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NURSES' RATINGS OF SERVICE QUALITY IN HOSPITAL WARDS WITH DIFFERENT NURSING ORGANIZATION. A MULTILEVEL ANALYSIS.

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Running head:
Nursing organisation and quality

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ABSTRACT

Aim. Assess the associations of nurses' perception of service quality with different nursing organization models, and if local conditions modified the associations. **Background.** There is little evidence to what model of nursing organization maximizes the quality of nursing services. **Method.** Cross-sectional survey of nurses' descriptions of quality of patient care and practice environment in a representative sample of Norwegian hospital wards. Intraward organization models were classified as: (1) Team leader (n=30), characterized by extensive responsibilities for team leaders, (2) **Primary** nurse (n=18), with extensive responsibilities for named nurses, and (3) Hybrid (n=37), (1) and (2) combined. We prepared multilevel regression models using scales describing Quality of patient care, Climate to learning, Job satisfaction, and Relations with physicians as dependent variables. As independent variables, we used variables representing local ward conditions. **Results.** 87 wards, 1,137 nurses (55% response rate) provided complete data. The total proportion of variance at ward level ranged from 0.11 (Job satisfaction) to 0.22 (Relations with physicians). The univariate effect of organization models on quality ratings was not statistically significant. Introducing local ward conditions lead to a statistically significant effect of **Primary** nurse organization on Relations with physicians, and to a substantial proportional reduction in ward level variance, ranging from 32% (Quality of patient care) to 24% (Climate to learning). **Conclusion**. This study could not show that any of the three organization models were better than the two others in terms of the nurses' perceived quality of patient care or practice environment.

Suggested key words

Nursing administration

Survey

Hospital

Research report

Adults

Quality

Organization

SUMMARY STATEMENT

What is already known about this topic

• Quality improvement is an important responsibility for hospital managers at all levels

• The commission of first level nurse managers is to pursue quality for patients, employees, and society

• There is little knowledge about the relations between nursing organization in hospital wards and the nurses' perceptions of the quality of patient care and practice environment

What this paper adds

• Nurses' ratings of quality is not related to the model of nursing organization

• Local conditions other than nursing organization are associated with quality in the eyes of the nurses

• Service quality seems to be a weak argument for choosing one model before another

INTRODUCTION

In hospital wards, the model of organizing nursing services is often considered to be of critical importance to achievehigh quality patient care and a practice environment that allows nurses to practice to their full potential. Different organizational models may imply differences in staffing and staff flexibility and therefore in human resource costs. Further, the organization of nursing influences the co-ordination between nurses and other professions in the hospital.

BACKGROUND

Three main typologies are used for describing the organization of nursing in hospital wards (Adams et al. 1998;Buchda 2004;Minnick et al. 2007;Tiedeman & Lookinland 2004). In *functional nursing,* tasks are allocated in accordance with each nurse's qualifications, similar to production line principles. For example, different nurses provide infusion therapy or wound dressings. A trend towards patient-centred care has rendered this model obsolete in most settings. In *team nursing,* a small group of nurses is responsible for the service to a small group of patients, thus making the number of interpersonal contacts more manageable and the lines of responsibility clearer. A registered nurse is team leader and supervises the work of registered nurse colleagues and less qualified personnel. Finally, in *Primary nursing* one single nurse is responsible for all care to a strictly limited number of patients during their hospital stay, in accordance with the idea of holistic care. This holistic approach together with increased autonomy and individual accountability, is believed to enhance job satisfaction, and encourage knowledge development (Ersser & Tutton 1991;Scott et al. 1999)

These three typologies are theoretical models of nursing organization. Implementation of the models to a ward setting implies adaptation to local conditions such as staff quality and quantity, workload, type of care and ward size. Therefore, in the real world, nursing organization models are adaptations of the typologies, often with characteristics or traits from

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more than one of them. Further, they often carry labels after the dominating typology, such as group nursing, patient responsible nurse, or primary nursing (Adams et al. 1998;Digernes 1986;Mark 1992;Tiedeman & Lookinland 2004).

Previous studies of the association of nursing organization and staffing and skill-mix with measures of quality have reported no difference between the organization models (Chavigny & Lewis 1984;Shukla 1982), or that primary nursing is associated with increased quality of care, nurse retention, and job satisfaction (Gardner 1991;Reed 1988). A recent systematic review did not find evidence to favor one of the models (Pearson et al. 2006).

In hospitals known to attract nurses, Magnet hospitals, the principles of primary nursing are appreciated. These hospitals are also characterized by emphasizing professional development and good relationship between nurses and physicians (Scott et al. 1999). Magnet hospitals also have favourable results in patient outcomes (Aiken et al. 1994).

However, these studies have limitations, for example deficiencies in the operationalization of organization models and limited data about the heterogeneity of the compared units. The use of hospital level data may conceal intra hospital variation in effectuating the models (Mimick et al. 2007). Finally, few studies have been reported from other countries than the USA or the UK, and differences in methodology complicate comparisons between studies. Therefore, previous studies provide little evidence of differences in quality of care, costs, or satisfaction between different models of nursing organization (Tiedeman & Lookinland 2004).

THE STUDY

Aim

The main objective was to assess (1) the relations between nursing organization models in hospital wards and nurses' perception of the quality of patient care and dimensions of the

practice environment, and (2) if these relations were modified by variations in local conditions at the ward level.

Design and sample

This study is based on the nurses' responses in a cross-sectional postal survey in 2005 of patients and registered nurses in a representative sample of hospital wards. Registered nurses in Norway have completed a three-year college program. In addition, Norwegian hospitals use licensed practical nurses with a vocational education, who were not included in this survey (for definitions, see Simoens et al. 2005, Box 2). We first identified all wards in public general hospitals in Norway that performed acute, somatic care for adults, had minimum18 beds, and 24 hours activity, 7 days a week. Maternity wards and wards with intensive or intermediate care beds were not included.

The required sample size was estimated to 100 wards based on data from a similar survey (Pettersen et al. 2004) and a 10% drop-out rate. In total, 156 of 243 eligible wards consented to participate in the study, of which we randomly selected 100 wards for the postal survey.

Data collection

In each ward, we collected three types of information:

(1) *The nurses' survey,* a survey of registered nurses working minimum halftime in the ward. The survey provided information to be used as dependent variables, about quality of patient care, climate for learning, individual job satisfaction, and relations with physicians, which are important dimensions of the practice environment (American Association of Colleges of Nursing 2002); (2) *The charge nurse survey* provided data to be used as explanatory variables, about distribution of responsibility within the ward, and also about local conditions such as number of beds, and type of care; and (3) a daily census, that provided data about local conditions concerning staffing and patient occupancy.

A liaison nurse in each ward received a survey package with cover letters and questionnaires to the registered nurses, including preaddressed, postage paid return envelopes for all questionnaires. The liaison nurse recorded the age and sex of nurses receiving questionnaires on a separate list, which was sent to the researchers. The completed questionnaires were sent anonymously to the researchers. Because of anonymity we could not send personal reminders, therefore e-mail and telephone contacts to the liaison nurse were used to maximize return rates.

Questionnaires

Nurse questionnaire

We collected data on the nurses' ratings of the quality of patient care and practice environment at their wards using a questionnaire which was developed using literature review and evaluations of instruments used previously in Norway. The questionnaire was pilot-tested in five hospital wards before arriving at a final version, which included items on sociodemographic and working life data.

The nurses rated quality of patients' nursing care using a scale that was based on a description of nursing by 14 activities of care (Henderson 1991). In a footnote the author states her *"... belief that this list of activities can be used in evaluating nursing"* (Henderson 1991, p. 23). We collapsed the 14 activities into six items and asked how the ward succeeded in giving good nursing care in these activities (See Appendix). The ratings were given on a **response** scale from 1 (Very poor) to 7 (Very good). The scale had Cronbach's alpha=0.84.

The questionnaire also contained an item used in a previous study (Aiken et al. 2002), which allowed us to check the validity of the above scale. The scale score correlation with the item "In general, how would you describe the quality of nursing care delivered to patients on your unit?", scored on a four point scale, was 0.456 (Spearman's rho, $p<0.001$).

To assess the nurses' ratings of practice environment dimensions we used three scales from the Ward Organisational Features Scales (WOFS) (Adams et al. 1995): Relationship with physicians, Climate to learning, and Job satisfaction. WOFS was developed in the United Kingdom to measure aspects of nurses' practice environment in acute hospital wards, and used in several studies (Adams & Bond 1997;Adams & Bond 2003a;Adams & Bond 2003b;Adams et al. 1998). The properties of the Norwegian version of WOFS have previously been documented (Sjetne & Stavem 2006). Based on an initial assessment in the current study and using widely accepted criteria for testing of questionnaires (Streiner & Norman 2003), we modified a 13-item scale describing professional practice to a one-dimensional scale of six items describing Climate to Learning (Cronbach's alpha: 0.78). The Job satisfaction scale was reduced from seven to three items (Cronbach's alpha: 0.79). The relationship with physicians was used with all nine original items (Cronbach's alpha: 0.83).

The scales above used four to seven point scales and were linearly transformed to a 0 to 100 scale to ease interpretation. High scores indicated favourable descriptions.

Patient acuity could be an important confounder in the relationship between organization model and our outcomes, but we had no available information on patient acuity. As a proxy, we used a scale on nursing care technology (Leatt & Schneck 1981;Mark et al. 2003;Overton et al. 1977), which was based on 14 items indicating the proportion of the ward's patients that needed complex care. All items were scored on a 5-level ordinal scale. The individual nurse responses were aggregated to a ward mean: high scores indicated a small proportion of patients with complex care needs.

Charge nurse questionnaire

The charge nurses provided information about distribution of responsibility among the nurses of the wards. Items for this purpose were adapted from previous studies and modified to a contemporary, Norwegian context (Adams et al. 1998;Bowman et al. 1991;Makinen et al. 2003;Thomas & Bond 1990). The questionnaire also included questions about type of service

(medical or surgical), number of beds, and the proportion of staff full time equivalents that had worked on the ward for less than 1 year, from 1 to 4 years, and 4 years or more.

Every day during 3 weeks, the charge nurses registered data on patient occupancy and staffing during the last 24 hours. They reported on number of beds in operation, number of patients at noon, number of patients in the corridor, number of shifts staffed by registered nurses and by practical nurses during the last 24 hours, number of shifts staffed by agency nurses, and whether shifts were staffed according to planned rotation.

Ethical consideration

The study was approved by the Regional Committee for Medical Research Ethics and The Ombudsman for privacy in research at Norwegian Social Science Data Service. The data are stored without information identifying wards or hospitals.

Intraward organization model

To construct a variable to discriminate wards according to their intraward organization model we used K-means cluster analysis (Hair,J.F. et al. 2006) using information from the charge nurse questionnaires about assignment of seven important nursing activities. We used the following classification, as previously reported (Sjetne et al, submitted 2007): (1) Team leader dominated organizations (n= 30), where the team leader was performing the majority of the listed nursing activities; (2) Primary nurse dominated (n=19), where the primary nurse was responsible for most activities; and (3) Hybrid organizations (n=38), where both team leaders and primary nurses had extensive responsibilities. The activity assignment profiles of the three derived models are shown in Figure 1.

Data analysis

We present descriptive statistics with mean and standard deviation. Analyses of variance and chi square statistics were used for comparison of the wards according to organization

models, and of responding versus non-responding nurses. For these procedures we used the software SPSS version 15 (SPSS Inc., Chicago, Ill.).

Because of the multi-stage sampling design, we used multilevel regression analysis with MLwiN version 2.01 (Centre for Multilevel Modelling, University of Bristol, The United Kingdom) to study if organizational model and/or local conditions in the wards contributed to explained variance in the nurses' ratings (Snijders & Bosker 1999). Multilevel regression analysis differentiates between within- and between-ward variation and takes the interdependency of the responses of nurses in the same ward into account. We modelled separate models with scales for Quality of patient care, Climate to learning, Job satisfaction and Relations with physicians as dependent variables, as described above. Exploratory analyses showed that individual nurse characteristics, such as age and sex, had small and statistically non-significant effects, and these were therefore not included in the regression models.

Explanatory variables representing potentially relevant ward characteristics were selected from previous research (Van den Heede et al. 2007) and initially assessed by exploratory univariate multilevel correlations. Organization model was coded using two dummy variables with Hybrid organization as reference value. We also used dummy variables (<median=0, >median=1) for coding the proportion of experienced and inexperienced personnel on the ward, the personnel to patients ratio, the prevalence of patients placed in the corridor, agency personnel, shifts staffed according to rotation plan, the skill mix, and type of ward (medical=0, surgical=1). The variables are described in Table 1. As a test of the sensitivity of the ward classification in use, we tested alternative models with different classifications of this variable, namely a two categories solution that was produced by cluster analysis, and finally with three organization model categories representing the labels reported by the charge nurses.

The analyses were performed in three steps. In Step 1 we first modelled the "empty" regression model at ward and hospital level with a random intercept and no explanatory variables. This model provides the intraclass correlation coefficient indicating the similarity

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between nurses in the same wards (Rasbash et al. 2005). In Step 2, we included organization model as explanatory variable. In Step 3, we included variables describing local conditions in the regression model. We checked for possible interaction effects between organization model and all other explanatory variables, and these effects were included in the final regression models when statistically significant.

Statistical significance of the effects of explanatory variables was tested by the t-ratio, defined as the estimated coefficient divided by its standard error. The proportional reduction in variance at ward level was assessed by the procedure described by Snijders and Bosker (Snijders & Bosker 1999). The number of nurses working on each ward varied. Therefore we used the harmonic mean to calculate the ward level explained proportion of variance. This mean was 11 in the present data. For all statistical tests we applied a critical value of 5%, using two-sided tests.

RESULTS

After excluding wards with incomplete data, we performed analyses on a subset of 87 wards with 1,137 nurses (54% response rate) from 39 hospitals. The mean number of responding nurses in the wards was 13 (range 4 to 25).

To compare nurse respondents and non-respondents we used data on age and sex, which was recorded by the liaison nurses for 76% of the participants that received questionnaires, and geographical region, type of care provided, hospital size, and ward bed capacity. Non-respondents were younger than respondents (36 and 38 years respectively, p=0.001), and the response rate was lower for nurses working in medical wards than in surgical wards (50% and 58% respectively, p=0.001). All other differences were non-significant.

The nurses were older in wards with Hybrid organization than the others. Most of the responding nurses worked in secondary referral hospitals in all organization models; however, the proportion of respondents from local hospitals was larger in the Team leader dominated

wards than in the other two organization models. Scores were lower on the Patient technology scale in Primary nurse wards than in the Team leader wards, suggesting more complex patient needs (Table 2). There were no differences in type and size of hospital, staffing level and skill mix, or other individual nurse characteristics between the groups of wards classified according to organization model.

The variance components for the four empty regression models (Step 1) indicated substantial clustering of nursing responses within hospital wards (Table 3). The intraclass correlation coefficient ranged from 0.106 for Job satisfaction to 0.217 for Relations with physicians. There was no significant clustering of responses within the level of hospitals (data not shown). The introduction of organization models as explanatory variables (Step 2) did not contribute to a significant reduction in ward level variance in any of the four models. The models with alternative classifications produced essentially the same results.

Quality of patient care

The full regression model for Quality of patient care indicated that inclusion of ward-level explanatory variables (Step 3) lead to a 32% reduction of the variance at ward level. Less complex care needs were associated with better patient care. A high prevalence of patients in the corridor was negatively associated with Quality of patient care. However, a significant interaction effect showed that this association was weaker in wards with Primary nurse organization than in Hybrid wards (Table 4).

Climate to learning

The full regression model for Climate to Learning (Step 3) indicated that ward-level explanatory variables reduced the variance with 24%. A high proportion of registered nurses was negatively associated with ratings on Climate to learning. Providing surgical care was negatively associated with Climate to learning. However, a significant, positive interaction

effect balanced the main effect and implied that this negative association was not present in Team leader wards when compared to Hybrid wards (Table 4).

Job satisfaction

Local conditions contributed with a 31% reduction of ward level variance in the Job satisfaction regression model (Step3). Job satisfaction scores were worse in larger wards. A large proportion of shifts staffed according to the rotation plan was positively associated with Job satisfaction in all wards. A high proportion of agency personnel was negatively associated with Job satisfaction. There was a significant interaction effect between Team leader organization and Agency nurses, indicating that the negative effect of Agency nurses was lower in Team leader wards than in Hybrid wards (Table 4).

Relations with physicians

In the full model (Step 3) for Relations with physicians the proportional reduction of variance at the ward level was 26%. The relations with physicians were worse in surgical wards than in medical wards, and also in wards with many registered nurses in the staff. After taking local ward conditions into account, Relations with physicians was worse in wards with Primary nurse than with Hybrid organization (Table 4).

DISCUSSION

Limitations

The response rate among nurses was low, yet comparable to surveys of health professionals (Asch et al. 1997). The respondents and non- respondents had similar demographic characteristics, though for 24% of the nurses in the wards we had no information about the non-respondents, and we cannot exclude a selection bias.

We can not rule out bias due to for example social desirability or strategic responses, which are common problems in surveys (Streiner & Norman 2003). Also, the individual nurses' scores may be influenced by the norms in the local culture. We think that this potential bias is reduced by the uniform education of the respondents and the multilevel approach.

The scales used as dependent variables have not been used extensively. We are not aware of well-established instruments developed in a Norwegian context for the topics under study. However, the measures appear to have face validity and satisfactory psychometric properties, internal reliability coefficients were all higher than 0.77 (see appendix) (Streiner & Norman 2003).

Also, the scale that was used as a proxy for patient acuity in the present study was not developed for that purpose. Other potentially confounding variables were not included in our models, such as patient and physician characteristics, and physical and psychosocial dimensions of the practice environment (Drach-Zahavy 2004;Tiedeman & Lookinland 2004).

We chose to recode the ratio variables, using median value as cut off points. Other recoding procedures could have been used, and may have produced different results.

Our cluster analysis based variable for organization model did not capture differences in nurses' perceived quality between the three models. Using alternative classifications in the models did not change the results. As we have described, ward characteristics and organizational models are continuous rather than discrete, and organization models can be classified in different ways. Still, any classifications are likely to have deficiencies and will lead to more or less heterogeneous categories. The variation in classification systems also limits comparisons with previous studies.

Our analysis was based on a representative sample of hospital wards in Norway, a country with a dominating public health service. Nursing education, staffing levels, staff composition and roles may differ between health systems and countries. Therefore one should be careful about extrapolating the present results to other health systems.

Finally, we had no data on costs. However, personnel to patient ratios may be used as a proxy for costs, and there were no differences in this measure between wards with different organization models.

In this study we have explored the relations of nursing organization models to nurses' ratings of quality of patient care and aspects of the practice environment, using multilevel regression techniques to account for the hierarchical nature of the data (Rasbash et al. 2005). The major finding is that the organization model of the hospital wards showed little association with the nurses' ratings, which implies that neither organization model can be given preference based on nurses' perceptions of quality of patient care or practice environment dimensions. The inclusion of local ward conditions as independent variables in the models contributed to a reduction in variation between wards, but none of them appeared as a major single predictor.

The finding in Primary nurse wards of a negative association with scores on the Relations with physicians may be a reflection of the interface between the two professional groups. The Primary nurse wards have a flat organization structure, and therefore responsibilities for the patients are divided between several nurses. This complicates the co-ordination of the nurses' and physicians' responsibilities and can lead to inter professional friction. However, this effect was not present before taking local conditions into account, which suggests that the effect of organizational model depends on other conditions in the wards. This finding contrasts previous reports from Magnet hospitals (Scott et al. 1999), and a UK study of nurses in wards organized similar to primary nursing (Adams et al. 1998).

In Norwegian hospitals, in particular in internal medicine wards, patients are frequently placed in extra beds in the corridor, leading to an occupancy rate > 100%. In the present study, having many patients in the corridor was associated with lower perceived quality of patient care, in line with previous findings (Larsen et al. 2000). The positive interaction between Primary nursing and patients in corridor suggests that individual responsibilities reduce

negative implications of this extra patient load, or that this organization model is chosen because it is considered to be most functional under such circumstances.

In wards with Team leader organization there was no negative association with the prevalence of agency nurses and job satisfaction, compared with Hybrid wards. A possible interpretation is that the hierarchical structure of Team leader organization provides a clearer distribution of responsibilities at all levels, which supports predictability, reduces stress, and leads to feeling of control (Benson & Dundis 2003;Lu et al. 2005;Spector 1997).

The lower ratings of relations with physicians in surgical wards than medical wards may be related to different activity patterns in surgical and medical wards. In medical wards, nurses and physicians rely on a more continuous co-operation during the patients' stay, whereas in surgical wards a large part of the surgeons' activities takes place in the operation room. A previous study reported that nurses in the UK perceived medical wards as less hierarchical than orthopedic and surgical wards, but described no difference in collaboration with medical staff (Adams & Bond 1997).

In the present study, an indicator of patient to total personnel ratio did not merit inclusion in the final regression models. Other studies have found total nurse hours to be positively associated with other outcome measures (Kane et al. 2007a).

A high prevalence of registered nurses on the nursing staff was negatively associated with Climate to learning and Relations with physicians. There are few reports to which we can compare this finding. A recent review found, by pooled analysis, positive associations between registered nurse staffing levels and measures of quality, such as lower hospital mortality and fewer adverse patient events (Kane et al. 2007b). Another study reported a positive association between rich grade mix and multidisciplinary collaboration, but no association between rich grade mix and professional practice (Adams & Bond 2003b). However, differences in grading systems limit the value of comparisons between studies from different countries.

Short-term staff stability, here defined as shifts staffed according to rotation plan, was positively associated with Job satisfaction. This finding supports the importance of prioritizing short-term stability of the staff, as previously suggested (Adams & Bond 2003b). Unexpected absence necessitates short-term solutions that may influence staff continuity and mix of qualifications on the shifts, and hence create distress.

In contrast, long-term stability of staffing was not included in the final regression models, due to non existing univariate associations with the outcomes of the present study. This finding contrasts previous findings that experienced nurses provide higher quality of care than less experienced (Benner 1984;Blegen et al. 2001)

Job satisfaction had the lowest variance partition coefficient among the scales. Job satisfaction is an individual attitude that is heavily influenced by the life and family situation. This might explain the smaller contribution of ward level variables to reduced variance on this scale.

Primary nursing organization is a framework to enable nurses to practice according to the values of patient-centred nursing (Ersser & Tutton 1991;Scott et al. 1999). The ideology of patient-centeredness has become so prevalent in nursing practice that differences in organizational frameworks may be less important, which may explain that there were only small differences between the organization models in the present study.

Conclusion

This study demonstrates the complexity of ward management, the different goals that should be pursued simultaneously, and draw attention to factors that are associated with positive performance in the eyes of the nurses. We have shown that differences in the nurses' ratings of Quality of patient care and dimensions of practice environment could not be attributed to intraward organization model. These findings call for caution about using service quality arguments when considering the possible benefits and drawbacks of either organization model.

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Table 1. Variable description

Variable	Definition (theoretical range)	Range or dispersion	Median	Data source
Explanatory variables				
Nurses				
Female	0=no, 1=yes	94% yes		Staff nurses
Age	Years	23-64		Staff nurses
Non-Norwegian/Non-Saami	0=no, 1=yes	4% yes		Staff nurses
Experience at the ward	Months	1-456		Staff nurses
Special education	0=no; 1=yes	14% yes		Staff nurses
Wards				
Organisation model	Three classes according to empirical classification			Charge nurse
Hospital size	Number of beds	50-991	261	Charge nurse
Hospital type	Local -, Secondary referral -, or University hospital	21%, 49%, 29%		Charge nurse
Ward size	Number of operating beds	18-42	24	Charge nurse
Type of care	0=medical; 1=surgical	47% surgical		Charge nurse
Bed occupancy (%)	Number of patients divided by number of operating beds *100	58.0-126.0	102,4	Charge nurse
Mean length of stay	Number of patients at noon divided by number of discharged patients	2.8-14.6	5,7	Charge nurse
Ratio patients in corridor to all patients	Number of patients in the corridor at noon divided by number of all patients	0.0-0.23	0,06	Charge nurse
Ratio personnel to patients	Number of all nursing personnel divided by number of patients	0.5-1.3	0,75	Charge nurse
Ratio registered nurses to all personnel	Number of registered nurses divided by number of all nursing personnel	0.52-0.95	0,72	Charge nurse
Ratio agency staffing to all personnel	Number of agency nurses divided by number of all nursing personnel	0.0-0.17	0	Charge nurse
Ratio non-Norwegian nurses to all nurses	Number of all nursing personnel divided by number of non-Norwegian/non-Saami personnel	0.0-0.17	0,02	
Ratio shifts according to rotation plan to all shifts	Number of nursing personnel working according to rotation plan divided by all nursing personnel	0.60-0.98	0,86	Charge nurse
Ratio experienced personnel to all personnel	Number of FTE* with minimum 4 years length of service divided by all FTE*	0.0-1.0	0,55	Charge nurse
Ratio unexperienced personnel to all personnel	Number of FTE* with maximum 1 year length of service divided by all FTE*	0.0-0.43	0,14	Charge nurse
Patient technology scale	Mean of ward nurses' scores indicating care complexity at ward (1-5 scale)	3.0-4.4	3,6	Staff nurses
Dependent variables				
Quality of patient care[†]	Mean score on six items based on Hendersons's components in nursing (0-100 scale)	25-100		Staff nurses
Climate to learning	Mean score on 6 WOFS scale items (0-100 scale)	11.1-100		Staff nurses
Job satisfaction	Mean score on 3 WOFS scale items (0-100 scale)	0-100		Staff nurses
Relations with physicians	Mean score on 9 WOFS scale items (0-100 scale)	0-96		Staff nurses

* Full time equivalents

[†] see Appendix for details

Table 2. Sample descriptives according to organization model. Mean (SD) unless otherwise stated.

	Team Leader Dominated		Primary Nurse Dominated		Hybrid	
Nurses						
Number of nurses	382		256		499	
Female, number (% within model)	357	(93.5)	247	(96.5)	463	(92.8)
Age, years*	35,5	(8.8)	35.4	(9.1)	37,7	(10.3)
Experience at the ward, months.	66.2[1]	(69.3)	65.1[2]	(64.5)	71.6[3]	(74.4)
Special education, number (% within model)	47	(12.4)	42	(16.6)	75	(15.0)
Type of care =Surgical, number (% within model)	190	(49.7)	117	(45.7)	263	(52.2)
Hospital type*						
University hospital, number (% within model)	112	(29.3)	86	(33.5)	161	(32.2)
Secondary referral hospital, number (% within model)	157	(41.2)	160	(62.5)	275	(55.1)
Local hospital, number (% within model)	113	(29.5)	10	(3.9)	63	(12.6)
Wards						
Number of wards	30		19		38	
Hospital size	256.3[4]	(232.1)	378.3[5]	(182.9)	334.2[6]	(245.4)
Hospital type						
University hospital, number (% within model)	6	(20.0)	7	(36.8)	12	(31.5)
Secondary referral hospital, number (% within model)	14	(46.6)	11	(57.8)	19	(50.0)
Local hospital, number (% within model)	10	(33.3)	1	(1.0)	7	(18.4)
Ward size	25.6	(5.9)	24.6	(3.5)	24.4	(4.8)
Type of care=Surgical, number (% within model)	15	(50.0)	6	(31.5)	19	(50.0)
Bed occupancy, %	103.2	(9.0)	102.2	(11.2)	99.4	(13.1)
Mean length of stay	5,9	(1.8)	5.9	(1.8)	6.4	(2.4)
Ratio patients in corridor to all patients	0.06	(0.05)	0.07	(0.06)	0.06	(0.05)
Ratio personnel to patients	0.74	(0.15)	0.75	(0.11)	0.77	(0.13)
Ratio registered nurses to all personnel	0.72	(0.09)	0.74	(0.10)	0.71	(0.07)
Ratio agency staffing to all personnel	0.02	(0.04)	0.01	(0.16)	0.01	(0.02)
Ratio non-Norwegian nurses to all nurses	0.04	(0.05)	0.03	(0.05)	0.03	(0.04)
Ratio shifts according to rotation plan to all shifts	0.85	(0.07)	0.86	(0.09)	0.86	(0.06)
Ratio experienced personnel to all personnel	0.54	(0.18)	0.57	(0.15)	0.54	(0.21)
Ratio unexperienced personnel to all personnel	0.17	(0.12)	0.14	(0.09)	0.14	(0.07)
Patient technology scale score, ward mean *	3.70	(0.24)	3.49	(0.29)	3.69	(0.31)

[1] Median =42; [2] Median=44; [3] Median=43.5; [4] Median=148; [5] Median =351; [6] Median =265.

* p≤0.05 for differences between organization models

Table 3. Step 1 and Step 2 models. Nurses' rating of Quality of patient care, Climate to learning, Job satisfaction, and Relations with physicians in 87 hospital wards (0-100 scale; high scores are favorable). Variance components, unstandardized coefficients (standard errors).

	Quality of Patient Care (n=1137)	Climate to Learning (n=1137)	Job Satisfaction (n=1136)	Relations with Physicians (n=1137)
Step 1, Empty models				
Variance components				
Ward level variance (u_{0j})	30.932	56.534	42.835	42.734
Nurse level variance (e_{0ij})	152.667	211.022	362.883	148.713
Intra class correlation coefficient	0.168	0.211	0.106	0.223
Step 2, Models with organization models				
Organization model				
Team leader dominated*	-0.295 (1.614)	1.795 (2.101)	3.263 (2.066)	-0.229 (1.797)
Primary nurse dominated*	-1.041 (1.850)	1.172 (2.410)	1.636 (2.364)	-2.888 (2.061)
Variance components				
Ward level variance (u_{0j})	30.661	55.899	41.241	41.329
Nurse level variance (e_{0ij})	152.698	211.020	362.697	148.728
Intra class correlation coefficient	0.167	0.209	0.102	0.217
Variance reduction from Step 1 to Step 2 models				
Level 2 explained proportion of variance	**0.006**	**0.008**	**0.021**	**0.025**

*reference category: Hybrid organization.

Table 4. Step 3 models. Nurses' rating of Patient care quality, Climate to learning, Job satisfaction, and Relations with physicians in 87 hospital wards (0-100 scale; high scores are favorable). Variance components, unstandardized coefficients (standard errors)

	Quality of Patient Care (n=1137)	Climate to Learning (n=1137)	Job Satisfaction (n=1136)	Relations with Physicians (n=1137)
Models with explanatory variables				
Ward size	-0.126 (0.122)	-0.214 (0.169)	-0.376 (0.160)§	0.039 (0.142)
Care technology scale	6.189 (2.605)§	1.011 (3.700)	3.688 (3.403)	-2.870 (3.067)
Type of care				
Surgical*	-0.372 (1.301)	-5.616 (2.315)§	-1.720 (1.679)	-6.145 (1.533)§
Patients in corridor†				
prevalence > median	-5.166 (1.456)§	0.331 (1.815)	-0.619 (1.720)	-2.690 (1.550)
Registered nurses†				
prevalence > median	-1.252 (1.256)	-4.870 (1.734)§	-3.199 (1.622)	-4.204 (1.479)§
Shifts according to rotation plan†				
prevalence > median	1.936 (1.234)	2.300 (1.712)	3.447 (1.619)§	1.024 (1.454)
Agency nurses†				
prevalence > median	-1.087 (1.342)	-2.554 (1.847)	-8.616 (2.093)§	-0.862 (1.576)
Organization model‡				
Team leader dominated	-1.353 (1.358)	-3.668 (2.623)	0.119 (2.053)	-0.822 (1.594)
Primary nurse dominated	-4.031 (2.284)	0.584 (2.183)	1.655 (2.039)	-4.049 (1.865)§
Interactions				
Primary nurse dominated * Patients in corridor	6.771 (2.934)§	-	-	-
Team leader dominated * Type of care	-	10.708 (3.568)§	-	-
Team leader dominated * Agency nurses	-	-	9.641 (3.745)§	-
Variance components				
Ward level variance (u_{0j})	16.536	38.068	19.497	28.215
Nurse level variance (e_{0ij})	153.006	211.32	363.281	148.769
Intra class correlation coefficient	0.098	0.153	0.051	0.159
Variance reduction from Step 1 to Step 3 models				
Level 2 explained proportion of variance	0.321	0.244	0.307	0.258

* reference category: medical wards.

† reference category: prevalence < median.

‡ reference category: Hybrid organization.
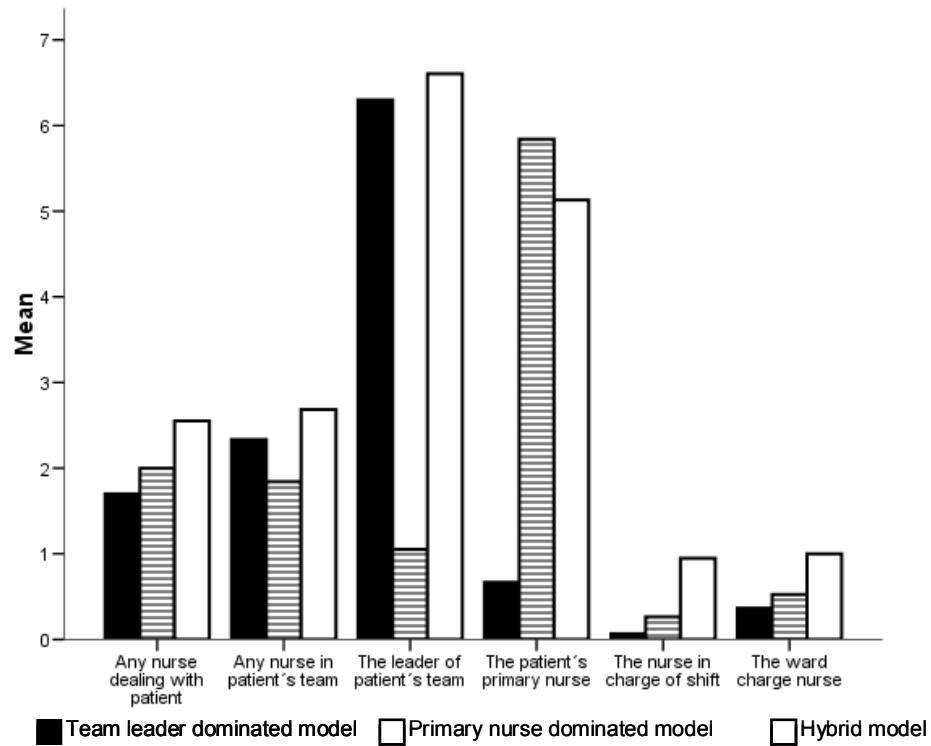
§ p≤0.05 (t-ratio).

Figure 1. The mean number of activities assigned to different registered nurse roles in the three models of nursing organization

APPENDIX

APPENDIX Scale items and psychometric measures

Quality of patient care

Seven point scale (Very poorly-Very well). *Cronbach's alpha=0.84; Item-total correlation range=0.595-0.602.*
We would like to know your opinion on how the ward, in general, succeeds in delivering good nursing service
in the following domains. Have the last four weeks in mind and tick the appropriate box.

1. To meet the patients' basic physiologic needs
2. To meet the patients' needs for communication and contact with others
3. To meet the patients' needs for sleep, rest, and peace.
4. To meet the patients' needs for infection control and hygiene
5. To ensure correct treatment and care and prevent adverse events
6. To give counselling on health promotion and adequate use of healt care facilities