

# **The influence of the nursing work environment on nurse-perceived quality of care and missed care: a cross-sectional study**

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## **Abstract**

*The relationship between the nursing work environment and nurse-perceived quality of care and missed care: a cross-sectional study*

*Background:* With the increasing complexity of nursing care, quality of care is a relevant and important topic in hospitals. The quality of the nursing work environment is associated with quality of care and missed care in international studies. Though, in the Netherlands evidence on this association is insufficient.

*Aims:* To measure the influence of nursing work environment on (1) nurse perceived quality of care (NPQoC) and (2) missed care on general nursing wards in a top clinical hospital in the Netherlands. Secondary, the association between missed care and nurse-perceived quality of care was explored.

*Methods:* A cross-sectional survey was sent to all registered nurses of 6 general wards in a topclinical hospital in The Netherlands. The questionnaire included the Practice Environment Scale of the Nursing Work Index (PES-NWI) to measure the nursing work environment and measured nurse and patient characteristics (e.g. age, working experience, patient-to-nurse ratio). In a multiple linear regression analysis the influence of the nursing work environment on NPQoC and missed care was assessed, corrected for nurse and patient characteristics. In a univariate regression NPQoC was explained by missed care.

*Results:* 92 nurses were included in the study. An increase in the nursing work environment of 1 increased the NPQoC with 22% ( $p=0.534$ ). An increase in the nursing work environment of 1 lead to a 26.6% decrease in missed care ( $p=0.576$ ). No association was found between missed care and the nursing work environment ( $p=0.21$ ).

*Conclusion:* This single-center study with a small sample could not provide sufficient evidence on the influence of the nursing work environment on NPQoC and missed care in The Netherlands.

*Recommendations:* A multicentre study with a larger sample must be conducted on the influence of the nursing work environment on NPQoC and missed care to provide reliable results on the work environments of Dutch hospitals.

**Keywords:** nursing work environment, quality of care, missed care, hospital, regression model

## Samenvatting

*Achtergrond:* Door toenemende complexiteit van verpleegkundige zorg is kwaliteit van zorg een veelbesproken onderwerp in ziekenhuizen. De associatie tussen de verpleegkundige werkomgeving en de waargenomen kwaliteit van zorg door verpleegkundigen en gemiste zorg door verpleegkundigen is in meerdere studies aangetoond. Voor Nederland specifiek is het bewijs onvoldoende om deze associatie aan te tonen.

*Doelstelling:* Het meten van de invloed van de verpleegkundige werkomgeving op de waargenomen kwaliteit van zorg door verpleegkundigen en de gemiste zorg door verpleegkundigen. Daarnaast het voorspellen van de kwaliteit van zorg uit de mate van gemiste zorg.

*Methode:* Een dwarsdoorsnede onderzoek werd uitgevoerd met behulp van een vragenlijst. De vragenlijst werd verspreid onder alle verpleegkundigen van 6 algemene afdelingen van een topklinisch ziekenhuis in Nederland. De vragenlijst bestond uit de Practice Environment Scale of the Nursing Work Index (PES-NWI) en vragen over en patiënt karakteristieken verpleegkundige (o.a. leeftijd, werkervaring, aantal patiënten per verpleegkundige). In een multiple regressie analyse werd de invloed van de verpleegkundige werkomgeving op de uitkomsten bepaald, gecorrigeerd voor verpleegkundige en patiënt karakteristieken. In een univariate regressie werd de kwaliteit van de zorg voorspeld uit de hoeveelheid gemiste zorg.

*Resultaten:* 92 verpleegkundigen werden geïnccludeerd in de studie. Een toename in de verpleegkundige werkomgeving van 1 verhoogde de waargenomen kwaliteit van zorg met 22% ( $p=0.534$ ) en verlaagde gemiste zorg met 26.6% ( $p=0.576$ ). Er werd geen relatie gevonden tussen gemiste zorg en kwaliteit van zorg ( $p=0.21$ ).

*Conclusie:* Dit onderzoek had een te kleine sample om een significant effect aan te tonen tussen de verpleegkundige werkomgeving en de kwaliteit van zorg en gemiste zorg in Nederland.

*Aanbevelingen:* Meer onderzoek is nodig, waarbij een grotere sample en meer ziekenhuizen geïnccludeerd moeten worden om betrouwbare conclusies te kunnen trekken over de invloed van de verpleegkundige werkomgeving op kwaliteit van zorg en gemiste zorg in Nederlandse ziekenhuizen.

**Trefwoorden: verpleegkundige werkomgeving, kwaliteit van zorg, gemiste zorg, ziekenhuis, regressie model**

## Introduction

Globally, healthcare institutions are struggling with shortages of registered nurses, while the need for registered nurses is expected to increase in the coming years. Concurrently the complexity of nursing care is also increasing, due to advances in technology and reductions in the length of stay for patients.(1) Consequently, In the light of these developments, maintaining quality of nursing care is a relevant and important topic in hospitals.(2,3)

The World Health Organization (WHO) defined quality of care as: “the extent to which health care services provided to individuals and patient populations improve desired health outcomes. In order to achieve this, health care must be safe, effective, timely, efficient, equitable and people centred.”(4) Contributing to the quality of care in hospitals are organizational factors. A substantial body of knowledge exists on adequate nurse staffing levels and how they are associated with quality of care.(5,6) Although, these studies show that adequate staffing is not the only organizational factor contributing to quality of care. Schubert et al. (2008) suggest that complexity of patients as well as the nursing work environment influence the quality of care.(7)

According to Aiken et al (2011), poor work-environments in hospitals are common and associated with lower quality of care and are contributing to nurse retention.(9) Work environment can be defined as “factors that enhance or attenuate a nurse's ability to practice nursing skilfully and deliver high quality care”(10). The nursing work environment in Europe is mostly measured using the Practice Environment Scale of the Nursing Work Index (PES-NWI) for being a validated and widely used questionnaire.(11)

Quality of care can be assessed by using the Donabedian' quality framework quality of care. This framework distinguishes structure, process and outcome variables, all influencing quality of care. 'Structure' contains the attributes and resources of care on personnel, patient and organizational level, 'process' contains all activities (e.g. by nurses or patients) affecting direct nursing care.(12) The outcome quality of care is influenced by a combination of factors on these structure and process levels. Nurse-perceived quality of care (NPQoC), measured by a single-item indicator, was found to correspond with indicators of hospital quality and is considered to be a representative value for the quality of care in a hospital.(13)

Additionally, the nursing work environment is associated with the amount of missed nursing care: “the withholding or failure to carry out necessary nursing tasks due to inadequate time, staffing level, and/or skill mix.”(7) Kalisch et al (2013) found that by increasing teamwork behaviour missed nursing care decreased, as reported by nurses.(14) A study of Ball (2016), conducted in Sweden, showed a significant effect of work-environment on missed care as reported by nurses. In this study seventy-four per cent of the 10,174 nurses reported any care left undone in their last worked shift.(15) A factor significantly influencing the association

between nursing work environment and missed care is the amount of non-nursing tasks nurses are performing during their shift. (16) These tasks are defined as 'Necessary but left undone because you lacked time to complete them'. (7)

In previous research significant differences were found in the quality of work environment between different countries.(9,17,18) Therefore, evidence from these studies cannot be generalized to nursing care in the Netherlands. Evidence on the nursing work environment and its effect on nurse-perceived quality of care in The Netherlands is limited to the study of Stalpers et al. (2016) on ICU nurses, which found positive associations between the work environment characteristics: adequacy of staffing, patient- centeredness, competent peers and support for education.(19) Additional research on general nursing wards has not yet been done.

This study will measure the influence of the nursing work environment on nurse perceived quality of care and missed care, on general wards in a top clinical hospital in the Netherlands. Therefore, this study will add to the existing knowledge on nursing work environment and nurse outcomes in the Netherlands. This knowledge can contribute to improving the quality of care in hospitals in The Netherlands.

## **Aims**

The primary aim of this study was to measure the influence of nursing work environment on (1) nurse perceived quality of care and (2) missed care on general nursing wards in a top clinical hospital in the Netherlands. In addition, a secondary aim of this study was to explore the association between missed care and nurse-perceived quality of care.

## **Methods**

### *Design*

A cross-sectional survey was conducted in a top clinical hospital in The Netherlands. This design is suitable when evidence is indicating that one variable is preceding the other(20) and to measure the relationship between specific determinants and an outcome measure. (15)

### *Population*

The participants in this study were registered nurses, selected from six general nursing wards in a top clinical hospital; internal medicine, oncology, surgery, plastic surgery/urology, gastro-intestinal and orthopaedics. A convenience sample was considered to provide the most representative data for the outcomes of this study.(20)

All registered nurses performing direct patient care were invited to participate in the study. Student nurses and flex workers were also invited to participate. Excluded from the study were health care assistants, since they were not directly responsible for the quality of nursing care.

### *Procedures*

Data was collected between January 2018 and March 2018. All study parameters were merged into one questionnaire which was guided by a participant information letter. All nurses of the included wards were invited to respond to the digital questionnaire, which was distributed by the heads of the departments through the work e-mail address. After 2 weeks a reminder for completing the questionnaire was sent, by e-mail. Nursing staff was rewarded with candy at a 70% response rate to stimulate participation in the study. The questionnaires were based on the last worked shift, so nurses could easily recall the information and provide the most accurate data.

### *Data collection*

Data collection was guided by the Donabedian model, identifying influencing factors for quality of care and missed care on structure, process and outcome level (figure 1). The Donabedian model is a widely used framework to assess quality of care.(8,18-19)

### *Figure 1: The Donabedian model*

### *Measures*

NPQoC was measured by a single item indicator that asks nurses to rate the quality of care as excellent (0), good (1), fair (2) or poor (3). The measure has an interclass correlation of 0.61 (24) to 0.73 (25) and is widely used in research. (13,26) The score will be interpreted as a

continuous variable varying between 0 and 3. For baseline characteristics a mean score will be calculated.

Missed care was measured using a 13 topic list; "Things left undone", based on the research of Schubert (2008) on care rationing(7). With this topic list nurses indicate which necessary care they were not able to perform during their last worked shift by answering the items by yes (missed) or no (not missed). This topic list is available in Dutch - translated based on Cosmin criteria REF), but not validated- although the topic list has been used in extensive research(27). The number of items indicated as missed, in the last worked shift, is the final score for "Things left undone" (table 3).

Structure parameters of this study included the nursing work environment, nurse characteristics and patient characteristics. The nursing work environment was measured using the Practice Environment Scale of the Nursing Work Index (PES-NWI). The PES-NWI consists of 32 items, using a 4-point Likert scale; strongly disagree (0), disagree (1), agree (2) and strongly agree (3). The instrument has a total mean score, plus it distinguishes 5 dimensions of work environment; Nurse Participation in Hospital Affairs; Nursing Foundations for Quality of Care; Nurse Manager Ability, Leadership and Support of Nurses; Staffing and Resource Adequacy; and Collegial Nurse-Physician Relations. The minimum score in total and per dimension is 0 and the maximum is 3, a mean score of  $\geq 1,5$  is considered as a positive rating of the work environment and the subscales.(28) The PES-NWI is validated and available in Dutch(11,17).

Nurse characteristics collected were age, gender, educational level, working experience, number of bachelor nurses per shift and specialism (table 1). Patient characteristics collected were number of patients admitted on the ward, number of patients per nurse, number of ADL dependent patients per nurse, number of patients requiring hourly checks per nurse and number of discharges and transfers per nurse per shift (table 1). All characteristics were collected through the questionnaire and were based on the last worked shift. The selected patient characteristics were measured per nurse as an indication for the complexity of patient care.

Non-nursing tasks were included as a process parameter in this study. The non-nursing tasks were measured using the 'non-nursing tasks' 9 item scoring list developed by Schubert (29) and available in Dutch(17). This 9 item list includes delivering and retrieving food trays, performing non-nursing care, arranging discharge referrals and transportation, routine blood drawing for tests, transporting of patients within the hospital, cleaning patients' rooms and equipment, filling in for non-nursing services not available off hours, obtaining supplies or

equipment, answering phones clerical duties. All items can be scored as never (0), sometimes (1) and often (2) performed. Interpreting the scores for this 9-item list is not clearly set, some studies interpret the list as binary values (15), others as a continuous variable (16). For this study a total score was calculated, with possible values between 0 and 18.

### *Data analysis*

Analyses were conducted using the IBM Statistical Package for the Social Sciences (SPSS) version 23 for Windows (IBM corp., Armonk, US). Continuous characteristics of the sample were described using descriptive statistics by means and standard deviations (SD).

Categorical characteristics were presented in proportions. A multiple linear regression analysis was conducted to determine the effect of the nursing work environment on nurse perceived quality of care and missed care. The analysis was equal for both models and a  $p < 0.05$  was considered statistically significant. All variables were first tested in a univariate regression and were included in the multivariate model if they were significant at  $p < 0.2$ . The multiple regression analysis was performed using the standard method to create a model with all variables selected. The secondary aim was answered with a univariate regression of NPQoC and missed care. The variables specialty and educational level had multiple categories. For educational level all categories were entered hierarchical (vocational as lowest education and master as highest) and for specialty dummy variables were created as there was no hierarchy in the different specialisms.

Assumptions for multiple regression are normality, linearity and homoscedasticity. These were assessed respectively by a Q-Q plot, a residual plot and a scatter plot. Normality was assumed when the data was spread normally in the histogram, linearity was assumed when all data points were close to the straight line, homoscedasticity was assumed when all data points were widely spread. Multicollinearity was assessed by a correlation matrix. (30) When 2 independent variables were correlated higher than 0.8 confounding was present and one of the variables was excluded from the model.

When using a multiple regression analysis the rule of thumb is to include 10 cases per independent variable. Although this rule is questioned for being too conservative, this is the most commonly used method(31). This study included 22 predictors, and thus a sample size of 220 was considered optimal.

Missing data was considered missing completely at random (MCAR), since the missing data was evenly spread and the data collected did not include sensitive subjects. An available



case analysis was performed, producing conservative results and unbiased estimates when missing data is MCAR.(32)

### *Ethical issues*

This study was conducted according to the principles of the Declaration of Helsinki(33). The study was excluded from the Medical Research Involving Human Subjects Act (WMO) and did not have to be approved by a Medical Review and Ethics Committee (METC), for subjects were not submissive to any intervention or behavioural rule(34). The research was approved by the local regularities committee for local feasibility. Informed consent from nurses was not necessary for this study, since participation was voluntary and no personal data was collected, so the investigator could not retrace the data to single nurses. Data will be coded with identification numbers.

Data will be stored for 15 years on the location of the principal investigator. All documents will be locked by a password, which can be obtained through the principal investigator. All researchers working on this study have access to the data.

## Results

Approximately 160 nurses were approached to participate in the study and 92 nurses were included between January 2018 and March 2018, resulting in a response rate of 58%. Most participating nurses were female (92%). The nurses had a mean age of 40 (SD 14.06) years old and a mean working experience of 16,5 (SD 13.37) years. Nurses were responsible for approximately 7 (SD 3.40) patients per shift (patient-to-nurse ratio) (table 1). Missed care and NPQoC are described in table 2.

### *Nurse-perceived quality of care*

In the univariate analysis ward specialty and non-nursing tasks were associated ( $p < 0.2$ ) with NPQoC (table 1). These were included in the multivariate model together with work environment. In total 58 available cases were included in the multivariate model, while 34 cases were excluded because data was missing on one of the variables.

The model explained 25.6% of the variance in NPQoC. No significant association was found between the nursing work environment and NPQoC. An increase in the nursing work environment of 1 increased the NPQoC with 22% (CI -0.484-0.923,  $p = 0.534$ ). Significant associations were found for non-nursing tasks and the gastrointestinal ward. An increase per non-nursing tasks was associated with a 4.4% decrease in NPQoC (CI -0.085- -0.002,  $p = 0.04$ ). When working on the gastrointestinal ward nurses assessed the quality of care 41,9% (CI 0.067-0.772,  $p = 0.021$ ) higher than nurses working on the surgery ward (RC) (table 1).

### *Missed care*

In the univariate analysis age, working experience, specialism, non-nursing tasks, number of ADL dependent patients and number of patients requiring hourly checks were associated ( $p < 0.2$ ) with missed care (table 3). Age and working experience were highly correlated (Pearson  $r > 0.8$ ), excluding working experience from the model, for age being more significant. Work environment was not significant, but was included in the model for being the main factor researched in this study. In total 48 complete cases were included in the multivariate model, while 44 cases were excluded because data was missing on one of the variables.

The model explained 33.1% of the variance in missed care. No significant association was found for the nursing work environment and missed care. An increase in the nursing work environment of 1 lead to a 26.6% decrease in missed care (CI -6.718-3.790,  $p = 0.576$ ). A significant association was found for non-nursing tasks. An increase of non-nursing tasks of 1 lead to a 33.5% increase in missed care (CI 0.063-0.607,  $p = 0.017$ ).

### *Missed care and Nurse Perceived Quality of Care*

In a univariate regression the association between missed care and NPQoC was assessed. An increase in missed care of 1 lead to a 2,5% (CI -0.065-0.015, p=0.21) decrease in NPQoC (table 1).

*Table 1: Univariate and multivariate analyses of the nursing work environment on nurse perceived quality of care*

*Table 2: Missed care and nurse perceived quality of care.*

*Table 3: Univariate and multivariate analyses of the nursing work environment on missed care*

## Discussion

This study was conducted to examine the influence of the nursing work environment on NPQoC and missed care in a topclinical hospital in The Netherlands. No associations were found between the nursing work environment and NPQoC or missed care after correction for structure (nurse and patient characteristics) and process variables (non-nursing tasks). Similar results were found in research of Stalpers et al. (2016), who examined the association between the nursing work environment and NPQoC in ICU nurses. This multicenter study in the Netherlands did not find associations between nurse characteristics (gender, education level, working shifts, schedule, age and ICU experience) and NPQoC, which is consistent with the findings in this study.(19) Controversely, studies using the Essentials of Magnetism II questionnaire to measure the nursing work environment, did found associations between the work environment characteristics and quality of care. These differences could be explained by the multicentre design of these studies and the larger samples sizes of respectively 123 and 247 nurses.(8,19)

For the secondary aim of this study, to explore the association between missed care and NPQoC, no association was found. Although, research of Ball et al. (2012) showed a strong relationship between the number of items of missed care and nurse perceived quality of nursing care (polyserial correlation= $-0.37$ ,  $p<0.001$ ). (15) This study did also correct for the time of shift in which different amounts of missed care were found. In the afternoon 80% of nurses reported some care missed, while in a night shift this was only 59%. In the current study the time of shift was not included in the model.

Otherwise, an increase in the number of non-nursing tasks performed lead to an increase in missed nursing care of 33.5% ( $p=0.017$ ) and a decrease in NPQoC of 4.4% ( $p=0.04$ ). Aussenhofer et al. (2014) studied the association between the amount of non-nursing tasks performed by nurses and missed care in 12 European countries, including The Netherlands.(16) In this study a significant association was found between nurses performing non-nursing tasks and the amount of missed care reported. In addition Ball et al. (2016) found a significant RR of 1.087 ( $p<0.001$ ) between the number of non-nursing tasks performed and the number of items of missed care reported. The present study supports this existing evidence, implying that supporting staff is necessary to minimize the time nurses spent on non-nursing tasks, for nurses to be able to deliver high-quality care.

Furthermore, nurses working on the gastrointestinal department assessed the quality of care significantly (41.9%) higher than nurses working on the surgery ward. This could possibly be explained by the difference in complexity of patient care between the specialties. Nurses reported a mean number of patients needing help with ADL tasks of 4,55 on the surgery ward and 3,38 on the gastrointestinal ward per nurse per shift. On the surgery ward a mean of

2,60 patients needed hourly checks and on the gastrointestinal ward this were 1,90 patients per nurse per shift. This indicates that the surgical specialty has more complex patients as the gastrointestinal ward.

This study has some limitations to be mentioned. First, the study had a small sample and a disappointing response rate of 58%, for which the most mentioned reasons were the length of the questionnaire and the high work load of nurses. The researchers have attempted to increase the response rate by visiting the wards, expressing the need for this study to the nurses and by sending reminders through e-mail and social media. However, the response rate remained low. Another explanation could be that this hospital was just merged from 2 hospitals into 1. This has caused a lot of disbalance and changes for nurses, resulting in less motivation for extra work like filling in questionnaires. It is expected nurses who were experiencing a high workload would have scored lower values on the nursing work environment and on NPQoC and higher on missed care. Missing this data from these nurses results in a non-realistic representation of the work environment, nurse perceived quality of care and missed care. In a previous study of Aiken et al. (2013) 35% of Dutch nurses assessed the quality of care poor or fair, this was only 22% in the current study, which supports this hypothesis.(26) Another explanation may be that this was a single centre study, previous research was multi centred and even internationally performed.(16,23,26) The measures nursing work environment in this study did not have much variation, being measured in the same hospital. Specifically the specialties internal medicine (N=2) and oncology (N=4) provided small samples, but excluding these nurses did not provide different results and thus these small samples did not affect the study.

Secondly, the data collected had a substantial amount of missing data. From the initial relatively small sample respectively 48 and 58 cases could be used for the final models in the multivariate analyses, resulting in an even smaller sample. This may have contributed to the lack of evidence found in this study.

Thirdly, patient complexity could not be assessed by a representative value. A value for patient complexity, used in the hospital the study was conducted, is the Charleson Comorbidity Index (CCI). The results of the CCI were not yet available for this population of patients. Patient complexity was thus measured by the patient demographics as reported by nurses, being a less reliable source for patient complexity.

In this study, supported by previous evidence of multiple studies, an increase per non-nursing tasks was associated with a 4.4% decrease in NPQoC ( $p=0.04$ ) and an increase of 33.5% in missed care ( $p=0.017$ ). This is demonstrating a way to increase quality of care in

hospitals. therefore, the hospital management should focus on preventing nurses to spent time on non-nursing tasks and provide sufficient supporting staff to carry out these tasks.

The results of the current study contribute to the knowledge on factors influencing the ability to maintain the quality of nursing care. In this single centre study no associations were found. We did discover that it is difficult to get nurses who are already experiencing a high workload to participate in a survey study. For future research it is recommended to find more options for nurses to be able to participate, for example by developing questionnaires which contain fewer items. Collecting data on a routine basis, like patient complexity as the Charleson Comorbidity Index (CCI) and having this data available for researchers, reduces the length of the surveys and makes extensive research possible. Standardizing this routine data collection for all hospitals in the Netherlands makes it possible to combine data from different hospitals for research. This data on the nursing work environment is essential for policy decisions on structure, process and outcome levels. By influencing these indicators quality of care can be optimized for not only patients, but also for nursing personnel, resulting in patient satisfaction and job satisfaction for nurses.

## **Conclusion**

In this study the influence of the nursing work environment on missed care and on nurse perceived quality of care in the Netherlands was assessed, with no associations found. This study was a single centre study with a low response rate, so the sample of the study was small. To be able to draw reliable conclusions on the influence of the nursing work environment on NPQoC and missed care in The Netherlands a multicentre study with a larger sample has to be conducted.

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## Figures and tables

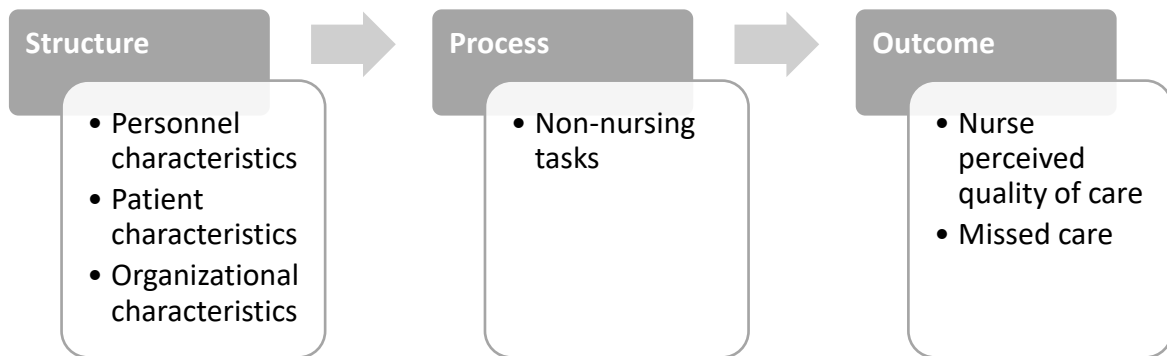


Figure 1: Donabedian model

Table 1: Univariate and multivariate analyses of the nursing work environment on Nurse Perceived Quality of Care. N = number of participants responding to item; SD = standard deviation; B = beta; CI = confidence interval; RC = reference category

Characteristics	N (%)	Mean (SD)	Range	Univariable			Multivariable		
				Estimate (B)	CI 95%	P-value	Estimate (B)	CI 95%	P-value
<b>Nurses</b>									
Age	80	39.96 (14.06)	20-63	-0.001	-0.010-0.009	0.901			
Gender (males)	7 (8.10)			-0.079	-0.513-0.354	0.717			
Educational level	84			-0.066	-0.189-0.058	0.291			
▪ Vocational	42 (50.00)								
▪ Inservice	18 (21.40)								
▪ Bachelor	18 (21.40)								
▪ Specialization	6 (7.10)								
▪ Master	0 (0)								
Working experience (years)	74	16.50 (13.37)	1-44	-0.005	-0.015-0.005	0.308			
Percentage Bachelor/shift	71	25.11 (0.28)	0-100	-0.116	-0.587-0.354	0.354			
Specialism	80								
▪ Surgery	21 (26.3)			RC					
▪ Orthopaedics	19 (23.8)			0.316	-0.023-0.655	0.067	0.275	-0.084-0.633	0.130
▪ Plastic surgery/urology	12 (15.0)			0.360	-0.025-0.745	0.067	0.144	-0.320-0.607	0.536
▪ Internal medicine	2 (2.5)			0.026	-0.750-0.803	0.946	0.809	-0.232-1.851	0.125
▪ Oncology	4 (5.0)			0.276	-0.298-0.851	0.341	-0.210	-0.851-0.432	0.515
▪ Gastrointestinal	22 (27.5)			0.572	0.245-0.899	0.001	0.419	-0.067-0.772	0.021
Work environment	83	1.42 (0.46)	0.25-2.50	0.240	-0.452-0.931	0.490	0.220	-0.484-0.923	0.534
▪ Subscale 1	81 (97.59)	1.92 (0.24)	1.14-2.71	0.191	-0.089-0.470	0.179			
▪ Subscale 2	81 (97.59)	1.98 (0.31)	1.25-2.75	0.212	-0.736-0.311	0.422			
▪ Subscale 3	79 (95.18)	1.82 (0.22)	1.00-2.33	0.014	-0.409-0.436	0.949			
▪ Subscale 4	72 (86.75)	1.52 (0.29)	0.63-2.13	0.425	-0.155-1.005	0.148			
▪ Subscale 5	66 (79.52)	1.73 (0.20)	1.09-2.20	0.048	-0.418-0.514	0.837			
Non-nursing tasks (no.)	76	7.70 (3.26)	0-16	-0.025	-0.064-0.013	0.196	-0.044	-0.085- -0.002	0.040
<b>Patients</b>									
Number of patients admitted	75	25.15 (9.48)	3-45	-0.007	-0.020-0.007	0.343			
Number of patients per nurse	75	7.16 (3.40)	0-17	0.002	-0.037-0.040	0.930			
Number of ADL dependent patients per nurse	71	4.63 (2.94)	0-16	-0.024	-0.071-0.023	0.315			
Number of patients requiring hourly checks per nurse	72	2.53 (2.33)	0-9	-0.013	-0.070-0.044	0.655			
Number of discharges and transfers per nurse per shift	76	1.50 (1.94)	0-10	0.016	-0.061-0.093	0.682			
<b>Secondary analysis</b>									
Missed care				-0.025	-0.065-0.015	0.219			

Table 2: Missed care and nurse perceived quality of care. N = number of participants responding to item; SD = standard deviation

Outcome variables	N (%)	Mean (SD)	Range
<b>Missed care</b>	80	3.60 (3.22)	0-13
▪ Adequate patient surveillance	26 (32.5)		
▪ Skin care	16 (20.0)		
▪ Oral hygiene	26 (32.5)		
▪ Pain management	11 (13.8)		
▪ Comfort/talk with patients	50 (62.5)		
▪ Educating patients and family	22 (27.5)		
▪ Treatments and procedures	13 (16.3)		
▪ Administrating medications on time	24 (30.0)		
▪ Prepare patients and families for discharge	12 (15.0)		
▪ Adequately documenting nursing care	26 (32.5)		
▪ Develop/update nursing care plans/care pathways	35 (43.8)		
▪ Planning care	13 (16.3)		
▪ Frequently changing of patient position	14 (17.5)		
▪ Any care missed	63 (78.9)		
<b>Nurse perceived quality of care</b>	79		
▪ Poor	1 (1.27)		
▪ Fair	19 (24.05)		
▪ Good	55 (69.62)		
▪ Excellent	4 (5.06)		
<b>Mean nurse perceived quality of care</b>		1.78 (0.55)	
▪ Oncology		1.75 (0.96)	
• Orthopaedics		1.79 (0.42)	
• Plastic surgery/urology		1.83 (0.58)	
• Internal medicine		1.50 (0.71)	
• Surgery		1.50 (0.61)	
• Gastrointestinal		2.05 (0.38)	

Table 3: Univariate and multivariate analyses of the nursing work environment on missed care. N = number of participants responding to item; SD = standard deviation; B = beta; CI = confidence interval; RC = reference category

Characteristics	N (%)	Mean (SD)	Range	Univariable			Multivariable		
				Estimate (B)	CI 95%	P-value	Estimate (B)	CI 95%	P-value
<b>Nurses</b>									
Age	80	39.96 (14.06)	20-63	-0.065	-0.111- -0.018	0.007	-0.022	0.092-0.047	0.515
Gender (males)	7 (8.10)			-0.236	-2.986-2.513	0.865			
Educational level	84			-0.169	-0.912-0.574	0.625			
▪ Vocational	42 (50.00)								
▪ Inservice	18 (21.40)								
▪ Bachelor	18 (21.40)								
▪ Specialization	6 (7.10)								
▪ Master	0 (0)								
Working experience (years)	74	16.50 (13.37)	1-44	-0.069	-0.123- -0.015	0.013			
Percentage Bachelor/shift	71	25.11 (0.28)	0-100	1.069	-1.624-3.763	0.431			
Specialism	80								
▪ Oncology	4 (5.0)			RC					
▪ Orthopaedics	19 (23.8)			1.515	-1.985-5.014	0.391	2.362	-4.395-0.119	0.483
▪ Plastic surgery/urology	12 (15.0)			2.750	-0.976-6.478	0.145	4.851	-2.569-12.271	0.193
▪ Internal medicine	2 (2.5)			1.750	-3.704-7.204	0.524	4.807	-4.360-13.973	0.295
▪ Surgery	21 (26.3)			1.321	-2.114-4.757	0.446	3.787	-3.078-10.625	0.271
▪ Gastrointestinal	22 (27.5)			0.705	-2.719-4.128	0.683	4.332	-2.834-11.498	0.228
Work environment	83	1.42 (0.46)	0.25-2.50	0.266	-3.978-4.510	0.901	-1.464	-6.718-3.790	0.576
▪ Subscale 1	81 (97.59)	1.92 (0.24)	1.14-2.71	-0.905	-2.467-0.656	0.252			
▪ Subscale 2	81 (97.59)	1.98 (0.31)	1.25-2.75	-0.371	-3.614-2.872	0.820			
▪ Subscale 3	79 (95.18)	1.82 (0.22)	1.00-2.33	0.355	-2.027-2.738	0.767			
▪ Subscale 4	72 (86.75)	1.52 (0.29)	0.63-2.13	0.316	-3.149-3.781	0.856			
▪ Subscale 5	66 (79.52)	1.73 (0.20)	1.09-2.20	1.165	-1.613-3.944	0.405			
Non-nursing tasks (no.)	76	7.70 (3.26)	0-16	0.350	0.130-0.571	0.002	0.335	0.063-0.607	0.017
<b>Patients</b>									
Number of patients admitted	75	25.15 (9.48)	3-45	0.029	-0.050-0.108	0.465			
Number of patients per nurse	75	7.16 (3.40)	0-17	0.085	-0.137-0.306	0.448			
Number of ADL dependent patients per nurse	71	4.63 (2.94)	0-16	0.231	-0.018-0.480	0.068	0.054	-0.359-0.466	0.794
Number of patients requiring hourly checks per nurse	72	2.53 (2.33)	0-9	0.389	0.080-0.698	0.014	0.288	-0.195-0.771	0.234
Number of discharges and transfers per nurse per shift	76	1.50 (1.94)	0-10	0.034	-0.351-0.418	0.862			