play a significant and independent role, beyond that of nurse staffing, in effecting patient outcomes.

Preparation of a Multinational Nurse Survey

To assess the face validity and applicability of the U.S. survey instrument across each of the international sites, two approaches were employed: focus groups (Krueger, 1994; Morgan, 1998; O'Brien, 1993) and pilot/feasibility studies. The focus group procedure entailed distributing the survey to small groups comprising staff nurses, nurse researchers, and nurse administrators. Each member of a focus group was asked to review the instrument for its face validity, completeness, appropriateness, applicability, and language. An integral task of the focus group was to determine if the NWI-R offered a meaningful and appropriate way to capture key features of nursing practice environment. The groups were then convened and collectively they reviewed the instrument, item by item, on the above criteria. A total of 10 focus groups were held in the six non-U.S. study sites. Each focus group comprised from five to 10 members, and the mix of nurses, while dominated by staff nurses, varied across the groups. In each site, the consensus from the focus group was that the NWI-R possessed considerable face validity for the purposes of the study. Minor language changes were required in a minimal number of items to accommodate site-specific terms and expressions. The Maslach Burnout Inventory was also viewed as having sufficient face validity and required no changes, and it had been used in other nursing studies in Canada, the U.K., and Germany (Hatcher & Laschinger, 1996; Hayter, 1999).

Modifications were required of some items assessing the nurses' work experience and characteristics of their current job and setting in order to reflect accurately the realities of the practice settings. For example, shift lengths, lines of reporting, and safety devices to prevent needle-stick injury varied widely among the study sites. Items assessing these features were individually tailored across sites in ways that would preserve the *intent* of the item while reflecting the actual practice in the setting.

In three of the six sites, two hospitals were selected in which to pilot test the survey. The goal of the pilot test was to assess the applicability of the instrument in these settings and to determine if similar nursing practice environment attributes could be found in these non-U.S. sites. The survey was distributed to a random sample of inpatient staff nurses in two hospitals in Ontario, England, and Germany, and at least half of the nurses in each hospital completed and returned the survey. A statistically significant difference was found between hospitals in Ontario and England on the nurses' access to patient-care resources, and the difference approached statistical significance in Germany (see Table 3). In each country, the hospital with the higher mean score was a large teaching hospital with national reputation for excellence in patient care and nursing practice. The scores obtained for nurse access to patient-care resources for a magnet (Hospital A) and non-magnet (Hospital B) in the U.S. show the same pattern as the international sites. Both the range of scores and their pattern suggest that the NWI-R can be used in international settings to capture attributes of the nursing practice environment that may help to explain differences in patient outcomes.

Table 3 *Differences in Mean Scores on Nurse Access to Patient-Care Resources for Hospitals in England, Germany, Ontario, and the U.S.*

Site	Hospital A	Hospital B	t-stat	p
England	10.9 (3.2) (n = 260)	9.6 (3.0) (n = 336)	4.90	<0.001
Germany	9.2 (2.7) (n = 235)	8.6 (2.6) (n = 99)	1.60	0.110
Ontario	9.1 (3.2) (n = 56)	6.9 (3.1) (n = 40)	3.30	0.001
U.S.	10.5 (2.9) (n = 177)	8.0 (2.9) (n = 138)	7.53	<0.0001

The results of the focus groups and the feasibility studies were part of the agenda for a 3-day investigators' meeting held in Washington, DC, in June 1998. Team members from each of the seven sites were convened to review the status of the study in each site and to prepare for fielding the staff nurse survey in the fall of 1998. An important goal of the meeting was the construction of a common nurse survey instrument for use in each site. To that end, each site presented the results of their focus groups and pilot/feasibility studies. The seven teams then collectively reviewed the instrument item by item. Consensus was reached that the international survey would comprise a revised common or "core" survey and a site-specific section at the end containing a limited number of items assessing issues of salience in that country or province. The core survey included the major elements of the pilot survey — the NWI-R, the Maslach Burnout Inventory, a streamlined set of questions on needle-stick injury and workplace safety, nursing care workload on the last shift worked, and characteristics of their position, their work experience, and job satisfaction. A number of items were added to the core survey to extend the domains assessed and to facilitate cross-site comparisons. These items included questions on the quality of nursing care, frequency of adverse events (e.g., patient falls, nosocomial infections), patient readiness for discharge, use of student nurses to support nursing personnel, prevalence of overtime, and nursing interventions left undone for lack of time. The items added at the end of the survey varied by site: Alberta and British Columbia added questions on abuse in the workplace to explore the scope and degree of this problem, which has been increasingly reported by nurses; Ontario included a scale measuring effort-reward imbalances in the workplace (Peter & Siegrist, 1997); and England and Scotland added items on the incidence of and reasons for time away from work and perceptions of involvement in decision-making at the hospital.

Data Preparation and Documentation

With consensus on the survey items in place, preparation of a database that can be shared across sites has become the next task. While not commonly addressed in the health-research literature, data sharing and the attendant preparation required is increasingly common in the social sciences (Estabrooks & Romyn, 1995). Here the task is twofold: assuring uniformity in coding and data entry; and developing a suitable data file that can be shared and used across sites. Typically, the temptation in many studies is to expedite the data-entry phase so that tabulations can be generated, while the data files themselves may end up, unfortunately, being treated as by-products or research "refuse." However,

when data sharing is a planned objective, the data products take on a much higher profile and must be viewed as separate and significant contributions of the overall research project. The data products include raw data files, machine-readable data documentation, command files for statistical software, and internal or system files from statistical systems such as SAS or SPSS.

To share data — or to prepare data so that sharing is a possibility — attention must be given to several issues. First, since the data may be available to researchers other than the investigators who collected the data, details about the data must be clearly documented. Several data sources comprise this study — the staff nurse survey, the administrative data files containing information on hospital characteristics, and hospital discharge data files from which patient outcomes data are derived — each of which is a separate data file. Documenting each data source and its resulting data products is a critical step, including the original instrument for each and the rules for converting items to variables in the data file. Furthermore, since the study design requires linking these three data sources, each data file must include a common identifier, in this case a hospital identifier, so that they can be subsequently merged.

Second, if comparisons are to be conducted across sites, the common variables need to be organized similarly in each data file. Mapping the record layout so common items have comparable formats and can be readily located across the multiple surveys is essential at an early stage in planning the content of these files. Coding schemes must be harmonized to ensure that the values of variables across the surveys are identical. Furthermore, administrative variables that identify the component parts of the overall project need to be incorporated in both the documentation and the data. For example, a separate variable to identify the country within which the survey was conducted may be the first variable in the data file.

Third, data sharing raises further concerns about protecting the identity of subjects and taking steps to guard against disclosure. While confidentiality is an issue, options do exist for anonymizing data to minimize the risk of disclosure. There are various ways of preparing data so that they can be shared with others outside the original research team. For example, all personal information that might lead to the easy identification of subjects may be kept in a file that will not be shared but that has a key variable permitting access to the data file by the original investigators. Another strategy employed by national statistical agencies is to prepare public-use files of confidential surveys:

A master file is produced containing all of the information in its fullest detail; from this file, a public-use file is created and shared with other researchers.

The study team in Alberta took the lead in developing the template for data coding, entry, and documentation for the study. Careful mapping of the record layout was undertaken so common items could be readily located, and coding schemes were harmonized so that the values assigned to all the variables would be comparable. Furthermore, administrative variables (e.g., country/site) were incorporated in both the documentation and the data. Steps are now underway to establish the final protocol to protect the identity of subjects and to guard against disclosure. The product of these efforts in data preparation, we believe, will be data products that will not only support sophisticated analysis to meet the research aims of the international study, but will also be useful in the pursuit of a broader agenda in outcomes research.

Implications and Future Directions

Primary data collection with the nurse survey is complete in six of the seven study sites and we anticipate completion of the nurse survey by the end of 1999. Survey response rates have ranged from 45% to nearly 60% across the six sites, and a review of the data across sites has revealed minimal missing data across the entire survey. A second meeting of the investigators was held in June 1999 in conjunction with the International Council of Nurses Centennial meetings in London. At this meeting, preliminary analyses of the survey data were presented and reviewed and plans for intra- and inter-site analyses were developed (these are currently underway). Acquiring the survey data has been a labour-intensive and resource-intensive process, made more so by our goal of maximizing the utility and comparability of the data sets and our commitment to sharing the survey data across sites and more broadly on completion of the study. The result, we believe, is an unprecedented and valuable collection of nurse and organizational data that can be linked to patient outcomes — data from thousands of hospital staff nurses in five countries that can be used to characterize the organizational environment of hospitals. To date, much of the research undertaken to characterize hospitals and the effects of organizational change uses information obtained from surveys and interviews of small numbers of executive and administrative staff. In this endeavour, it is the staff nurses in the hospital who are providing an assessment of the organization and an evaluation of the presence of features important to the delivery of quality patient care.

As with the survey data, work is underway to develop and refine the patient outcomes measures, particularly the failure-to-rescue measure. Calculation of the failure rate requires the identification of patients experiencing complications during their hospital stay, a challenge in many sites where administrative or secondary data sources lack the depth and detail in diagnosis and procedure coding necessary to accurately and reliably identify complications among hospitalized patients (Iezzoni, Daley, Heeren, Foley, Fisher, et al., 1994; Iezzoni, Daley, Heeren, Foley, Hughes, et al., 1994; McKee, & James, 1997). An alternative method for calculating the failure rate that does not rely on these data to identify patients with complications — one that substitutes a prolonged hospital length of stay (LOS) for a documented complication event — is currently being tested. Preliminary work with hospital discharge data in the U.S. and Canada shows strong correlations between failure rates calculated using complications data and rates using prolonged LOS for complications (Silber, Even-Shoshan, Sutaria, Tu, & Anderson, 1998). Extension of this work is currently underway among the other study sites to determine whether sensitive failure rates can be calculated from existing secondary data sources.

This study will also advance the agenda of nursing outcomes research by employing multi-level models to examine the influence of organizational characteristics of nursing on patient outcomes. The study design calls for estimating hospital-level scores on organizational attributes of the practice environment by nesting responses from nurses within the hospital at which they are employed (Aiken, Sochalski, & Lake, 1997). An attribute is deemed to be reliably measured when the variability in responses within hospitals is small relative to the variability among hospitals. However, responses may be influenced by certain nurse characteristics, independent of the setting where they practice, and as such could confound interpretation of the findings. For example, nurses with a baccalaureate degree, regardless of where they work, may be more likely to agree that certain attributes are present at their hospital. Recent methodological advances provide the researcher with robust methods for combining individual and aggregate-level data in the same analysis, while controlling for such potentially confounding effects, when using aggregate measures to predict patient outcomes (Aiken, Sloane, & Sochalski, 1998; Goldstein & Spiegelhalter, 1996).

Finally, this study is serving as a springboard for other research initiatives and collaborations, extending the life of the data generated in this effort well beyond the international study described here. Not only are these data a rich source of analysis in themselves, but they hold considerable potential for linkage with other relevant databases. Indeed,

the Ontario team has sought and received funding for two additional studies using the nurse survey data, one of which links the practice environment attributes and burnout scores with other databases in the province containing information on workplace injuries among nurses in hospitals. The Penn team, meanwhile, is linking their study data with those from a study that has catalogued hospital reorganization activities over a 5-year period in a subset of Pennsylvania hospitals. Cross-site collaborations are also being forged, leading to secondary studies and joint publications on wide-ranging topics. For example, the research teams across the three Canadian provinces are examining nurse burnout, its causes, and its relationship to patient outcomes, and the teams at Penn, Canada, and the U.K. are exploring the relationship between quality of care assessments and patient outcomes.

This international study and its resulting collaborations have stimulated a systematic study of the influence of nursing on patient outcomes, in large part because of the availability of such a rich data source with which to do so. There is every indication that new opportunities to extend this outcomes research agenda will continue to arise. We envision that work on this study will lead to additional international partnerships, and will leave behind a legacy of interdisciplinary research that serves nursing and patients well.

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