O R I G I N A L P A P E R

Implementation of the Nursing Role Effectiveness Model

Antonio Fernando Salgueiro Amaral, RN, MSc, PhD (c)
Professor, Nursing School of Coimbra, Portugal
Member of the Sigma Theta Tau International
Researcher on the Health Sciences Research Unit affiliated on FCT (Portuguese Foundation for Science and Technology)

Pedro Lopes Fereira, PhD
Associated Professor, Faculty of Economics, University of Coimbra, Portugal
Member of the CEIS (Study Center for Health Studies), Member of the Portuguese Observatory of the National Health Service, Portugal

Maria Lucilia Cardoso, MSc
Research Scholarship, University of Coimbra, Portugal

Telma Vidinha, RN
Research Scholarship, University of Coimbra, Portugal

Correspondence: António Fernando Salgueiro Amaral, Escola Superior de Enfermagem de Coimbra. Rua 5 de Outubro | Apartado 7001 | 3046-851 Coimbra – Portugal e-mail: Amaral@esenfc.pt

Abstract

Given the economic constraints and efforts to achieve efficiency and effectiveness in health care systems, nurses' contribution should be analyzed. The Nursing Role Effectiveness Model examines nurses' contribution to health care based on specific relationships between structure, process and outcome variables. A cross-sectional and longitudinal study was carried out in 26 units of four hospitals in the central region of Portugal to test this model. A total sample of 1764 patients and 364 nurses was obtained. Data were analyzed using SPSS and AMOS 21. The relationships between the variables were tested using the Structural Equation Modelling, indicating a good data fit and statistical significance. In addition to assessing nurses' contribution, this model underlines the value and effectiveness of nursing care.

Keywords: Nursing care, Effectiveness, Process and Outcome Assessment (Health Care), Structure of Services.

Introduction

Health organizations which promote strategies focused on delivering value to patients and practice environments where professionals feel more autonomous are more likely to produce benefits (Britnell, Ambres, & Berg, 2012). Organizations have to be restructured from a perspective of value and accountability to ensure the quality of nursing care, safety and satisfaction of users and health care providers in a cost-containment environment (Irvine, Sidani, Keatings, & Doidge, 2002; Newbold, 2008). Efficiency and effectiveness measures in the health care system should take into account the contribution of professionals, particularly nurses, so as to ensure a cost-effective quality care (Aiken, Clarke, Cheung, Sloane, & Silber, 2003). Since nurses are the largest group of health care professionals, the costs and impact of their actions must be an area of concern for the decision-makers and policies in this sector (Newbold, 2008). Irvine, Sidani and McGillis (1998) developed a conceptual model to guide the assessment of nurses' contribution within the complex environment of health care provision - the Nursing Role Effectiveness Model (NREM). This model relates the achievement of nursing-sensitive patient outcomes to the independent,

dependent and interdependent roles assumed by nurses.

This paper aims to present the NREM, as well as the results of a study that tested some of the model's propositions.

Nursing Role Effectiveness Model

The literature highlights two research approaches to the measures that best capture the effectiveness and quality of nursing care in hospital settings (Van den Heede, Clarke, Sermeus, Vleugels, & Aiken, 2007). The first approach focuses on the care process, and is based on the assumption that outcome achievement is variable, and that this variability depends on the characteristics of patients, nurses and settings, the type of care provided and the expected outcomes, as well as the patients' health status prior to the event that triggered hospital admission (Sidani, Doran, & Mitchell, 2004). The second approach focuses on patient safety, which includes the unintended effects of care, such as medication errors, patient falls, and nosocomial infections (McGillis-Hall, Doran, & Pink, 2004). These effects are analyzed based on nurses' level of education and the teams' skill mix (Needleman, Buerhaus, Mattke, Stewart, & Zelevinsky, 2002; Aiken, Clarke, Cheung, Sloane &, Silber, 2003).

Unlike other approaches, the NREM intends to explain the multiple factors that influence patient status and nursing care, thus reflecting their mediating role (Sidani, Doran, & Mitchell, 2004). This model explored the perspective focused on the care process, in which the domains of the nursing role (independent, dependent and interdependent) are analyzed as a link between the organizational structure, patients' characteristics and the outcomes achieved. Thus, the model describes the relationships between the structure, process and outcome variables, following the taxonomy proposed by Donabedian (1980) to qualify the variables that promote health care quality and effectiveness (Irvine, Sidani, & McGillis-Hall, 1988). Therefore, nursing-sensitive outcomes emerge whenever changes in patients' condition can be justified by an empirical link between them and nursing interventions (Given et al., 2004).

Structure variables are associated with nurses, patients and the inpatient unit, and they influence the processes and outcomes of care. Experience level, knowledge and skill level are nurse variables (Preuss, 1997). Patient variables include age, physical function, diagnosis, and co-morbidities (Irvine, Sidani, Keatings, & Doidge, 2002). The number of nursing care hours per patient day, care organization and the practice environment are variables related to the inpatient unit (Irvine, Sidani, & McGillis-Hall, 1988; Lake, 2002). The process component relates to the independent, interdependent and dependent roles of nursing. Nursing's independent role concerns the functions and responsibilities of nurses initiated in response to a nursing diagnosis, and which do not require a physician's order (Irvine, Sidani, & McGillis-Hall, 1988; Sidani, Doran, & Mitchell, 2004). The interdependent role concerns the functions which nurses share with other members of the health care team to ensure the integration and coordination of patient care (Irvine, Sidani, Keatings, & Doidge, 2002). Finally, the dependent role concerns activities initiated by nurses in response to a medical order. These activities were not investigated in this study due to data access problems. Outcome variables include the patient's functional status, their performance of activities of daily living (ADLs) and instrumental activities of daily living (IADLs), and their therapeutic self-care ability as a way to manage the disease, the symptoms and the treatment (Sidani, 2011).

Conceptual Model of Analysis

Nurses' capacity to engage is influenced by individual variables and organizational structure variables (Irvine, Sidani, Keatings, & Doidge, 2002). For instance, successful interventions require an effective nurse-patient interaction, and, as both patient and nurse characteristics can influence this relationship and, consequently, outcome achievement, they both should be analyzed.

Therefore, the level of education, in particular advanced education, and the professional category are indicators of nurses' knowledge and skills. Studies highlight an association between these indicators and patient outcomes. Clinical expertise is defined as a

hybrid between formal theoretical knowledge and practical knowledge (from experience), thus reflecting the ability to make critical decisions in complex situations (Benner, 2001). This variable is highly correlated with patient outcomes and the overall quality of health care (Aiken, Clarke, Cheung, Sloane, & Silber, 2003). Simultaneously, the ability to establish an effective communication with the patient/family has been associated with the effectiveness of therapeutic self-care management following discharge (Sidani, 2011). This characteristic is also referred to as a guarantee of good physician-nurse relationships (Doran, 2011), reduction in length of stay (Shortell et al., 1994), mortality rates (Knaus, Draper, Wagner, & Zimmerman, 1986), emergency admissions and unplanned readmissions (Naylor cited by Doran, 2011).

Patient variables, such as age, gender, type of disease and immune status influence the responses to some nursing interventions, especially interventions related to health education, therapeutic education (Sidani & Braden, 1998), and the person's health status prior to becoming ill (Sidani, Doran, & Mitchell, 2004).

The organizational characteristics of inpatient units that facilitate or limit professional nursing practice, which was defined by Lake (2002) as practice environment, can also influence the nursing care process and outcomes (Aiken, Clarke, Cheung, Sloane, & Silber, 2003; Estabrooks, Midodzi, Cummings, Ricker, & Giovannetti, 2005). The number of Nursing care hours per patient day (HPPD) is a structure variable that influences the performance of interventions and, consequently, outcome achievement. It has been associated with patient safety in terms of the occurrence of falls, pressure ulcers and medication errors, but also in terms of the relationship with lack of psycho-educational and social interventions. Several studies indicate that nurses' work overload and undersized teams are associated with more negative outcomes (Aiken, Clarke, Cheung, Sloane, & Silber, 2003; McGillis-Hall, Doran, & Pink, 2004) and a functional decline between admission and discharge (Lush et al. cited by Doran, 2011). Other studies show that variables related to work organization, nurse staffing and diversity of care providers may influence the communication between the nurse and the patient/family, as well as patients' perceptions of their needs, thereby hampering individualized care (Suhonen, Välimäki, Katajisto, & Leino-Kilpi, 2007).

As for the process/outcome relationship, nursing's independent interventions have a direct effect on clinical and functional patient outcomes, as well as on patients' satisfaction with care. Education has been the most investigated independent nursing intervention (Brown cited by Doran, 2011). Patient/family education focuses mainly on strategies to manage symptoms and self-care, which means educating for independence while performing ADLs (Doran, 2011).

Methodology

A cross-sectional and longitudinal design was used to collect data on nurses and patients. The study was conducted in 26 medicine and surgery units of four hospitals in the central region of Portugal. One was a university hospital with 1375 beds; two were central hospitals, both with all the services (416 and 626 beds); and one was a district hospital (356 beds). These hospitals were selected by convenience given that they could be easily accessed and represented, in some way, the Portuguese reality. Although two hospitals merged into a university hospital during the study, that did not compromise the study and results.

Permission to conduct the study was granted by the hospitals' administration boards, after positive opinion of the ethics committees. The participation from both nurses and patients was voluntary, and each patient or representative was asked to give his/her writing consent.

Except for head nurses, all of the nurses were part of the sample. Only patients who had been hospitalized for three or more days were included in the sample. To self-complete the instruments, they needed to be able to read and write in Portuguese and could not have any cognitive and/or physical impairment preventing them from filling out the instruments.

Patient's data were collected between March and July, 2012, while nurses' data were collected between July and August, 2012.

Nurses' data were collected through questionnaires, while patients' data were collected using self-administered instruments and instruments completed by nurses based on their assessment of the patients' health status. To ensure anonymity, patients/relatives had a specific box in each unit to put the questionnaires.

Variables and Instruments

An evidence-based model of analysis of the relationships between structure, process and outcome variables was built for this study, which followed the assumptions of the NREM.

Structure variables

Structure variables correspond to organizational, nurse and patient variables.

The following organizational variables were used: (i) the practice environment and (ii) the number of nursing hours per patient day. The practice environment was assessed using the Portuguese version of the *Practice Environment Scale of the Nursing Work Index* (PES-NWI) (Amaral, Ferreira, & Lake, 2012), which is composed of 31 items grouped into five dimensions: (1) nurse participation in hospital affairs; (2) nursing foundations for quality of care; (3) nurse manager ability, leadership and support; (4) staffing and resource adequacy; and (5) collegial nurse-physician relations. The instrument was completed by nurses, who indicated their level of agreement on a scale from 1 (strongly agree) to 4 (strongly disagree). The scores of each item were reversed so that the highest score corresponded to a higher level of agreement. For data analysis, Lake (2002) proposed the use of the means calculated in each answer.

The number of nursing hours per patient day corresponds to the sum of the number of nurses working in a 24-hour period multiplied by the number of hours worked by nurses divided by the number of existing beds. For this, we took into account the unit's full capacity, instead of the bed occupancy rate.

In relation to nurses, the variables used were as follows: (i) ratio of specialist nurses in the team and (ii) clinical expertise. The ratio of specialist nurses was calculated by dividing the number of nurses with advanced training in a nursing specialty by the total number of nurses in the team. Clinical expertise was assessed using the *Clinical Nursing Expertise Survey* (CNES), validated for the Portuguese population by Amaral and Ferreira (in press). The survey is composed of 34 items corresponding to the nurses' roles and functions, and nurses are asked to report their level of ability for the role or function on a 5-point scale, ranging from competent to expert.

The variables related to patients' characteristics were: (i) age, (ii) diagnosis, (iii) health status prior to the event that triggered hospital admission, and (iv) average length of stay. Data for these variables were collected using the instrument to record the patients' condition, the *International Resident Assessment Instrument - Acute Care* (InterRAI-AC) for the Portuguese population (Amaral & Ferreira, 2014), which will be described ahead.

Process Variables

The following process variables were used: (i) nurses' perspective of individualized care and communication, which we associated with the independent activity; and (ii) the physician-nurse relationship, which we related to interdependent activity.

Individualized care was assessed using the *Individualized Care Scale - Nurse Version*, validated for the Portuguese population by Antunes et al. (2011), where nurses report how they ensure that care is person-centered. This 34-item scale assesses two dimensions:

(1) support for patients' individuality through specific nursing interventions and

(2) nurses' perception of the value assigned to individuality in care provision.

These two dimensions are composed of 17 items that assess three sub-dimensions:

(1) support for clinical situation;

(2) support for personal life situation; and

(3) support for the patients' decisional control over care.

Nurses answered on a Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree), with high scores reflecting a high level of agreement with the practice of

individualized care. The variable *communication* was also assessed using a 13-item subscale of the CNES. The physician-nurse relationship was assessed using a subscale of the PES-NWI (Amaral, Ferreira, & Lake, 2013).

Outcome variables

We focused on the patients' functional status because it emerged in the literature as a measure for capturing how people perform their ADLs and also because it allows for a positive perspective of outcomes. In addition, the functional status, as an outcome measure, is likely to be sensitive to nursing care because much of the nursing practice is concerned with diagnosing and intervening in the patients' response to illness and its treatment (Irvine, Sidani, Keatings, & Doidge, 2002).

Functional status was assessed using the interRAI AC (Amaral & Ferreira, 2014), which is composed of several dimensions that assess different clinical areas, in three stages: (i) Preadmission, i.e. within a three-day period prior to the onset of the situation which precipitated admission (informants can be family if patients are unable to cooperate); (ii) Admission, i.e. within the 24 hours following admission; and (iii) Discharge, in which the assessment relates to the 24-hour period prior to discharge. Knowing the health status prior to the episode of illness allows not only establishing a connection with the current status, but it may also be used as a reference for patients' rehabilitation and treatment, since it influences the outcomes of care (Sidani, Doran, & Mitchell, 2004).

The instrument has several sections, but we used the algorithms recommended by the InterRAI organization which combine items related to the person's functional and cognitive dimensions and produce the following scales: (i) Instrumental Activities of Daily Living Scale; (ii) Activities of Daily Living Hierarchy Scale; and (iii) Short Activities of Daily Living Hierarchy Scale. The Instrumental ADL Scale assesses the level of dependence in the performance of activities and is based on the recoding and summation of the variables Self-Performance in IADLs and Capacity for 'meal preparation', 'ordinary housework', 'managing finances', 'managing medications', 'phone use', 'stairs', 'shopping' and 'transportation'. This scale produces a total score ranging from 0 to 48, the highest scores representing greater dependence. The ADL Hierarchy Scale assesses the level of dependence in the performance of ADLs, and is based on an algorithm which combines the variables 'self-performance in personal hygiene', 'self-performance in locomotion, 'self-performance in toilet use', and 'self-performance in eating'. This scale is divided into seven different levels of performance: 'Independent', 'Supervision required', 'Limited impairment', 'Extensive assistance required – 1', 'Extensive assistance required – 2', 'Dependent', 'Total dependence'. The Short ADL Hierarchy Scale uses the variables: 'self-performance in personal hygiene', 'self-performance in mobility', 'self-performance in toilet use' and 'self-performance in eating', which are recoded and summed to range from 0 to 16. The highest scores show greater dependence in performing ADLs. For these variables, we calculated the difference between the scores at admission and at discharge, in which a greater difference corresponds to a better evolution.

The Therapeutic Self-Care Scale which was translated and validated for the Portuguese population by Cardoso, Queirós, Ribeiro, & Amaral (2014) was also used. The total score in this scale corresponds to a better or worse preparation for returning home.

This 12-item scale is applied at discharge, and asks patients to rate on a scale from 1 to 6,

(i) their knowledge of the prescribed medications and treatments;

(ii) their ability to recognize signs and symptoms;

(iii) their ability to carry out treatments as prescribed; and

(iv) their knowledge of what to do in case of an emergency.

In addition to these variables, patients' perception of individualized care was also analyzed using the Portuguese version of the *Individualized Care Scale - Patient* (Amaral, Ferreira, & Suhonen, 2014). This 34-item self-administered scale was applied at discharge and divided into two parts: (i) patients' perspective of whether individuality

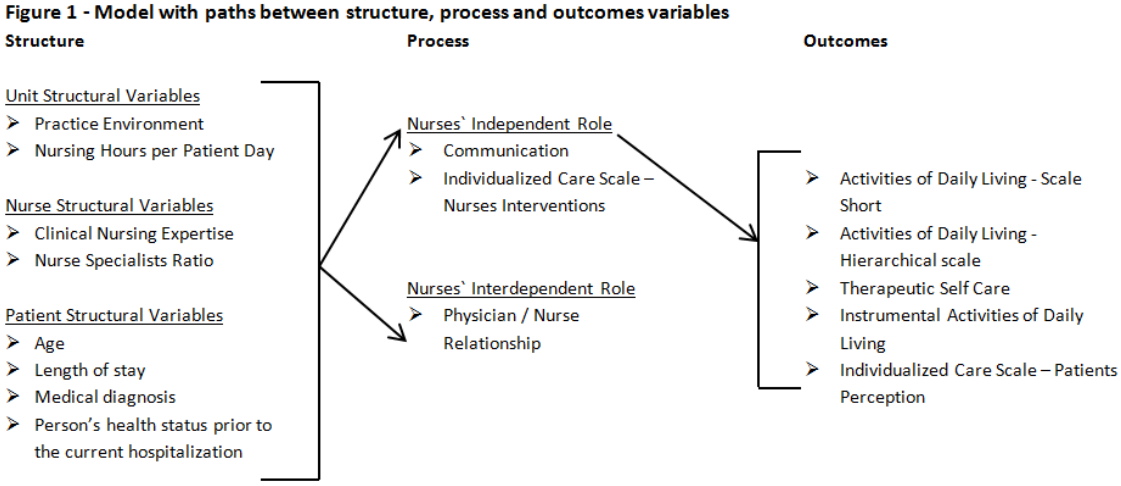
is taken into account in specific nursing interventions (17 items); (ii) to what extent patients perceive their care as being individualized (17 items).

Data Analysis

Data were analyzed using SPSS (version 22) and AMOS (version 21). The relationships among the structure, process and outcome variables were tested using the structural equation modelling (SEM). This method is recommended to test the validity of theoretical models which aim to explain hypothetical causal relationships among variables. A scheme or model of associations is created between the variables, which are verified through parameters indicating the impact of independent variables on dependent variables (Marôco, 2010).

A model of relationships between the variables was created and tested using SEM (Figure 1). As the model is only composed of manifest variables with mediating effects between them, the Path Analysis model was used.

Figure 1 - Model with paths between structure, process and outcomes variables



The purpose of SEM is to determine if the propositions depicted in the *NREM* are consistent with our data. Consistency between the predicted and the observed relationships lends empirical support to the model. To ensure its reliability, the variables were tested for normality using the asymmetry and kurtosis values; the lack of outliers; and the lack of multicollinearity between independent variables (VIF and Tolerance values). The significance of the regression coefficients was assessed by estimating the parameters using the maximum likelihood method.

The quality of the SEM was assessed by analyzing the coefficient of determination(R^2), in which values above 0.5 indicate models with adequate explanatory power. The test used to assess the significance of the regression coefficients of the model's exogenous variables was the Z-statistics, and respective significance. To assess the statistical significance of the mediator variables, Cohen, Cohen, West, and Aiken (2003) suggested that if all paths between mediators were significant, then the total effect of mediation would also be significant.

Taking into account that the model is not saturated, the model's goodness-of-fit was determined using the chi-square (x^2), in which the most accepted values are $p > 0.05$ or $p > 0.10$ (Barret cited by Marôco, 2010); the *Comparative Fit Index* (CFI), in which CFI values below 0.9 indicate a poor fit, between 0.9 and 0.95 indicate a good fit, and above or equal to 0.95 indicate a very good fit; and the *Root Mean Square Error of Approximation* (RMSEA), in which values above 0.1 indicate a poor fit and below 0.08 indicate an appropriate fit (Marôco, 2010).

In order to test the relationships between structure, process and outcome variables, it was necessary to aggregate the nurse data to the unit level and then disaggregate the data to

the patient level. Thus, each patient was assigned an average value for the nurse and unit structural and process variables.

The aggregation of each variable was validated by determining the level of agreement of each individual in the group and the level of variance of each group in relation to each variable. Ideally, the latter variance should be greater than the former. A significant F-ratio indicated that the between-group variance was large and confirmed the possibility of data aggregation (Dixon & Cunningham, 2006). One-way analysis of variance was run to assess this possibility, and significant F-ratios were obtained for all variables, which indicate that units were statistically different in terms of the structure and outcomes variables.

Prior to the SEM, a linear regression was performed using the patients' age, length of stay, diagnosis and outcomes to control for their effects on outcome achievement. To this end, diagnoses were divided into nine groups (pulmonary diseases, kidney diseases, heart diseases, cerebrovascular diseases, infections, abdominal diseases, neoplasms, trauma and others) and transformed into dummy variables before regression as they were qualitative variables. The most common diagnostic groups were those associated with abdominal and pulmonary diseases. Length of stay was also added because it could influence nurses to obtain significant patient outcomes. Our analysis is based on the assumption that when length of stay is short, there is not enough time to achieve results; and when length of stay is long, there is perhaps a more complex clinical situation that, in its turn, may attenuate the effect of nursing interventions (Irvine, Sidani, Keatings, & Doidge, 2002). After the regression, the unstandardized residuals for each outcome variable were saved and then used as dependent variables in the SEM.

Results

A total of 1823 patients was selected, but after excluding the records that either were very incomplete or did not meet the inclusion criteria, a total sample of 1764 patients was obtained.

After comparing the samples from the four hospitals, the *chi-square* test showed that there were no significant differences between the number of men and women (χ^2= 6.626; p= 0.085). The mean age of the patients was 70.78 years (σ=16.9 years).

The ANOVA test showed no significant differences in the mean ages between the four hospitals (F=0.604; p=0.612).

As the SEM analysis cannot include missing values, the cases with missing values in the variables were excluded. As the response rate of the Therapeutic Self-Care instrument was lower (1016) than the total response rate, the number of missing cases increased. Thus, after excluding these cases, 702 valid cases were used.

The nurses' response rate was 66.2% (361 valid questionnaires): 55.7% from medical units and 44.3% from surgery units. The respondents' average age was 35 years (σ=8 years). With respect to their level of education, 80.4% of nurses had a bachelor's degree, 15% had a post-graduation, 2.6% had a master's degree and 16.9% had a specialization degree in nursing. Of these, 37.7% were specialized in medical-surgical nursing and 34.4% in rehabilitation nursing.

The average length of professional experience was 12 years (σ=7 years). On average, nurses had been working in their units for 8 years (σ=6 years). The average number of nursing care hours per patient day was 3 hours (σ=0.57h). Sample distribution is presented in Table 1.

Table 2 presents the results obtained in each variable, as well as the reliability of each scale. The internal consistency of the scales was assessed using the Cronbach's alpha. All of them scored above 0.80, which indicates good internal consistency (Cramer & Bryman, 2003). After excluding the missing values and *outliers*, the patients' average age dropped to 68.99 years (σ= 16.99 years).

After the effects of patients' characteristics had been removed and using the non-standardized residuals, the path analysis produced the model shown in Figure 2.

Table 1 - Sample distribution

	Variable	Values		No.	%	Mean	Standard Deviation
Patients	Gender	N=1764	Male	849	50.0%		
			Female	850	50.0%		
		N=702	Male	379	56.1%		
			Female	296	43.9%		
	Age	N=1764				70.78	16.99
		N=702				68.88	17.02
		N=682 Without outliers				68.99	16.996
Nurses	Age	N=361				35.17	8.02
	Education	Bachelor's degree		274	80.4%		
		Master's degree		9	2.6%		
		Post-graduation		51	15.0%		
	Specialization	With specialization		61	16.9%		
		Without specialization		300	83.1%		
	Type of specialization	Medical-Surgical Nursing		23	37.7%		
		Rehabilitation Nursing		21	34.4%		
	Type of unit	Medicine		201	55.7%		
		Surgery		160	44.3%		
	Length of professional experience					11.87	7.35
	Length of professional experience in the unit					8.08	6.49
Units	Hours per patient day					3.00	0.57
	Total mean of nurses in the 26 units					20.93	6.20
	Patients by unit					28.54	7.58

Results of the Model

Several paths with non-significant direct effects and outliers emerged from result analysis. The non-significant paths analyzed using the z-statistic were: the effect of the specialist nurses ratio on communication (Z=1.318; p=0.187); the effect of the practice environment on interventions for individualized care (Z=0.868; p=0.385); the effect of communication on patients' performance of ADLs using the Short Scale (Z=-0.001; p=0.999); the effect of communication on patients' performance of ADLs using the Hierarchy Scale (Z=-0.620; p=0.535); the effect of communication on patients' performance of IADL (Z=1.548; p=0.122); the effect of interventions for individualized care on patients' therapeutic self-care (Z=0.185; p=0.853); the effect of interventions for individualized care on patients' performance of IADL (Z=-0.726; p=0.468); and the effect of relationships on patients' therapeutic self-care (Z=1.092; p=0.275).

After the outliers were excluded, the non-significant paths of the original model remained the same and we were left with 682 cases. After rerunning the analyses and excluding the non-significant paths, two paths continued to emerge with non-significant direct effects between the variables: the effect of relationships on patients' performance of ADLs using the Hierarchy Scale (Z=1.353; p=0.176), and the effect of communication on patients' perception of individualized care (Z=-0.219; p=0.826). These paths were also excluded, thus resulting in the final model without non-significant paths presented in Figure 2.

The values of the adjusted model are presented in Table 3. The model explains 1% of the variance of activities of daily living measured using the Short ADL Scale and 2% o using the ADL Hierarchy Scale. It was also observed that the model only explains 0.6% of the variance of the Therapeutic Self-Care Scale and 0.7% of the IADL Scale. Also, the model explains 7% of the variance of patients' perception of individualized care. As for the process variables, the model explains 72% of the dimension "Collegial nurse-physician relationships" and 91% of the dimension "Establishing a good communication and a

relationship of trust with patients and family", as well as 14% of the interventions carried out by nurses for individualized care. All direct effects between variables are significant.

Table 2 - Cronbach's α, Mean and Standard Deviation among the model variables

Model variables (Cronbach's α)		Mean ($\bar{x}$)	Standard Deviation (σ)
Individualized Care Scale - Nurses (α=0.949)		4.06	0.450
Practice Environment (α=0.891)		2.57	0.307
Physician/Nurse Relationship (α=0.813)		2.66	0.503
Clinical Experience (α=0.986)		3.464	0.814
Communication (α=0.968)		3.30	0.821
Hours per patient day		3.004	0.579
Individualized Care Scale - Patients (α=0.954)		4.232	0.7109
Specialist Nurses Ratio (%)		0.123	0.079
Therapeutic Self-Care	With outliers n=702 α=0.978	3.331	1.413
	Without outliers n=682 α=0.978	3.332	1.416
ADL Hierarchy Scale	With outliers n=702 (algorithm)	1.35	2.094
	Without outliers n=682 (algorithm)	1.34	2.101
Instrumental activities of daily living scale	With outliers n=702 α=0.961	17.47	18.776
	Without outliers n=682 α=0.961	17.25	18.741
ADL Short Scale	With outliers n=702 α=0.972	3.34	5.535
	Without outliers n=682 α=0.972	3.33	5.554
Length of stay	With outliers n=702	9.75	6.481
	Without outliers n=682	9.68	6.425

Figure 2 - Final Model with Trajectories between structure, process and outcomes variables

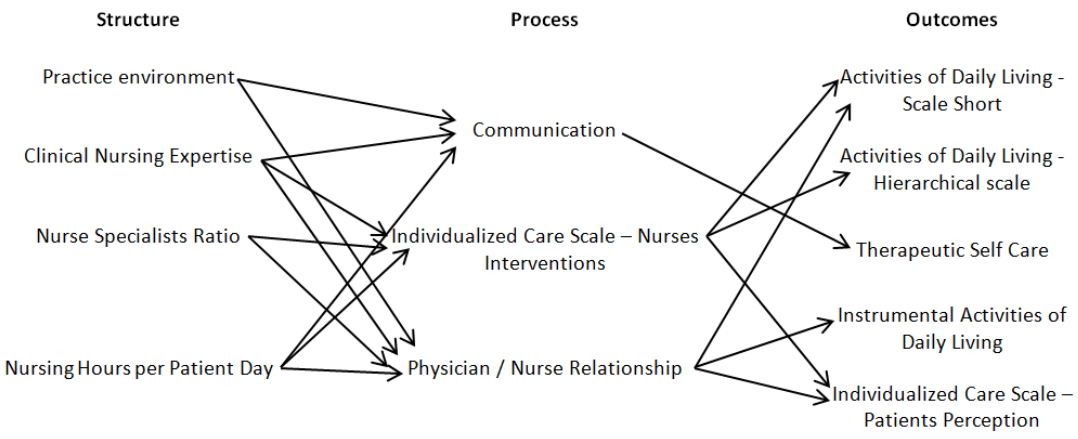


Table 3 - Standardized Regression Coefficients and respective Statistical Significance

		Communication	Individualized Care - Nurses	Relationships	Therapeutic Self-Care	Activities of Daily Living Hierarchy	Activities of Daily Living	Instrumental Activities of Daily Living	Overall Average Individualized care scale - Patients
Specialist Nurses Ratio	**Z (p value)**	-	Z=11.646 p<0.05	Z=3.876 p<0.05	-	Sig.	Sig.	Sig.	Sig.
	Total Effect	-	.400	.093	-	.063	.040	-.008	.107
Hours per patient day	**Z (p value)**	Z=-5.278 p<0.05	Z=5.586 p<0.05	Z=3.039 p=0.002	Sig.	Sig.	Sig.	Sig.	Sig.
	Total Effect	-.065	.230	.074	-.006	.036	.024	-.006	.060
Level of Clinical Expertise	**Z (p value)**	Z=75.875 p<0.05	Z=4.761 p<0.05	Z=9.052 p<0.05	Sig.	Sig.	Sig.	Sig.	Sig.
	Total Effect	.947	.182	.201	.081	.029	.029	-.017	.038
Practice Environment	**Z (p value)**	Z=14.959 p<0.05	-	Z=37.690 p<0.05	Sig.	-	Sig.	Sig.	Sig.
	Total Effect	.153	-	.828	.013	-	.056	-.068	-0.56
Communication	**Z (p value)**	-	-	-	Z=2.308 p=0.021	-	-	-	-
	Total Effect	-	-	-	.085	-	-	-	-
Individualized Care - Nurses	**Z (p value)**	-	-	-	-	Z=4.229 p<0.05	Z=2.194 p=0.028	-	Z=2.968 p=0.003
	Total Effect	-	-	-	-	.158	.083	-	.283
Relationships	**Z (p value)**	-	-	-	-	-	Z=3.032 p=0.002	Z=-2.243 p=0.025	Z=-2.053 p=0.040
	Total Effect	-	-	-	-	-	.068	-.083	-.067
R^2		.909	.141	.716	.006	.025	.012	.007	.073

x^2=28.667, **g.l.** =29, **p**=0.482 ; **Comparative Fit Index** =1.000; **Root Mean Square Error of Approximation**<0.08

The goodness-of-fit index shows that the model fits to data: x^2=28.667, g.l.=29, p=0.482; Comparative Fit Index=1.000; and Root Mean Square Error of Approximation<0.08.

Analysis of the relationships between the structural, procedure and outcome variables

The ratio of specialist nurses had a significant positive direct effect on individualized care and on nurse-physician relationships. However, it also had a significant positive indirect effect on the patients' functional status measured using the ADL Hierarchy Scale and mediated by the nurses' interventions aiming at individualized care. Finally, there was also a significant positive indirect effect on the patients' functional status measured using the Short ADL Scale and mediated by the physician-nurse relationships.

The number of nurse hours per patient day had a significant positive direct effect on individualized care and on nurse-physician relationships, and a significant negative direct effect on the communication established with patients and their families. This variable also had a significant positive indirect effect on patients' perception of individualized care, which was mediated by the communication established between nurses and patients and their families.

The level of clinical expertise had significant positive direct effects on the following variables: communication established between nurses and patients and their families; nurse-physician relationships; and nurses' interventions aiming at individualized care. It also had a significant positive indirect effect on patients' therapeutic self-care ability, which was mediated by the communication established between nurses and patients and their families.

The practice environment had a significant positive direct effect on the communication established between nurses and patients and

their families and on the nurse-physician relationships. It also had a significant positive indirect effect on the patients' functional status, measured with the Short ADL Scale.

The communication established between nurses and patients and their families had a significant positive direct effect on patients' therapeutic self-care ability.

Nurses' interventions aiming at individualized care had a significant positive direct effect on patients' functional status, measured using the ADL Hierarchy Scale and the Short ADL Scale , and on patients' perception of individualized care.

On the other hand, the nurse-physician relationships had a significant positive direct effect on patients' functional status, measured using the Short ADL Scale, and a significant negative direct effect on patients' functional status, measured with the IADL Scale, and on patients' perception of individualized care.

Discussion

The contribution of nursing is influenced by many factors, so improving them may lead to higher quality care, more organized health systems and more satisfied professionals. Most studies do not examine the complex set of relationships that are established. Therefore, the SEM was considered the most appropriate statistical analysis technique to provide a holistic view of the phenomenon.

The structural variables that relate to the unit, such as the practice environment, have effects on communication as a nurses' intervention process, and on the patients' functional status. These results are consistent with several international studies which identify the practice environment as a variable that influences nursing care outcomes (Aiken, Clarke, Cheung, Sloane, & Silber, 2003; Estabrooks, Midodzi, Cummings, Ricker, & Giovannetti, 2005). However, most studies analyses them in terms of the patients' risk and safety, such as the increase of the 30-day mortality rate and the rate of complications in unfavorable environments (Friese, Lake, Aiken, Silber, & Sochalski, 2008). This analysis based on a positive perspective according to which better environments lead to better patient outcomes is essential to assess the value and effectiveness of nursing care, thus creating an evidence base for decision-making on health policies and care.

The average number of nursing hours per patient day is another variable of the unit-related structural component with effects on the performance of nurses' dependent and interdependent roles, as well as on patients' perception of individualized care. This variable has been related to patients' safety in terms of falls, pressure ulcers, medication errors, etc., and several studies indicate that nurses' work overload is associated with the incidence of such negative outcomes (Aiken, Clarke, Cheung, Sloane, & Silber 2003). In addition, Doran (2011) identified a positive relationship between the time available to provide care and nurses' independent role.

The ratio of specialist nurses, which is a nurse-related structural variable, had an effect on the performance of their dependent and interdependent roles, as well as on the patients' functional status. Training and professional category are commonly used as indicators of nurses' knowledge and skills. Studies indicate a positive association between these variables and the prevention of complications, including mortality (Aiken, Clarke, Cheung, Sloane & Silber 2003; Needleman, Buerhaus, Mattke, Stewart, & Zelevinsky, 2002), resulting in patients' satisfaction and decrease in the number of incidents, although implying more costs (Lengacher et al., 1996), and also in a positive effect of the quality of care on patient outcomes (Doran, 2011).

The level of clinical expertise is another nurse-related structural variable with effects on the performance of their dependent and interdependent roles and on patients' therapeutic self-care ability. This is consistent with the theory that presents the level of clinical expertise as a variable that is associated with nursing care outcomes and the overall quality of health care (Lake, 2002; Christensen M, Hewitt-Taylor J. 2006);

The nurses' interdependent role, which was assessed in our model through the nurse-physician relationships, has an impact on patients' functional status. Other studies (Knaus, Draper, Wagner, & Zimmerman, 1986; Shortell et al., 1994;

Naylor cited by Doran, 2011; Irvine, Sidani, Keatings, & Doidge, 2002) also mentioned the relationship between the nature of the communication established among health professionals and patient outcomes. Nurses' independent role was assessed through both the communication established between nurses and patients and their families. This communication had an effect on patients' therapeutic self-care ability. It was also assessed through the interventions carried out by nurses for individualized care, which had an effect on patients' functional status and on their perception of individualized care. These results were consistent with other studies, which had also identified associations between nursing's independent interventions and patients' functional status (Brown & Grimes cited by Doran, 2011) and therapeutic self-care ability (Doran, 2011).

The theoretical background of the model tested in this study was based on the conclusions related to the associations established among the model's variables. However, there were some limitations, such as the low variance explained by the structural and process variables in the outcome variables. This may result from several factors, namely the model's variables, which may have a poorer effect on patients' outcomes than other variables that were not considered in this study. Another explanation may be the fact that the variables that were aggregated to the unit level corresponded to 26 units. It would thus be important to replicate this type of study in more units.

Despite being an embryonic approach to the complex system of relationships in nursing care provision, this study is relevant because of its conclusions related to the value and effectiveness of nursing care, thus becoming an evidence base for future studies and decision-making processes relating to health systems.

Acknowledgement

This research is financed by the FCT/MCTES (PIDDAC) and co-financed by FEDER throughout COMPETE; POFC of QREN

Conclusion

The model tested in this study, which was based on the NREM, allows us to examine the contribution of nurses within the health care system, by supporting decision-making processes. It also highlights the value and effectiveness of nursing care by providing a positive perspective according to which better environments lead to better outcomes. Based on the nursing care theory, a model of relationships between the structural, process and outcome variables of nursing care was built. This model was tested using the SEM and it presented a good data fit and statistical significance in the associations between the model's variables. This provides empirical evidence that patient outcomes are influenced not only by patient characteristics, but also by other factors relating to the context, the professionals and the nursing interventions, thus capturing the effectiveness and quality of nursing care. Furthermore, results also suggest that the associations established between the structural and outcome variables are mediated by the process variables related to nursing interventions. However, this model has some limitations, such as the low variance explained by the structural and process variables in the outcome variables. For this reason, further studies should consider other variables and include a higher number of units.

References

Aiken, L., Clarke, S., Cheung, R., Sloane, D., & Silber, J. (2003). Educational levels of hospital nurses and surgical patient mortality. *Journal of American Medical Association*. 290 (12), 1617-1623.

Amaral, A.F.; Ferreira, P.; Gray, L.C. (2014). Validation of the International Resident Assessment Instrument - Acute Care (InterRai-AC) for the Portuguese population. *Revista de Enfermagem Referência.* IV (1) Fev/Mar. p 103-115

Amaral, A.F., & Ferreira, P. (2014). Adaptation and validation of the clinical expertise survey to the Portuguese nursing population. *Anna Nery Revista de Enfermagem (accepted for publication).*

Amaral, A., Ferreira, P., & Lake, E. (2012). Validation of the Practice Environment Scale of the Nursing Work Index (PES-NWI) for the Portuguese nurse population. *International Journal of Caring Sciences*, 5(3), 280-8.

Amaral, A., Ferreira, P., & Suhonen, R. (2014). Translation and Validation of the Individualized Care Scale. *International Journal of Caring Sciences,* 7 (1), 90-101.

Antunes, D., Batuca, C., Ramos, A., Fonseca, C., Ferreira, M., Suhonen, R., Sousa, V. (2011). International Cross-Cultural Comparative Study on Perceptions of Nurses in relation to the Individualized Nursing care. *Revista de Investigação em Enfermagem*, 24, 7-15 (in Portuguese).

Benner, P. (2001). *From Novice to Expert* (1ª ed.). Quarteto Editora. Coimbra, Portugal (in Portuguese)

Britnell, M., Ambres, C., & Berg, M. (2012). *Healthcare. Contracting value: Shifting paradigms.* [online]. Accessed in March 1, 2014, in http://www.kpmg.com/Global/en/IssuesAndInsights/ArticlesPublications/contracting-value/Documents/contracting-value-v7.pdf

Cardoso, A., Queirós, P., Ribeiro, C., & Amaral, A. (2014). Cultural Adaptation and Psychometric Properties of the Portuguese Version of the Therapeutic Self-Care Scale. *International Journal of Caring Sciences.* 7 (2), 426-436

Christensen M, Hewitt-Taylor J. (2006). From expert to tasks, expert nursing practice redefined? *Journal of Clinical Nursing*. 15: 1531–1539

Cohen, J., Cohen, P., West, S., & Aiken, L. (2003). *Applied multiple regression/correlation analysis for the behavioural sciences* (3ª ed.). L. Erlbaum Associates. Mahwah, New Jersey, USA.

Cramer, D., & Bryman, A. (2003). *Data Analysis in Social Sciences.* Celta Ed. Oeiras, Portugal. (in Portuguese)

Dixon, M., & Cunningham, G. (2006). Data Aggregation in Multilevel Analysis: A Review of Conceptual and Statistical Issues. *Measurement in Physical Education and Exercise Science*, 10(2), 85-107.

Donabedian, A. (1980). *Exploration in quality assessment and monitoring* (Volume 1) - *The definition of quality and approaches to its assessment*. Health Administration Press. Ann Arbor, Michigan, USA

Doran, D. M. (2011). *Nursing Sensitive outcomes: State of the science* (2ªed). Jones & Bartlett Learning. Mississauga, Ontário, Canada.

Estabrooks, C., Midodzi, W., Cummings, G., Ricker, K., & Giovannetti, P. (2005). Determining the impact of hospital nursing characterization 30 day mortality among patients in Alberta acute care hospitals. *Nursing research*, 54(2), 74-84.

Friese, C., Lake, E., Aiken, L., Silber, J., & Sochalski, J. (2008). Hospital nurse practice environment and outcomes for surgical oncology patients. *Health Service Research*, 43(4), 1145-1163.

Given, B., Beck, S., Etland, C., Gobel, B., Lamkin, L., & Marsee, V. (2004). Nursing sensitive patient outcomes – description and framework. *Oncology Nursing Society*. Accessed in http://www.ons.org/research/nursingsensitive/description.

Irvine, D., Sidani, S., & McGillis-Hall, L. (1998). Linking outcomes to nurses' roles in health care. *Nursing Economics*, 16, 58–64.

Irvine, D., Sidani, S., Keatings, M., & Doidge, D. (2002). An empirical test of the Nursing Role Effectiveness model. *Journal of Advanced Nursing*, 38(1), 29-39.

Knaus, W., Draper, E., Wagner, D., & Zimmerman, J. (1986). An evaluation of outcome from intensive care in major medical centers. *Annals of Internal Medicine*, 104, 410–418.

Lake, E. T. (2002a). Development of the Practice Environment Scale of the Nursing Work Index. *Research in Nursing & Health*, 25, 176-188.

Lake, Eileen (2002). Measuring Clinical Nursing Expertise for Outcomes Research. *Paper presented to the State Of The Science Congress*. Washington, DC.

Lengacher, C., Mabe, P., Heinemann, D., Van Cott, M., Swymer, S., & Kent, K. (1996). Effects of the PIPC model on outcome measures of productivity and costs. *Nursing Economics*, 14(4), 205-213.

Marôco, J. (2010). *Structural Equations analysis: Theoretical Foundations, Software and applications.* Author edition. Pêro Pinheiro, Portugal.

McGillis-Hall, L., Doran, D., & Pink, G. (2004). Nurse Staffing Models, Nursing Hours, and Patient Safety Outcomes. *The Journal of Nursing Administration*, 34 (1), 41-45.

Needleman, J., Buerhaus, P., Mattke, S., Stewart, M., & Zelevinsky, K. (2002). Nurse-staffing levels and the quality of care in hospitals. *New England Journal of Medicine*, 346, 1715-1722.

Newbold, D. (2008). The production economics of nursing: A discussion paper. *International Journal of Nursing Studies*. 45(1), 120-128.

Preuss, G. A. (1997). Labor, skills, and information in service delivery: An examination of hospital care. *Academy of Management*, 1, 282-286.

Shortell, S., Zimmerman, J., Rousseau, D., Gillies, R., Wagner, D., Draper, E. Duffy J. (1994). The performance of intensive care units: does good management make a difference? *Medical Care*, 32, 508–525.

Sidani, S. (2011). Self-Care. In Doran, D. *Nursing Outcomes: the state of science*. (2ª ed., pp. 131-200). Jones & Bartlett Learning. Mississauga, Ontário, Canada.

Sidani, S., & Braden, C. J. (1998). *Evaluating nursing interventions - A theory-driven approach*. SAGE. London, United Kingdom.

Sidani, S., Doran, D., & Mitchell, P. (2004). A Theory-Driven Approach to Evaluating Quality of Nursing Care. *Journal of Nursing Scholarship*, 36(1), 60-65.

Suhonen, R., Välimäki, M., katajisto, J., & Leino-Kilpi, H. (2007). Hospitals' organizational variables and patients' perceptions of individualized nursing care in Finland. *Journal of Nursing Management*, 15, 197-206.

Van den Heed, K., Clarke, S., Sermeus, W., Vleugels, A., & Aiken, L. (2007). "International experts" perspectives on the state of the nurse staffing and patient outcomes literature. *Journal of Nursing Scholarship*, 39(4), 209-297.