

Nursing workload and patient safety – a mixed method study with an ecological restorative approach¹

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Objective: The aim of this study was to analyze the potential association between nursing workload and patient safety in the medical and surgical inpatient units of a teaching hospital. **Method:** a mixed method strategy (sequential explanatory design). **Results:** the initial quantitative stage of the study suggest that increases in the number of patients assigned to each nursing team lead to increased rates of bed-related falls, central line-associated bloodstream infections, nursing staff turnover, and absenteeism. During the subsequent qualitative stage of the research, the nursing team stressed medication administration, bed baths, and patient transport as the aspects of care that have the greatest impact on workload and pose the greatest hazards to patient, provider, and environment safety. **Conclusions:** The findings demonstrated significant associations between nursing workload and patient safety. We observed that nursing staff with fewer patients presented best results of care-related and management-related patient safety indicators. In addition, the tenets of ecological and restorative thinking contributed to the understanding of some of the aspects in this intricate relationship from the standpoint of nursing providers. They also promoted a participatory approach in this study.

Descriptors: Nursing Service, Hospital; Workload; Nursing Staff, Hospital; Safety Management; Patient Safety.

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Carga de trabalho da equipe de enfermagem e segurança do paciente - estudo com método misto na abordagem ecológica restaurativa

Objetivo: analisar a carga de trabalho da equipe de enfermagem e sua potencial relação com a segurança do paciente, em unidades de internação das áreas clínica e cirúrgica de um hospital universitário. Método: adotou-se um método misto de pesquisa com desenho sequencial explanatório. Resultados: a etapa quantitativa inicial do estudo sugere que o aumento do número de pacientes designados para a equipe de enfermagem implica em aumento das taxas de queda do leito, infecções relacionadas ao cateter vascular central, rotatividade de profissionais e absenteísmo. Durante a etapa qualitativa subsequente, a equipe de enfermagem destacou os cuidados relacionados à administração de medicação, banho de leito e transporte de pacientes, como aqueles que mais repercutem na carga de trabalho e mais representam riscos para a segurança do paciente, dos profissionais e do ambiente. Conclusões: os achados deste estudo evidenciaram associações significativas entre carga de trabalho e a segurança dos pacientes. Observa-se que os quadros de pessoal com menos pacientes apresentaram os melhores indicadores de qualidade assistencial e gerencial de segurança do paciente. Além disso, os princípios do pensamento ecológico e restaurativo contribuíram para a compreensão de alguns dos aspectos envolvidos nessa intrincada relação, a partir dos olhares dos próprios profissionais e também promoveram abordagem participativa para o estudo desse tema.

Descritores: Serviço Hospitalar de Enfermagem; Carga de Trabalho; Recursos Humanos de Enfermagem no Hospital; Gerenciamento de Segurança; Segurança do Paciente.

Carga de trabajo de enfermería y seguridad de pacientes – estudio con método mixto y aproximación ecológica restaurativa

El estudio tuvo por objetivo analizar la carga de trabajo de enfermería y su potencial relación con la seguridad del paciente en unidades de internación de las áreas clínica y quirúrgica de un hospital universitario. Se adoptó un método mixto de investigación con diseño secuencial explicativo. Los resultados de la etapa cuantitativa indican que el aumento del número de pacientes atribuidos al equipo de enfermería implica en elevación de las tasas de caída de cama, infección relacionada a catéter vascular central, turnover y absentismo. En la etapa cualitativa, el equipo de enfermería destacó los cuidados relacionados con la administración de medicación, baño de cama y transporte de pacientes como aquellos que más repercuten en la carga de trabajo y representan riesgos para la seguridad de los pacientes, de los profesionales y del ambiente. Los resultados mostraron asociaciones significativas entre la carga de trabajo y la seguridad del paciente. La mejor dotación de personal mostró mejores resultados para el manejo y para el cuidado del paciente. Los principios del pensamiento ecológico y restaurativo contribuyeron a la comprensión de algunos de los aspectos involucrados en esta intrincada relación, a partir de las miradas de los profesionales, con un enfoque participativo.

Descriptores: Servicio Hospitalario de Enfermería; Carga de Trabajo; Recursos Humanos de Enfermería en el Hospital; Gerenciamiento de Seguridad; Seguridad del Paciente.

Introduction

Debate centered on the association between nursing workload and patient safety is one of the most persistent themes in the field of health, mobilizing resources from the World Health Organization⁽¹⁾ and nursing organizations worldwide. The debate surrounding this issue includes aspects related to staffing levels and to the role of managers as leaders of this process within the healthcare system and highlights the complexity of the challenge that lies ahead.

Worldwide, the fields of health and nursing are beset by serious issues related to scarce workforce resources, lack of qualifications, excessive workloads, absenteeism, and providers leaving the profession⁽²⁻⁴⁾. Healthcare in Brazil is no exception to this rule, where the complexity of the publicly funded Unified Health System (UHS) is compounded by a series of structural, political, economic, and cultural issues that must be overcome to sustain and improve the care

environments. The media often reports on poor working conditions, limited resources, overcrowding and long waits at the emergency departments of public hospitals, and exposés on medical error and breakdowns in patient care are increasingly frequent. These reports can fuel a conception of healthcare providers as inefficient among the lay population.

Despite efforts undertaken to investigate the implications of nursing workload on patient safety, many knowledge gaps remain in this field. There is a pressing need for studies designed to ascertain the extent and nature of nurses' roles in patient safety improvement⁽⁵⁾. Therefore, attempts to describe and analyze the factors involved in nurses' work that go beyond tracking the time spent on specific tasks are essential to form a more comprehensive understanding of all of the dimensions of care that require substantial time and energy from providers⁽⁶⁾.

One theoretical perspective that offers a more comprehensive approach to studying nurses' workload is found in the tenets of ecological and restorative thinking. In this mode of research, eco-restorative thinking combines attention to socio-technical systems of care (such as medication, charting, and other care delivery systems) with close scrutiny of the overall ecology of the care environment. This requires close examination of how people relate to each other and to the places they collectively inhabit in order to develop best practices within continuous cycles of research, assessment, and adaptive management⁽⁷⁻¹⁰⁾.

Although the literature warns of the hazards to patient safety posed by inadequate numbers of nursing providers^(2-3,11-13), the specifics of different practice settings and different group of providers who carry out care activities are key elements that must be explored in each situation. With attention to both systemic and local factors, the adoption of eco-restorative thinking may provide a more comprehensive understanding of the intricate association between nursing workload and patient safety from the standpoint of the healthcare providers who work in these settings. Within this context, the aim of this study was to analyze and nursing workload and its potential association with patient safety in the medical/surgical inpatient units of a teaching hospital.

Methods

This study was conducted at a very large (>500-bed) teaching hospital in Southern Brazil using a mixed-

methods approach, which consisted of a combination of quantitative and qualitative research stages within a sequential explanatory design⁽¹⁴⁻¹⁶⁾. The first stage employed a retrospective cross-sectional study design, which was followed by a three phase, second stage qualitative exploration of nurses' workload using participatory restorative photographic methods as outlined in related safety research^(7-8,10).

During the initial quantitative stage, the study population consisted of all inpatients and all nursing professionals at the hospital's medical and surgical units. The sample size was 11,071 patients and 449 nursing providers across 11 inpatient units and the study period was January–December 2009. The hospital's minor surgery unit was excluded from analysis due to its peculiarities, e.g. it admits both pediatric and adult patients, provides care of a much lower complexity and is characterized by very short stays. Patients with a length of stay of <24h, regardless of admission unit, were excluded from the sample. The information processed at each admission unit on a monthly basis was based on a sample of the 11 units over the 12-month period (n=132). The 11 inpatient units included in the study accounted for 390 (49.62%) of the beds available at the hospital and were covered by 449 nursing providers: 104 (23%) nurses and 345 (77%) nurse's aides and nurse technicians.

During the subsequent qualitative stage, the study population encompassed the nursing staff – nurses, nurse technicians and nurse's aides – of the inpatient units where the study was conducted. A purposive sampling strategy was used to choose one of the study units where a diverse group of potential nurse and nursing aid participants provided care to patients whose degree of dependence and required nursing care processes were similar in nature and acuity.

In Stage 1, the data were entered into secondary databases after collection by means of an instrument designed to obtain information on patient gender, age, reason for admission, admitting specialty, care-related quality indicators (central line-associated bloodstream infection, catheter-related urinary tract infection, incidence of pressure sores, incidence of bed-related falls, and mean length of stay) and management-related quality indicators (rate of patient satisfaction with nursing care, nursing staff absenteeism, and nursing staff turnover). Another instrument was used to collect data on bed occupancy rate (monthly) and number of inpatients, number of nurses, and number of nurses' aides and nurse technicians (daily) on each unit.

Identification of the number of inpatients and the number of nursing providers at each unit enabled calculation of a nursing workload indicator for each unit, expressed as the ratio of mean number of patients to mean number of nursing providers per day. This indicator was then stratified into mean number of patients per mean number of nurses per day and mean number of patients per mean number of nurse's aides or nurse technicians per day.

Data were expressed as means, standard deviations, medians, and interquartile ranges as appropriate, stored in a Microsoft Excel® spreadsheet and analyzed in the Statistical Package for the Social Sciences (SPSS)18.0 for Windows® software environment. The generalized estimating equations method was used to determine whether associations exist between the factor of interest (nursing workload as expressed by the patient-to-provider ratio) and dependent variables (patient safety-related indicators of care quality and management quality). The significance level was set at 5%.

During the second qualitative stage of the study, data were collected in three successive phases between September and October 2011. In Phase A, an initial focus group with three nurses and eight nurse's aides (n=11) was conducted to explore providers' ideas and experiences related to their workload and the safety of inpatients in order to prepare a preliminary list of photographs to collect in Phase B. During Phase B, using this preliminary photo list as a guide, one of the principal investigators (AMM) conducted a photo walkabout of the study unit with a nurse, nurses' aide, and research assistant. During the photo walkabout, the researcher collected digital photos of the unit based on the Phase A list and any other suggestions by participants as they explored the environment together. As images were collected, the nurse participant provided digitally recorded narratives of the workload and safety issues being photographed; the nurses' aide participant helped determine the best scenes for photography, and the research assistant documented notes on the photos using a form adapted from previous eco-restorative visual research⁽⁷⁻¹⁰⁾. Thirteen photos taken during the walkabout were then selected to serve as prompts for discussion and debate during a third phase (Phase C) photo elicitation focus group with four nurses and eight nurse's aides (n = 12), including some team

members who worked the night shift.

To support the qualitative data analysis, the focus group and walkabout audio recordings were transcribed and organized into files in the NVivo 9 software alongside complementary field notes and photos. Using a protocol refined in previous eco-restorative visual research⁽⁷⁻⁸⁾ and qualitative rigor, the thematic analysis was guided by a systematic process of pre-analysis, exploration, data treatment, inference, and interpretation⁽¹⁷⁾. Initially, we sought to identify and codify preliminary themes, which were then grouped according to the nature and extent of overlapping content which explained one or more aspects of nurses' workload and related patient safety issues. A thematic categorization was then constructed to aid description and understanding of the study phenomenon.

This study has been approved by Institutional Ethics Committee under the number 10-0037. Secondary data were covered by responsible data use forms, and all participants involved in the qualitative phase of the study (patients or relatives and nursing professionals) signed the written informed consent for participation at each stage (Focus groups, Photo walkabout, Digital photographs for patients and relatives, Digital photographs for providers).

Results

Analysis of the selected admissions units revealed a bed occupancy rate of 86.16 ± 12.09 and a mean number of 31.48 ± 11.65 admitted patients per day. The mean number of nurses and nurse's aides/technicians across the various shifts of the day was 4.79 ± 0.72 and 16.70 ± 4.02 respectively. On pooled analysis of all studied units, the ratio of patients to nurses was $6.44 \pm 2.01/\text{day}$ (range, 2.97–8.97), and the ratio of patients to nurse's aides/nurse technicians, $1.82 \pm 0.33/\text{day}$ (range, 1.13–2.17).

On the unit with the lowest patient-to-nurse ratio (2.97), each nurse was in charge of approximately 9 patients per shift, whereas the unit with the highest patient-to-nurse ratio (8.97) had approximately 27 patients per nurse per shift. The unit with the lowest patient-to-aide/technician ratio (1.13) had a distribution of approximately 3–4 patients per aide/technician per shift, whereas the unit with the highest ratio (2.17) had 6–7 patients per aide or technician per shift. These data are described in Table 1.

Table 1 – Daily nursing provider workload, calculated as the ratio of mean number of patients to mean number of providers per 24h, per unit, Porto Alegre, RS, Brazil, 2009

Unit	Nº patients admitted per year	Bed occupancy rate*	Nº inpatients per day*	Nº nurses per day*	Nº nurse aides or technicians per day*	Nº patients per nurse per day*	Nº patients per aide/tech per day*	Nº patients per nurse per shift*	Nº patients per aide/tech per shift*
1	591	67.70±9.99	11.51±1.70	3.88±0.25	10.17±0.91	2.97±0.43	1.13±0.15	8.91±1.27	3.39±0.46
2	691	82.95±7.00	18.25±1.54	4.00±0.24	12.14±0.59	4.57±0.36	1.50±0.09	13.70±1.09	4.50±0.26
3	902	73.03±9.76	18.26±2.44	4.26±0.42	12.10±0.58	4.32±0.66	1.50±0.19	12.94±1.97	4.52±0.58
4	947	98.47±1.92	44.31±0.86	4.99±0.52	20.41±0.71	8.97±1.04	2.17±0.09	26.92±3.11	6.52±0.27
5	1056	98.91±0.56	44.51±0.25	5.18±0.78	20.62±0.46	8.79±1.47	2.15±0.48	26.37±4.42	6.47±0.14
6	502	88.23±3.86	30.00±1.31	5.06±0.46	16.50±0.57	5.98±0.69	1.82±0.12	17.93±2.07	5.46±0.36
7	916	99.47±0.72	44.76±0.32	5.59±0.62	21.45±0.67	8.10±0.86	2.08±0.06	24.29±2.57	6.26±0.19
8	1054	71.06±5.69	24.16±1.93	4.55±0.39	14.04±0.76	5.32±0.35	1.72±0.11	15.96±1.05	5.16±0.33
9	1605	87.46±4.60	39.36±2.07	5.43±0.30	20.39±0.72	7.27±0.40	1.93±0.08	21.79±1.20	5.79±0.24
10	919	90.75±3.09	30.86±1.05	4.45±0.41	15.54±0.81	6.97±0.53	1.98±0.07	20.91±1.60	5.96±0.21
11	1805	89.72±4.08	40.37±1.84	5.32±0.33	20.32±0.91	7.62±0.57	1.98±0.06	22.84±1.70	5.96±0.19
Geral	11071	86.16±12.09	31.48±11.65	4.79±0.72	16.70±4.02	6.44±2.01	1.82±0.33	19.33±6.03	5.46±0.99

* Mean ± standard deviation

Source: Study data, Magalhães AMM, Porto Alegre, RS, Brazil, 2012.

B values, which measure the association between the study factor and outcomes of interest, showed that each one-unit increase in the patient-to-nurse ratio was associated with a 0.189 increase in the incidence of bed-related falls, a 0.157 increase in central line-associated infections, a 0.171 increase in turnover and a 0.268 increase in absenteeism. The rate of patient satisfaction

with the nursing team was the only outcome significantly associated with aide/technician workload (B, -10.799; p=0.024). There was a significant inverse association, that is, for each one-unit increment in the patient-to-aide/technician ratio, there is a 10.799 decrease in patient satisfaction with the nursing team. These data are described in Table 2.

Table 2 – Association between care-related and management-related patient safety indicators and nursing team workloads in medical and surgical inpatient units, Porto Alegre, RS, Brazil, 2010

	Nursing team workload			
	Patients per nurse, 24h		Patients per aide/tech, 24h	
	B*	P-value	B*	P-value
Care-related patient safety indicators				
Bed-related fall, incidence	0.189	<0.001	1.437	0.001
Pressure sores, incidence	0.040	0.484	0.223	0.562
Mean length of stay	0.247	0.208	1.843	0.119
Invasive procedure-related urinary tract infection	0.055	0.508	0.535	0.344
Central line-associated bloodstream infection	0.157	0.024	1.095	0.029
Management-related patient safety indicators				
Turnover	0.171	0.025	0.864	0.046
Absenteeism	0.268	0.002	1.933	0.002
Rate of patient satisfaction with the nursing team	-1.157	0.155	-10.799	0.024

*Generalized estimating equations describe the extent of association between the factors and outcomes of interest. Associations were considered significant if p<0.05.

The empirical materials produced as the result of focus group debates, observation, field notes, and images obtained during the photo walkabout were grouped into three broad themes with related subcategories:

- Caring for patients and their relatives – workload and hazards; Medication – factor that generate a high workload for the nursing team and pose a major patient safety hazard; Bed bath – a care activity that requires

major physical effort on the part of the nursing team; Patient transport – a race against time;

- (Lack of) coordination with support services and physical structure of the unit;

- Workload and patient safety – job characteristics and coping strategies.

Medications were regarded as one of the main factors that have an impact on workload and pose

potential patient hazards. This topic, which arose at the end of the first focus group, was discussed by participants in terms of their concerns and fears with respect to errors in medication administration and

reporting challenges faced in their daily work routine. The Figure 1 illustrates the team preparing medication at the beginning of the shift.



(Source: Photo walkabout, 9 September 2011)

- I think our work – even though nursing is focused on care, our work revolves way too much around patients' medications... when nurses start call, what do we check in the patient's chart? We see whether meds have been checked. So, our number one concern is whether meds have been checked. Our second activity is to pick up meds, and our third activity is to administer meds [...] meds are ultimately our number-one patient concern. (P10)

(Source: Focus group 2, 5 October 2011)

Figure 1 – Photo #1: Picking up and preparing medications

The physical strain and fatigue brought about by interventions such as bed baths and patient transport were highlighted as some of the main factors leading to illness

and missed work among the nursing staff. These care activities were reported as a source of hazards to patient and nursing team safety alike, as the Figure 2 illustrates.



(Source: Photo walkabout, 21 September 2011)

- [...] I apologized to one of the patient's relatives for giving the patient such a quick bath. And she said: don't worry, I can see you're rushing more than you did on the other days. It's not a problem, his priorities have been addressed (P5)

(Source: Focus Group 1, 5 September 2011)

Figure 2 – Photo #67: Moving a patient during a bed bath

Discussion

The integration of quantitative and qualitative data by means of a mixed methods design enabled the establishment of associations and broadened the focus of discussion on a number of aspects related to nursing team workload and patient safety in the medical/surgical inpatient units of a large teaching hospital. Indicators such as the incidence of bed-related falls, central line-associated infections, and absenteeism were identified

both by means of statistical testing and within the focus group and photo walkabout data as risk factors for patient safety.

The findings of a significant association between nursing team workload and adverse events such as bed-related falls and central line-associated infections demonstrated that within the study setting, the assignment of greater numbers of patients to the care

of each nurse, nurse's aide or nurse technician increases the incidence of these indicators and has a negative impact on patient safety. These findings are consistent with those of previous studies^(11-13,18), which suggested that adequate nurse staffing levels, with lower patient-to-provider ratios, help reduce the incidence of adverse events, including bed-related falls and infections.

The differences in workload experienced by nursing teams on different inpatient study units that were identified in the quantitative portion of the research were also confirmed at the qualitative stage, where focus group participants reported that their unit is one of the most demanding at the study hospital due to its high occupancy rate, patient population and staffing level. These situations may increase the odds of adverse events. This is consistent with past studies⁽¹⁸⁻¹⁹⁾ that have shown excessive workload to be a significant driver of adverse events and human error due to haste.

Patient care such as bed bath, transport, and medication administration were pointed out in this study as some of the main factors, which have an impact on nursing workload and patient safety. These aspects should be studied further to decrease the risks to which inpatients are exposed. These findings support the results of previous studies⁽²⁰⁻²¹⁾, in which there was some concern about insufficient nursing staff and the occurrence of medication errors or other adverse events in Brazilian hospital wards.

The findings of this study and of previous investigations⁽²²⁻²³⁾ highlight the importance of analyzing absenteeism and provider turnover as critical management indicators of nursing service quality and inputs for the establishment of proper staffing levels. High absenteeism and turnover rates suggest that staffing levels are inadequate to maintain the continuity of patient care, which in turn contributes to the incidence of patient safety hazards due to nurse fatigue, illness, and turnover itself. The detection of an association between increased nursing team workloads – as expressed by higher patient-to-nurse ratios – and increases in these indicators, as shown in Table 2, is a red flag that reveals potential hazards to patient and provider safety alike.

The significant association between the workload of nurse's aides/nurse technicians and patient satisfaction rates is also consistent with the findings of other studies⁽²⁴⁻²⁵⁾, in which increases in provider workload or assignment of greater numbers of patients to each nursing professional were found to decrease patient satisfaction with provided care. This topic was also

addressed during focus groups, where participants expressed a concern with the expectations of patients and their relatives when care has to be rushed due to understaffing.

Although the relevance of the study results should not be understated, its limitations should be taken into account in view of the complexity of the phenomenon under study and the constraints of the methodological approach employed. The use of a cross-sectional, single-center design over a limited study period restricts comparative analysis with other investigations. This is compounded by the lack of standardized patient safety indicators and outcomes within the Brazilian health system and the scarcity of national and international research in this field.

These limitations notwithstanding, these findings provide innovative contributions toward a greater understanding of the intricate relationship between nursing workload and patient safety, and identify several areas that can be targeted for hazard prevention with respect to patient, provider, and environmental safety in a teaching hospital inpatient unit setting. Participants' committed engagement in the eco-restorative visual stage of the study also suggests that we can generate more meaningful knowledge of the relationship between nurses' workload and patient safety by actively involving practicing nurses in this line of research. They also pave the way for future research projects to explore this matter in different contexts and at other healthcare facilities.

Conclusions

In this study we found that the increase in the number of patients assigned to nursing staff per day was significantly associated with the increase in incidence of falls from beds, incidence of central line-associated bloodstream infections, absenteeism and turnover. We also found that the more patients assigned to nurse's aides/technicians per day the lower the rate of patient satisfaction with the nursing team.

The adoption of the tenets of eco-restorative thinking in the study of the potential association between nursing team workload and patient safety in inpatient units proved to be a relevant approach, providing an understanding of some of the countless facets involved in the complex environment where patient care activities take place in the hospital setting, through the eyes of nursing providers themselves. This participatory approach, built on the foundations of eco-restorative

thinking and implemented by means of photographic research methods and focus group debates, provided an opportunity for reflection on routine practices associated with the results of care-related and management-related patient safety indicators.

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References

- World Health Organization (WHO). World alliance for patient safety. [Internet]. Washington DC; 2004 [acesso 8 out 2007]. Disponível em: <http://www.who.int/patientsafety/enf>
- Aiken LH, Clarke SP, Sloane DM, Sochalski J, Silber JH. Hospital Nurse Staffing and Patient Mortality, Nurse Burnout, and Job Dissatisfaction. *JAMA*. 2002;288(12):1987-93.
- Aiken LH, Clarke SP, Cheung RB, Sloane DM, Silber JH. Educational levels of hospital nurses and surgical patient mortality. *JAMA*. 2003;290(12):1617-23.
- O'Brien-Pallas L, Li XM, Wang S, Meyer RM M, Thomson D. Evaluation of a Patient Care Delivery Model: System Outcomes in Acute Cardiac Care. *CJNR*. 2010;42(4):98-120.
- Richardson A, Storr J. Patient safety: a literature review on the impact of nursing empowerment, leadership and collaboration. *Int Nurs Rev*. 2010 Jun;57(2):12-21.
- Magalhães AMM, Riboldi CO, Dall'Agnol CM. Planejamento de recursos humanos de enfermagem: um desafio para as lideranças. *Rev Bras Enferm*. 2009;62(4):608-12.
- Marck PB, Kwan JA, Preville B, Reynes M, Morgan-Eckley W, Versluys R, et al. Building safer systems by ecological design: using restoration science to develop a medication safety intervention. *Qual Safety Health Care*. 2006;15(2):92-7.
- Backman C, Marck PB, Krogman N, Taylor G, Sales AE, Roth V, Bonten, MJM, Gigengack-Baars ACM. Barriers and bridges to infection prevention and control: results of a qualitative case study of a Netherlands' surgical unit. *BMJ Open*. 2012;2:e000511 doi: 10.1136/bmjopen-2011=00511
- Raduenz AC, Hoffmann P, Radünz V, Teresinha M, Dal Sasso G, Alves Maliska IC, Marck PB. Nursing care and patient safety: Visualizing the organization, storage and distribution of medication with photographic research methods. *Rev. Latino-Am. Enfermagem*. 2010;18(6):1045-54.
- Marck PB, Lang A, Macdonald M, Griffin M, Easty A, Corsini-Munt S. (2010). Safety in home care: A research protocol for studying medication management. *Implementation Sci*. 45:3 at <http://www.implementationscience.com/content/5/1/43>.
- Harless DW, Mark BA. Nurse staffing and quality of care with direct measurement of inpatient staffing. *Med Care*. 2010 Jul;48(7):659-63.
- Blegen MA, Goode CJ, Spetz J, Vaughn T, Park SH. Nurse staffing effects on patient outcomes: safety-net and non-safety-net hospitals. *Med Care*. 2011;49(4):406-14.
- Needleman J, Buerhaus P, Pankratz VS, Leibson CL, Stevens SR, Harris M. Nurse Staffing and inpatient hospital mortality. *N Engl J Med*. 2011;364(11):1037-45.
- O'Cathain A, Murphy E, Nicholl J. The quality of mixed methods studies in health services research. *J Health Serv Res Policy*. 2008;13(2):92-8.
- Tashakkori A, Teddlie C. *Mixed methodology: combining qualitative and quantitative approaches*. Thousand Oaks: Sage Publications; 1998.
- Creswell JW, PlanoClark VL. *Designing and conducting mixed methods research*. Thousand Oaks: Sage; 2007.
- Minayo MCS. *O desafio do conhecimento: pesquisa qualitativa em saúde*. São Paulo - Rio de Janeiro: HUCITEC-ABRASCO; 2006.
- Cho S, Ketefian S, Barkauskas VH, Smith DG. The effects of nurse staffing on adverse events, morbidity, mortality, and medical costs. *Nurs Res*. 2003;52(2):71-9.
- Corbellini VL, Schilling MCL, Frantz SF, Godinho TG, Urbanetto JdS. Eventos adversos relacionados a medicamentos: percepção de técnicos e auxiliares de enfermagem. *Rev Bras Enferm*. 2011;64(2):241-7.
- Cucolo DF, Perroca MG. Reestruturação do quadro de pessoal de enfermagem e seu impacto sobre as horas de assistência. *Rev. Latino-Am. Enfermagem*. [periódico na Internet]. mar-abr 2010 [acesso 12 set 2012]; 18(2):9 telas]. Disponível em: http://www.scielo.br/pdf/rlae/v18n2/pt_06.pdf
- Silva AEBC, Reis AMM, Miasso AI, Santos JO, Cassiani SHB. Eventos adversos a medicamentos em um hospital senti-vela do Estado de Goiás. *Rev. Latino-Am.*

- Enfermagem. [periódico na Internet]. mar-abr 2011 [acesso 12 set 2012];19(2):9 telas]. Disponível em: http://www.scielo.br/pdf/rlae/v19n2/pt_21.pdf
22. Sancinetti TR, Soares AVN, Lima AFC, Santos NC, Melleiro MM, Fugulin FMT, et al. Taxa de absenteísmo da equipe de enfermagem como indicador de gestão de pessoas. *Rev Esc Enferm USP*. 2011;45(4):1007-12.
23. Sochalski J, Konetzka RT, Zhu J, Volpp K. Will mandated minimum nurse staffing ratios lead to better patient outcomes? *Med Care*. 2008;46(6):606-13.
24. Hurst K. Does workforce size and mix influence patient satisfaction? *Nurs Stand*. 2007;21(46):15.
25. Jha AK, Oray EJ, Zheng J, Epstein AM. Patients' perception of hospital care in the United States. *N Engl J Med*. 2008;359:1921-31.