



HEALTH POLICY AND SYSTEMS

Predictive Validity of the International Hospital Outcomes Study Questionnaire: An RN4CAST Pilot Study

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Key words

Work environment-working conditions, quality improvement-quality of care-quality of services, health policy, survey methodology-data collection

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Accepted: 28 February 2009.

doi: 10.1111/j.1547-5069.2009.01272.x

Abstract

Purpose: To study the predictive validity of the instrument used in the International Hospital Outcomes Study (IHOS) for an upcoming EU-funded project (RN4CAST), which will indicate the effect of the nursing work environment and nursing staff deployment on nurse recruitment, retention, and productivity; and on patient outcomes in 11 European countries.

Methods: Cross-sectional analysis of data from 179 nurses (75% response rate) who completed an IHOS-like nurse survey questionnaire, which included the Revised Nursing Work Index and the Maslach Burnout Inventory. The nurses worked in four Belgian acute-care hospitals. Logistic regression modeling was performed to explore associations between nurse-perceived outcomes and nursing work environment factors that were checked with confirmatory factor analysis.

Findings: We confirmed associations between nurse-perceived outcomes and the following nursing work environment factors: nurse-physician relationship; staffing, and resource adequacy; and nurse manager ability, leadership, and support of nurses. A 1-point increase in the rating of the factor nurse-physician relationship was significantly associated with a 2.5-fold (*OR*, 2.53; 95% *CI*, 1.29–4.93; $p < 0.01$) increase in the odds of reporting high job satisfaction and with a fourfold (*OR*, 4.02; 95% *CI*, 1.85–8.70; $p < 0.001$) increase in the odds of reporting excellent nurse-perceived quality of care. A 1-point increase in the rating of the factor staffing and resource adequacy was significantly associated with an approximate threefold (*OR*, 2.81; 95% *CI*, 1.38–5.72; $p < 0.01$) increase in the odds of reporting high job satisfaction and with a fourfold (*OR*, 0.23; 95% *CI*, 0.12–0.47; $p < 0.001$) decrease in the odds of reporting burnout.

Conclusions: The predictive validity of the IHOS instrument was supported by the confirmation of key factors, which were previously identified by previous international research, and by the finding of similar associations between these factors and nurse-perceived outcomes. The IHOS questionnaire that will be used in the RN4CAST project is robust and psychometrically sound.

Clinical Relevance: The RN4CAST consortium, consisting of members from 15 countries, will use a similar instrument to that used in the International Hospital Outcomes study to measure the nursing work environment. This information will be linked with patients' experiences and data extracted from routinely collected hospital discharge data. RN4CAST will show the important role of nursing staff in providing high quality care and allow refinement of current forecasting models for personnel planning in nursing.

The International Hospital Outcomes Study (IHOS) and other studies have indicated an association between the nursing work environment and nursing staff deployment (number and qualification), and negative nurse outcomes (e.g., burnout, job dissatisfaction) and adverse patient outcomes (e.g., mortality, failure-to-rescue; Aiken, Clarke, Sloane, Sochalski, & Silber, 2002; Gunnarsdottir, Clarke, Rafferty, & Nutbeam, 2007; Kane, Shamliyan, Mueller, Duval, & Wilt, 2007; Needleman, Buerhaus, Mattke, Stewart, & Zelevinsky, 2002; Tourangeau, Cranley, & Jeffs, 2006; Vahey, Aiken, Sloane, Clarke, & Vargas, 2004). Developing the IHOS required designing a comprehensive questionnaire for collecting nurse data, and it consisted of the Maslach Burnout Inventory (MBI; Maslach & Jackson, 1981); the Revised Nursing Work Index (NWI-R; Aiken & Patrician, 2000); demographic questions; and questions on nurses' job, work, and employment, as well as questions about nurse-perceived quality of care and the last shift nurses had worked (Aiken et al., 2001).

The MBI is the international gold standard for allowing measurement of the three components of work-related burnout, namely emotional exhaustion, depersonalization, and reduced personal accomplishment. The NWI is a validated questionnaire for allowing measurement, evaluation, and comparison of nursing work-environment factors that influence workforce stability and quality of care. Different factor-analytic analyses of large participant samples showed three major factor solutions: the NWI-R (Aiken & Patrician, 2000); the PES-NWI (Estabrooks et al., 2002); and the PEI (Lake, 2002). The nurse-physician relationship; staffing and resource adequacy; nurse control over the practice setting, nurse autonomy, and nurse manager leadership are key factors.

Recently, Van Bogaert, Clarke, Vermeyen, Meulemans, and Van de Heyning (2008) studied the nursing practice environment in a Belgian setting with an instrument similar to the IHOS. Using exploratory factor analysis (EFA), they identified a three-factor solution (the nurse-physician relationship, nurse management at the unit level, hospital management and organisational support) and found significant associations among these factors and nurse outcomes. In addition, findings by Milisen, Abraham, Siebens, Darras, and Dierckx de Casterlé (2006) showed that Belgian nurses' concerns about the quality of leadership and management, insufficient staff, time demands, and a stressful work environment were obstacles in providing good nursing care.

The remarkable consistency in results from the IHOS and other studies, performed in differently organised healthcare systems, indicates the international relevance of this research field (Aiken et al., 2002; Gunnarsdottir et al., 2007; Kane et al., 2007; Tourangeau et al., 2006;

Vahey et al., 2004). Developing accurate and reliable forecasting models for personnel planning in nursing is the next logical step within this research field, because these models are focused on human resources management as well as on planning of education and care. The Registered Nurse Forecasting Consortium (RN4CAST), which consists of representatives from Belgium, Finland, Germany, Greece, Ireland, Poland, Spain, Sweden, Switzerland, the Netherlands, the UK, the USA, and three international cooperation partner countries (ICPC) of the European Union (Botswana, China, and South Africa), was founded with the aims of refining traditional inaccurate and unreliable forecasting models for personnel planning in nursing. Funded by the European Commission, this innovative project, one of the largest nurse workforce studies ever conducted, should enrich forecasting (O'Brien-Pallas et al., 2001) by including factors that indicate how features of the nursing work environment and staff deployment affect nurse recruitment, retention, productivity, and patient outcomes.

Detailed information of at least 15,000 nurses in 330 hospitals in 11 European countries will be obtained through the specialized research expertise of the IHOS-leading Center for Health Outcomes and Policy Research of the University of Pennsylvania (USA) and the use of an IHOS-like nurse survey. These data will be linked with patient outcome data, which are extracted from routinely collected hospital discharge data from 10s of 1,000s of patients (Aiken et al., 2002). Also, patients will be asked about their experience with their hospital stay. This way, the effect of the nursing work environment and nursing staff deployment on nurse recruitment, retention, and productivity and on patient outcomes can be investigated. Afterwards, traditional forecasting models of manpower planning in nursing will then be refined with these new elements. By improving the accuracy and reliability of forecasting models, RN4CAST provides the opportunity of generating new approaches to more effective management of nursing resources. The present pilot study is aimed at investigating the predictive value of an IHOS-like nurse survey questionnaire for the upcoming RN4CAST project.

Methods

Setting and Sample

Similar to the upcoming RN4CAST project, this study was a survey of nurses working in direct patient care in general acute hospitals. A convenience sample of four hospitals was selected through the network of the research team. As in the RN4CAST study, only general acute-care hospitals were included because these settings

are the largest employers of nurses and thus have major influence on demand for nurses in most countries. The nursing directors of the participating hospitals each selected three units (general surgical, internal medicine, or intensive care units), for a total of 12 units. Only nurses with a full-time equivalence greater than 40% were included in the study (the usual contracted full time working week is 38 hours). Nurses on maternity leave, extended sick leave, or study leave were excluded. Of the 245 nurses working on those 12 units, 239 nurses were eligible for participation. With a response rate of 75%, the total sample consisted of 179 nurses, all of whom participated voluntarily and returned a questionnaire valid for statistical analysis. Response rates ranged from 67% to 79% across hospitals.

Instruments

The original NWI-R and its Dutch translation (Van Bogaert et al., 2008) consisted of a 57-item forced-choice ordinal Likert scale; anchors were *strongly agree* and *strongly disagree*, with responses; high scores representing strong agreement about the presence of the organisational characteristic for their setting. Face validity of the Dutch translation of the NWI-R was verified by a staff nurse, one nurse manager, two nursing directors, and a physician; consensus on wording was achieved. Back-translation was performed by an academically qualified expert (Van Bogaert et al., 2008).

The MBI and its Dutch translation (Vlerick, 1994) consisted of a 22-item ordinal Likert scale with seven possible responses, ranging from *never* (scored as 0) to *every day* (scored as 6), with high scores representing greater degrees of emotional exhaustion (EE; nine items; maximum score, 54); depersonalisation (DP; five items; maximum score, 30); and personal accomplishment (PA; eight items; maximum score, 48). Levels of burnout (*low* to *high*) were described according to the norms of Maslach, Jackson, and Leiter (1996).

Other questions were about demographic characteristics; nurses' perceptions of quality of care and job, work, employment; and the last shift nurses had worked. The research team translated these questions into Dutch and adapted them to the state of the nursing education and work characteristics in Belgium. The total questionnaire consisted of 19 pages.

Data Collection

Data collection took place in December 2007. The primary investigator presented the purpose of the study and clear instructions for completing the questionnaire to individual participants at their nursing unit. All par-

ticipants personally received the questionnaire, a letter of information, and an envelope for returning the questionnaire. Participants were allowed 2 weeks to complete the questionnaire. A completion reminder was presented on the nurses' unit after 1 week. Questionnaires were returned in sealed envelopes to a designated resource person at the hospital and collected by the primary investigator.

Statistical Analysis

First, descriptive statistics were calculated for the nurse characteristics. To compute maximum likelihood estimates in our model with latent variables, multiple imputation with the expectation maximization (EM) algorithm (Dempster, Laird, & Rubin, 1977) was used to deal with missing data on NWI-R items (Li et al., 2007). Next, internal consistency reliability of the Dutch translation of the NWI-R was assessed by assigning NWI-R variables of our data to each of the factor solutions from the previous studies of Aiken and Patrician (2000), Lake (2002), and Estabrooks et al. (2002). Cronbach's alpha and corrected item-total correlations (Nunnally & Bernstein, 1994) were calculated. Subsequently, after the ordinal variables of the NWI-R had been transformed using RIDIT analysis (Bross, 1958; Sermeus & Delesie, 1996), confirmatory factor analysis (CFA) was performed on our data using the factor solutions of the three main prior studies—Aiken and Patrician (2000), Lake (2002), and Estabrooks et al. (2002)—with factors and items included simultaneously.

Factor loading was set at the suggested level of 0.30 (Gorsuch, 1983). Standard errors and *t*-statistics for factor loadings were inspected to determine whether any of the items failed to represent the respective factor (Jöreskog, 1993). The rooted mean square error of approximation (RMSEA; Steiger, 1990); the adjusted goodness of fit Index (AGFI; Jöreskog & Sörbom, 1989); the normed fit index (NFI; Bentler & Bonett, 1980); and the comparative fit index (CFI; Bentler, 1990) were used to indicate evidence of the model fit. Similar to those used by Li et al. (2007), cut-offs of less than 0.08 and 0.05, respectively, were evaluated as acceptable and good fits for RMSEA. Cut-off for AGFI was set at 0.90 and cut-off for NFI and CFI was set at 0.95 (Li et al., 2007).

Descriptive information about the items of the confirmed factors and about response variables used in logistic regression modeling was calculated. The nurse-perceived outcome variables were identical to those assessed in previous research and were all dichotomised to contrast nurses' perceptions (Aiken et al., 2002; Vahey et al., 2004). Job satisfaction was measured by using a single question that inquired about satisfaction with

current job; possible responses ranged from *very satisfied* to *very dissatisfied*. Responses were dichotomised as being very satisfied or not being very satisfied. To measure nurse-perceived quality of care, nurses were asked a question about perceptions of the quality of care in their units. Responses ranged from *excellent* to *fair*. Responses were dichotomised as nurses perceiving the quality of care in their unit as excellent or not excellent. To assess intention to leave, nurses were asked if they planned to leave their hospital jobs *within the next 12 months*, or *within the next 6 months*, or if they had no plans to leave. Responses were dichotomised as nurses willing to leave their job within the next year or not willing to leave their job within the next year. The EE subscale of the MBI represented nurse burnout. Responses from this subscale were dichotomised according to whether participants scored below or above the average of all nurses in the sample (Vahey et al., 2004). Cronbach's alpha, item-total correlations, and mean of the EE subscale are provided.

Univariate and multivariate logistic regression models testing the confirmed factors individually and simultaneously were fitted to determine whether the confirmed factors would be significant predictors of the response variables. Adjusted models controlling for nurse characteristics (age, degree, and years worked in direct patient care) were shown in an attempt to control for confounding factors. Statistical significance (p) level of the analyses was set at $\alpha=0.05$. All analyses were performed using SPSS for Windows, version 16, except for CFA and RIDIT analysis, which were conducted using SAS, version 9.1.

Ethical Considerations

The database was accessible only by the research team. The protocol for the study was reviewed and approved by the ethical commission of the Katholieke Universiteit, Leuven.

Findings

Sample Characteristics

Of the 12 units selected by the nursing directors of the four hospitals, five were general surgical, four were intensive care and three were internal medicine units. Of the participating nurses, those working on general surgical units were most frequently represented ($n=85$), followed by those working on intensive care units ($n=64$) and internal medicine units ($n=30$).

The mean age of the respondents was 36.9 years (range, 21–56 years; SD , 9.8), with the majority being female (92.2%). Most of the respondents had a bach-

elor's degree in nursing (67.4%), almost half worked full-time (49.2%), a majority were employed permanently (95.5%), and almost 60% had dependent children or other dependent relatives living with them (58.1%).

Confirmatory Factor Analysis

The mean response rate for the NWI-R was 96.1%. The missing data rate was greater for the second half of the questionnaire (4.9%; items 28–57) than for the first half (3.0%; items 1–27). This pseudorandom pattern of missing data could be explained by the fact that only three items with a missing data rate over 10%, existed; these were located in the second half of the survey. **Table 1** shows a summary of Cronbach's alphas and corrected item-total correlations for testing the reliability of the Dutch translation of the NWI-R by assigning variables from our data to factor solutions described by previous research. Given our small sample, Cronbach's alphas of the factors were acceptable (0.63–0.84), except for the Aiken and Patrician factor of autonomy (0.41) and Lake's factor of nursing foundations for quality of care (0.56). Cronbach's alphas and corrected item-total correlations for the PEI were satisfactory. In general, corrected item-total correlations were low and few item-to-subscale correlations exceeded the item-to-total correlation, indicating that many items might not fit well in some of the factors described by previous research.

Table 2 shows outcomes of the CFA. With AGFI ranging from 0.67 to 0.80, NFI from 0.36 to 0.69, and CFI from 0.44 to 0.77, the model fit appeared to be unsatisfactory. However, concerning factor loadings, three were acceptable for confirmation. The first factor pertains to the relationship between nurses and physicians. Items of the nurse-physician relationship factor of Aiken and Patrician (2000) and the collegial nurse-physician relationship factor of Lake (2002) showed high factor loadings (0.76–0.86).

These two factors consist of the same three items and will be considered as one factor in our logistic regression analyses (referred to as the factor of nurse-physician relationship). Items of the nurse-physician relationship factor showed low correlations with the items of other factors, suggesting that the items fit well to their corresponding factor. For the factor solution of Lake (2002), acceptable factor loadings and low correlations with items from other factors were also indicated with the factor about staffing and resource adequacy (0.38–0.93) and the factor about nurse manager ability, leadership, and support of nurses (0.32–0.78).

Table 1. Cronbach's Alphas and Corrected Item-Total Correlations of Data Assigned to Factor Solutions Determined Previously^{a,b}

	No. of Items	Cronbach's Alphas	Item-Total Correlation
Aiken & Patrician's NWI-R (2000)	15	0.72	0.12–0.44
Nurse-physician relationship	3	0.84	0.68–0.75
Control over practice settings	7	0.70	0.05–0.66
Autonomy	5	0.41	0.03–0.41
Lake's PES-NWI (2002)	29	0.83	0.05–0.56
Staffing and resource adequacy	4	0.77	0.42–0.71
Collegial nurse-physician relations	3	0.84	0.68–0.75
Nurse manager ability, leadership, and support of nurses	4	0.63	0.27–0.55
Nursing foundations for quality of care	9	0.56	0.08–0.44
Nurse participation in hospital affairs	9	0.72	0.20–0.55
Estabrooks et al.'s PEI (2002)	26	0.83	0.21–0.55

Note. The factor “nurse manager ability, leadership, and support of nurses” originally contained five items. The item “supervisors use mistakes as learning opportunities not criticism” was not included in Aiken & Patrician's original NWI-R, nor was it included in the corresponding Dutch translation. Table 1 is based on the example of Li et al. (2007). ^aFactor solutions determined by Aiken & Patrician (2000), Lake (2002), and Estabrooks et al. (2002). ^bMissing data imputed with the expectation maximization algorithm.

Descriptive Findings

Nurses perceived items of the confirmed factor nurse-physician relationship well. Approximately three of four nurses reported that collaboration (joint practice) exists between nurses and physicians (74.9%) and that they have good working relationships with physicians (77.3%). Almost three of five stated that much teamwork exists between nurses and physicians (58.9%).

Nurses also perceived items of the factor about nurse manager ability, leadership, and support of nurses well. More than four of five nurses reported that the supervisory staff is supportive of nurses (83.2%), that the nurse

manager is a good manager and leader (88.3%), and that the nurse manager backs nursing staff even if the conflict is with a physician (84.4%). Many of the nurses (72.1%) believed they received praise and recognition for a job well done.

Items of the factor staffing and resource adequacy were rather negatively perceived. Although 63.0% reported that adequate support services allowing them to spend time with their patients are available, and although 69.3% reported that they have enough time and opportunity to discuss patient care with other nurses, only 41.6% reported that enough staff is available to get the work done and only 36.1% believed that enough

Table 2. Results From Confirmatory Factor Analysis of Three Factor Solutions^a

	RMSEA (90% CI)	Factor Loading	R ²	AGFI	NFI	CFI
Aiken & Patrician's NWIR (2000)	0.100 (0.085–0.011)			0.80	0.69	0.77
Nurse-physician relationship		0.76–0.86	0.58–0.74			
Control over practice settings		0.06–0.93	0.00–0.87			
Autonomy		0.11–1.00	0.01–1.00			
Lake's PES-NWI (2002)	0.094 (0.087–0.101)			0.69	0.48	0.60
Staffing and resource adequacy		0.38–0.93	0.15–0.87			
Collegial nurse-physician relations		0.76–0.86	0.58–0.74			
Nurse manager ability, leadership, and support of nurses		0.32–0.78	0.10–0.60			
Nursing foundations for quality of care		0.10–0.74	0.01–0.55			
Nurse participation in hospital affairs		0.19–0.68	0.04–0.47			
Estabrooks et al.'s PEI (2002)	0.110 (0.103–0.118)	0.18–0.62	0.03–0.39	0.67	0.36	0.44

Note. RMSEA=rooted mean square error of approximation; AGFI=adjusted goodness of fit index; NFI=normed fit index; CFI=comparative fit index. ^aFactor solutions determined by Aiken & Patrician (2000), Lake (2002), and Estabrooks et al. (2002).

Table 3. Adjusted Univariate and Multivariate Models of Associations Between Confirmed Factors and High Job Satisfaction, Excellent Nurse-Perceived Quality of Care, Intention to Leave Within a Year, and Burnout ^a

	High job satisfaction (OR (95% CI) and <i>p</i> -values)		Excellent nurse-perceived quality of care (OR (95% CI) and <i>p</i> -values)		Intention to leave within a year (OR (95% CI) and <i>p</i> -values)		Burnout (OR (95% CI) and <i>p</i> -values)	
	UNI	MULTI	UNI	MULTI	UNI	MULTI	UNI	MULTI
Nurse-physician relationship/collegial nurse-physician relations	2.60 (1.40–4.82) <i>p</i> <0.01	2.53 (1.29–4.93) <i>p</i> <0.01	4.38 (2.07–9.36) <i>p</i> <0.001	4.02 (1.85–8.70) <i>p</i> <0.001	1.54 (0.45–5.32) <i>p</i> = 0.494	1.74 (0.50–6.08) <i>p</i> = 0.383	0.58 (0.33–1.00) <i>p</i> =0.052	0.56 (0.30–1.03) <i>p</i> =0.062
Staffing and resource adequacy	2.87 (1.48–5.58) <i>p</i> <0.01	2.81 (1.38–5.72) <i>p</i> <0.01	1.10 (0.57–2.13) <i>p</i> =0.783	1.04 (0.50–2.16) <i>p</i> =0.911	0.70 (0.19–2.51) <i>p</i> = 0.582	0.75 (0.18–3.06) <i>p</i> = 0.685	0.23 (0.12–0.46) <i>p</i> <0.001	0.23 (0.12–0.47) <i>p</i> <0.001
Nurse manager ability, leadership, and support of nurses	4.01 (1.65–9.76) <i>p</i> <0.01	2.62 (0.98–6.96) <i>p</i> =0.054	2.54 (1.01–6.35) <i>p</i> <0.05	1.73 (0.63–4.78) <i>p</i> =0.287	0.50 (0.09–2.94) <i>p</i> = 0.444	0.47 (0.07–3.11) <i>p</i> = 0.434	0.46 (0.20–1.02) <i>p</i> =0.056	0.77 (0.31–1.86) <i>p</i> =0.554

Note. UNI=univariate logistic regression modeling analysis; MULTI=multivariate logistic regression modeling analysis. Adjusted for highest degree obtained (undergraduate, bachelor's in nursing/registered nurse, master's in nursing); employment (part-time, full-time); and years worked in direct patient care. Burnout based on the emotional exhaustion subscale of the Maslach Burnout Inventory. ^aMissing data in the Nursing Work Index and Maslach Burnout Inventory imputed with the Expectation Maximization Algorithm.

registered nurses are available to provide high-quality patient care.

For the response variables, only 5.1% planned to leave their present job within the next year. However, 13.4% of the nurses reported being dissatisfied with their present jobs. Nurses' assessment of quality of care showed that only one in four nurses (26.8%) perceived the quality of care on their unit as being excellent.

The MBI had a mean response of 98.5%, a fully arbitrary pattern of missing data (1.2% for the first half and 1.9% for the second half of the instrument), and no items with a missing data rate over 3.4%. Cronbach's alpha and item-total correlations were acceptable for the EE subscale (0.82; 0.26–0.75). There was a low mean EE subscale score of 9.55 (*SD*, 6.49), and only a small number of nurses demonstrated high burnout levels (2.2%).

Logistic Regression Analysis

Univariate analysis indicated that all three factors (nurse-physician relationship; staffing and resource adequacy; nurse manager ability, leadership, and support of nurses) were significant predictors of high job satisfaction, for both unadjusted and adjusted models (Table 3). However, only the factors nurse-physician relationship and staffing and resource adequacy were significantly associated with high job satisfaction at the multivariate level. A 1-point increase in the average rating nurses gave to the nurse-physician relationship factor was significantly associated with approximately a 2.5-fold (*OR*, 2.53;

95% *CI*, 1.29–4.93; *p*<0.01) increase in the odds of reporting high job satisfaction. A 1-point increase in the average rating of the factor staffing and resource adequacy was significantly associated with approximately a threefold (*OR*, 2.81; 95% *CI*, 1.38–5.72; *p*<0.01) increase in the odds of reporting high job satisfaction. Additionally, a 1-point increase in the average rating of the factor nurse-physician relationship was significantly associated with a fourfold (*OR*, 4.02; 95% *CI*, 1.85–8.70; *p*<0.001) increase in the odds of reporting excellent nurse-perceived quality of care. Furthermore, a 1-point increase in the average rating of the factor staffing and resource adequacy was significantly associated with a fourfold (*OR*, 0.23; 95% *CI*, 0.12–0.47; *p*<0.001) decrease in the odds of reporting burnout. None of the three confirmed factors were significantly related to nurses' intention to leave the job within a year.

Discussion

The central aim of this study was to examine the predictive value of an IHOS-like questionnaire for the upcoming RN4CAST project. The strength of the NWI-R is its capability to allow exploring associations between nursing work environmental factors and nurse-perceived outcomes. In contrast to the studies of Van Bogaert et al. (2008) and Gunnarsdottir et al. (2007) in which EFA was used to define a new factorial solution, we conducted CFA on predefined factor solutions. As described by Li et al. (2007), in both methods factors are accepted based

on theoretical relevance and replication. Yet, EFA is conducted through a more arbitrary statistical approach and does not necessarily warrant a good model fit in CFA (Li et al., 2007). Agreement is necessary for selecting the standard method for analysing the predictive value of the NWI-R.

Using a sample of 179 nurses from four hospitals, we confirmed nursing work environment factors from Aiken and Patrician (2000) and Lake (2002). We, however, could not confirm the one-factor solution of Estabrooks et al. (2002). The confirmed nurse-physician relationship factor is identical for both Aiken and Patrician's three-factor solution and Lake's five-factor solution. The other confirmed factors—staffing and resource adequacy and nurse manager ability, leadership, and support of nurses—were both factors from Lake's solution. The most striking result of the present study was that the confirmed factors of nurse-physician relationship and staffing and resource adequacy were shown to be significant predictors of one or more nurse-perceived outcomes, thus indicating support for previous international research findings and the predictive validity of the NWI-R.

Descriptive analyses indicated that Belgian nurses perceived the various dimensions of the nursing work environment as positive, except for items related to the perception of staffing and resource adequacy. Interestingly, the factor staffing and resource adequacy was the main predictor of burnout. This finding may be useful for future policymaking, including forecasting personnel needs, in the field of nursing.

Belgian nurses were also far less likely to report burnout, job dissatisfaction, and the intention to leave their job within the next year compared to nurses from any of the five countries studied in the IHOS. This, however, might be explained by the findings of Schaufeli and Van Dierendonck (1995), which indicated that use of Maslach norms caused substantial underestimation of the number of burnout cases in the Netherlands and other European countries, because the mean burnout level in the US is higher. Schaufeli and Van Dierendonck (1995) defended the use of specific national norms. Furthermore, Vanheule, Rosseel, and Vlerick (2007) concluded that MBI factors have a different meaning for hospital nurses than for professionals working in welfare institutions. Harmonized instruments, as well as standardized analysis protocols, will be critical in the RN4CAST project because these allow cross-country comparisons.

The generalisability of our present results is tempered by the small sample size, which did not allow us to consider the variability of nursing work environments across units within or between hospitals. Generalisability of the results may also be tempered by the variation in nurse age structure in Europe. RN4CAST will provide data of

nurse demographics, including age structure, migration, and proportion of registered nurses and practical nurses in the workforce. Possible cultural diversity of the nursing work environment will be analyzed between and within countries.

Another limitation is that selection bias may have occurred as a result of the nonrandom selection of hospitals and nursing units. A clear threat to internal validity was that all findings represented perceptions of nurses' at-the-moment impressions of their practice setting. The RN4CAST investigators will randomly select hospitals and units and will obtain information not only of nurse survey data but also of hospital-level data about the characteristics of each facility under study and patient outcome data. This should reduce bias to a minimum. It is possible that this sample does not accurately represent the European nursing workforce.

Findings from our study and previous research worldwide indicate that reengineering the nursing workforce is inevitable. The tool of constrained optimization, which allows decision makers to seek the optimal choice (considering possible limitations of the choices), is not the best route to take for decision making in nursing care, given the joint effect of staffing and education of the nursing workforce on patient outcomes. The time has come to shift research on this subject from positive to normative analysis (Besanko & Braeutigam, 2008). We understand *who* is affected by nursing work environment and nursing staff deployment—patients and nurses—and *how* these are affected—adverse patient and negative nurse outcomes. Now we must focus on what can be done to accomplish the socially desirable goal of improved patient outcomes.

Through its research findings and stakeholder engagement, RN4CAST may sharpen debates and enlighten public policy. It may provide an answer to the questions, "Does the nurse workforce have to grow as extensively as some have projected?" and "Can patient outcomes be equally or better served by improving nurse education and enhancing work environment, both of which improve productivity?" RN4CAST may also indicate new approaches to more strategic investments in and management of the nursing workforce, thus improving the nursing work environment and consequently reducing negative nurse and adverse patient outcomes.

Conclusions

The predictive validity of the IHOS instrument was supported by the confirmation of key factors, which were previously identified by international research, and by

the finding of similar associations between these factors and nurse-perceived outcomes. The IHOS nurse survey questionnaire is a robust and psychometrically sound instrument that will be used in the RN4CAST project. The main objective of RN4CAST's leaders is to develop accurate and reliable forecasting models that will be useful for establishing attractive and comfortable practice settings, settings in which nurses perceive the various dimensions of their practice setting positively and are consequently able to provide high quality care.

Acknowledgments

We thank the nursing directors, chief nurses, and other nurses in the participating hospitals. Thanks also to Peter Van Bogaert for granting us permission to use the Dutch translation of the NWI-R. Many thanks to the principal investigators of the RN4CAST consortium: Tomasz Brzostek, Reinhard Busse, Maria Teresa Casbas, Sabina De Geest, Peter Griffiths, Juha Kinnunen, Anne Matthews, Anne-Marie Rafferty, Carol Tischelman, and Theo Van Achterberg.

Clinical Resources

- Website of the Registered Nurse Forecasting Consortium: www.RN4CAST.eu

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