**Across sectional study of ‘care left undone’ on nursing shifts in hospitals**

**Abstract**  (246 words)

*Aims*: To determine factors associated with variation in ‘care left undone’ (also referred to as “missed care”) by registered nurses in acute hospital wards in Sweden.

*Background:* ‘Care left undone’ has been examined as a factor mediating the relationship between nurse staffing and patient outcomes. The context has not previously been explored to determine what other factors are associated with variation in ‘care left undone’ by registered nurses.

*Design:*

Cross-sectional survey to explore the association of registered nurse staffing and contextual factors such as time of shift, nursing role and patient acuity / dependency on ‘care left undone’ was examined using multi-level logistic regression.

*Methods:*

A survey of 10,174 registered nurse working on general medical and surgical wards in 79 acute care hospitals in Sweden (Jan-March 2010).

*Results:* 74% of nurses reported some care was left undone on their last shift. The time of shift, patient mix, nurses’ role, practice environment, and staffing have a significant relationship with care left undone. The odds of care being left undone is halved on shifts where registered nurse care for 6 patients or fewer compared with shifts where they care for 10 or more.

*Conclusion:* The previously observed relationship between registered nurse staffing and care left undone is confirmed. Reports of care left undone is influenced by registered nurse roles. Support worker staffing has little effect. Research is needed to identify how these factors relate to one another and whether care left undone is a predictor of adverse patient outcomes.

**Summary Statement**

**Why is this research or review needed?**

* Care left undone by nurses has previously been found to contribute to poor care quality, increased risk and worse outcomes for patients.
* The context has not previously been explored to determine whether differences in factors such as registered nurse involvement in care provision, role, and time of shift may also be associated with variation in ‘care left undone’ by registered nurses.

**What are the key findings?**

* The time of shift, patient mix, nurses’ role, and practice environment, all have a significant relationship with care being left undone and the volume of activities not completed.
* Taking the observed contextual factors into account, registered nurse staffing remains a significant predictor of care being left undone.
* Support worker staffing levels have little effect in mitigating care left undone by registered nurses.

**How should the findings be used to influence policy/practice/research/education?**

* Workload tools and methods to plan nurse staffing need to take account of many different factors – role of staff, frequency of monitoring, dependency of patients, time of day/night – to ensure the level of nurse staffing provided is sufficient to meet patient needs at all times of the day or night, without care being left undone.

**Key words:** nurse staffing, nursing workload, practice environment, workforce planning, safe staffing levels, missed care, care left undone

**INTRODUCTION**

Research in both the USA (Kalisch, Tschannen et al. 2011) and Europe (Ausserhofer, Zander et al. 2014) has identified a relationship between nurse staffing levels and care left undone, suggesting that it may be mediating factor between registered nurse (RN) staffing and outcomes. In one study, missed care explained over 40% of the variation in care quality ratings (Sochalski 2004) and in New Zealand, care left undone is used as an indicator of staffing adequacy in hospitals (Carville, 2014). However little attention has been paid to other factors that may be associated with care left undone, the degree of variation in these factors and potential effect on staffing levels and care left undone.

**Background**

Based on their systematic review, Kane and colleagues concluded that higher RN staffing levels are associated with lower rates of hospital related mortality and lower rates of adverse patient events (Kane, Shamliyan et al. 2007). In a study that involved a retrospective review of 176 000 shifts, Needleman and colleagues reported that mortality rates were significantly greater for patients on shifts where RN staffing was 8 hours or more below the planned level (Needleman, Buerhaus et al. 2011). More recently, a review undertaken for the National Institute of Health & Care Excellence (NICE) reported that there was evidence from a number of large, good quality studies, that lower nurse staffing levels are associated with increased rates of death and falls, shorter lengths of stay and lower readmission rates (Griffiths et al., 2014).

Nurse staffing levels are not only recognised as predictors of care quality and the avoidance of patient harm but have also been consistently linked to nurse job satisfaction (Sheward, Hunt et al. 2005) and propensity to leave their jobs or the nursing profession (Heinen, van Achterberg et al. 2013). Differentials between the staffing levels of hospitals or in different geographical areas can thus become drivers for workforce mobility. In Sweden, recruitment agencies report that nurses have been attracted to work in hospitals in Norway partly due to the perception of better staffing levels and an opportunity to provide more complete care and work in a calmer environment (News in English, 2014).

Recent research from a large international study, RN4Cast, suggests that optimal levels of staffing are not being consistently achieved across Europe. Nurse staffing levels varied considerably both within and between countries; each additional patient per RN was associated with a 7% increase in the likelihood of a surgical patient dying within 30 days of admission (Aiken, Sloane et al. 2014). In another report from RN4Cast, RNs in Sweden who perceived that there was sufficient staffing and resources were two and a half times more likely to assess patient safety of their ward/unit positively (Alenius, Tishelman et al. 2013).

Ausserhofer and colleagues used survey data from 33,659 nurses participating in the RN4Cast study to examine care left undone and associations with organisational factors in 12 European countries (Ausserhofer, Zander et al. 2014). Nurses in hospitals with more favourable work environments and better patient to RN ratios were significantly less likely to report leaving any necessary nursing care undone. However, they note a limitation: the possible differences related to country were controlled for in the statistical model, but the effects of different country contexts were not fully explored. Considerable within-country variability was observed, which the authors suggest would merit further analysis. A more detailed examination of the local context and how this might influence the relationships between care left undone and staffing is therefore warranted.

Analysis of the English data from the RN4Cast study used a multi-level model to examine the relationship between care left undone and RN staffing, taking account of differences in hospital, specialty, patient dependency, time of shift, support worker staffing levels, and the practice environment (Ball, Murrells et al. 2013). On a day shift, the mean number of patients cared for was 7.8 per RN, and at night, 10.9. Eighty-six percent of nurses in England reported that at least one care activity had been left undone due to lack of time on their last shift. RN staffing levels were significantly associated with the incidence of care being left undone; 78% of those on the best staffed shifts (6.1 patients or fewer per RN) reported incomplete care compared with 89% on the worst staffed shifts (11.7 or more patients per RN). The study also reported a strong association between the amount of care left undone and quality of care. Variation in the level of nursing support staff was not related to variation in missed care, suggesting that support staff were neither substituting for nor complementing the work of RNs in relation to the areas of care assessed in the survey. Given the global interest in staffing levels, care quality and skill mix, replicating these analyses in other countries is a priority.

Previous research on ‘missed care’ and adverse events has identified a range of factors that are associated with increased likelihood of incomplete care or negative patient outcomes: RN staffing levels, skill-mix and the practice environment (Ball et al. 2013, Ausserhofer et al. 2014, Kalisch et al., 2011). Using data from the same project but a different country allows us to explore the influence of these and other contextual variables in greater detail. In this study we also posited that the time of shift, level of patient dependency, the degree of involvement of RNs in direct care provision, and level of support provided by other members of the nursing team may also affect whether care needed by patients is carried out and the level of staffing required to do so.

# THE STUDY

# Aims

The aim of the study was to examine factors associated with RN reports of ‘care left undone’ on acute medical/surgical wards in Sweden, and describe the relationship between staffing levels and ‘care left undone’. Specifically the following questions are addressed:

1. What is the type and prevalence of ‘care left undone’ reported by RNs?
2. What factors are associated with the incidence and prevalence of incomplete care?
3. How do RN and nursing support worker (nursing assistants and aides) staffing levels relate to care left undone?

# Design

A cross-sectional survey was conducted in Sweden as part of the Registered Nurse Forecasting (RN4Cast) study and provides the basis for the analyses presented here. The methodology of the RN4Cast survey followed a protocol established by the international RN4Cast consortium of 15 countries (Sermeus, Aiken et al. 2011).

**Sample/Participants**

All RN members working on general medical or surgical wards in all 79 acute hospitals in Sweden were identified via the Swedish Association of Health Care Professionals. The Association covers over 70% of all nurses so all wards and hospitals were potentially sampled.

**Data collection**

Between January and March 2010 the survey was sent out by ‘Statistics Sweden’, and respondents were given the option of answering either a web or postal survey (N=33,083). After three reminders, the response rate was 70% (n=23,087). Of these 10,174 were identified as working on in-patient adult medical or surgical care wards and thus match the inclusion criteria used for the RN4Cast study, and are used in this analysis.

**Ethical Considerations**

All nurses were surveyed voluntarily and anonymously. Ethical approval was received for the Swedish component of the RN4Cast project from the regional Ethical Review Board in Stockholm (Dnr 2009/1587-31/5).

**Measures**

*Nurse staffing*

Respondents were asked about the last shift they worked and to give the number of staff providing direct patient care and the number of patients on the ward. Nurse staffing is comprised of RNs and unregistered nurse support workers, who in Sweden are enrolled nurses (three years of training) and auxiliary nurses (one year training).

From these responses we identified the:

* + Number of patients per RN providing direct care.
	+ Number of patients per nursing support worker (non-registered nursing assistants, auxiliaries or aides) providing direct care.
	+ Total nurse staffing (RN plus all support worker staffing).

*Patient dependency and acuity*

In order to estimate patient dependency, nurses were asked to report the number of patients that they were directly responsible for requiring assistance with all activities of daily living (ADL) on their last shift. This was divided by the total number of patients they reported they had responsibility for, to produce an indication of the patient dependency.

Similarly, to estimate patient acuity, nurses were asked to report the number of patients that required monitoring at least hourly. This was divided by the total number of patients they reported they had responsibility for, to produce a percentage.

*Practice environment*

We measured the nurse work environment using a validated measure: the practice environment scale of the nursing work index (PES-NWI) (Lake 2002). The PES-NWI measures: nurse participation in hospital affairs, managerial support for nursing, promotion of care quality, and views of the relationships between nurses and doctors. Respondents rated each item on a four point scale (strongly disagree, disagree, agree, strongly agree). Four of the items in the Practice Environment Scale related specifically to nurse staffing and resourcing. These were excluded to avoid overlap (ie. common variance) with the other measures of nurse staffing used in the analysis, and the resultant 28 item scale was used (‘PES\_28’). The mean score (from 1-4, where one is low) provides an overall rating of the practice environment.

*Role in care provision*

Nurses were asked to describe their role in providing care on the last shift they worked, to indicate if they: ‘provided most care themselves’, ‘supervised care provided by others and provide some themselves’, or ‘provide only limited care with most direct care being carried out by others’.

*Transferrable activity*

A measure of the variation in RNs’ activity – in terms of activities that could be argued as being transferable - was ascertained by presenting respondents with a list of nine activities that could be undertaken by others (such as obtaining supplies, delivering food trays, covering for other services out of hours) and asking them to indicate how frequently they undertook each: ‘never’, ‘sometimes’, ‘often’ (see Box 1). It includes the item ‘performing non-nursing care’ (which was translated as ‘Utförde arbetsuppgifter som borde göras av andra yrkesgrupper’ in Swedish). The categories were combined to create a binary variable; ‘often’ vs. ‘sometimes or never’.

*Care left undone*

Missed care on the last shift was assessed by asking nurses to identify which of a list of 13 activities, informed by work by Schubert et al., 2008 on care rationing, that were considered to be ‘Necessary but left undone because you lacked time to complete them?’ (see Box 1).

**Validity and reliability**

The questionnaire survey (and measures within it) is described in more detail elsewhere (Sermeus, Aiken et al. 2011) and has been used extensively in previous studies of nurse staffing and patient safety. The practice environment scale of the nursing work index (revised) (PES-NWI) used to measure the nurse work environment has been internationally validated (Lake 2002) and has been used previously in Europe (Rafferty, Clarke et al. 2007). The activities in the measure of ‘care left undone’ are derived from BERNCA, an instrument that has validated associations between missed care, patient’s experience of care, and patient related outcomes (Schubert et al. 2008). It was translated into Swedish, achieving a content validity index of 0.91 (Squires, Aiken et al. 2013).

# Data Analysis

Statistical analysis was performed using SPSS version 20. Descriptive statistics were used to explore the data and identify the distribution of responses, create a profile of respondents and identify any data anomalies such as extreme outliers or out of range responses. The staffing variables were grouped into eight bands (< 4 patients per nurse, 4.0 – 4.99, 5.0 - 5.99 and so on up to ≥10 patients per nurse).

The relationship between ‘missed care’, staffing levels and other factors was explored through two multi-level regression models: a mixed model Poisson regression (where the dependent variable was the number of items of missed care) and a mixed model logistic regression (no missed care vs. one or more aspects of missed care). To analyse the hierarchical cross-sectional design with RNs within hospitals, a two-level model was fitted to the data. Hospital ID and modified practice environment score (PES-28) were treated as first (hospital) level variables. All other variables – shift, patients per RN, patients per nursing support worker, patients requiring assistance with daily living (number of patients), patients requiring frequent monitoring, RN involvement in care and transferrable activity levels - were treated as second level variables (individual nurse / shift). These independent variables were regressed onto a global nominal dependent variable.

The percentage of missing data were low and therefore complete cases analyses were performed.

**RESULTS**

The nurse respondent characteristics are presented in Table 1. They are predominantly women (93%), average 40 years of age, and the vast majority trained in Sweden (98%). More than half (59%) have a bachelor’s degree in nursing.

**Prevalence and type of care left undone**

Seventy-five percent reported that at least one of the 13 care activities listed had not been done on their last shift due to lack of time. The mean number of items of care left undone across all shifts is 2.9. More care was left undone on day and afternoon shifts than night shifts (Table 2).

The most commonly reported activities that were left undone were: comfort/talking with patients (46%), developing or updating nursed care plans/care (34%) and oral hygiene (31%). Pain management (6%) and treatment and procedures (6%) were least likely to be reported as missed. All activities were less likely to have been considered ‘necessary but undone’ on night shifts (table 2). On day shifts, those reporting some care had been left undone were on shifts with an average of 6.2 patients per RN, compared with 4.76 patients per RN on shifts where no care was reported as undone.

**Staffing and other factors**

Many of the factors that we hypothesised may relate to the incidence and prevalence of care left undone also vary by shift (Table 3). Both RN and total staffing levels (i.e. including support staff) varied considerably by time of shift: early/day shifts averaging 5.5 patients per RN, afternoon shifts 7.0 patients per RN and night shifts 11.4 patients per RN.

Fifty-five percent of RNs reported that they supervise care provided and provide some care themselves, whereas 27% provide most care themselves. At night, more nurses reported providing most care themselves (52% vs 19% in the day).

Many of the factors examined ~~are~~ appear to be interrelated. For example, RNs providing ‘most care’ themselves are working on shifts with 4.9 patients per RN in the day, whilst those providing ‘some care’ are on shifts with an average of 6.1 patients per RN, and those reporting only ‘limited’ direct involvement, 6.5 patient per RN. However, no difference is observed between overall staffing level (i.e. patients per member of nursing staff including support workers/assistant nursing staff) and the reported level of RN involvement in care provision.

The average number of transferrable activities often undertaken is 2.35 (out of a possible 9); 25% of nurses specifically indicate that they have often undertaken ‘non-nursing care’. A difference is also observed in the extent to which nurses undertake potentially transferrable activities by time of shift. For example, nurses on afternoon shifts are less likely to have reported they ‘often’ arranged patient discharges/transportation or performed routine phlebotomy, but more likely to have answered phones, performed other clerical duties or reported that they filled in for non-nursing services. The extent to which nurses undertake these ‘transferrable’ activities also varies according to the type of role fulfilled – the greater the level of ‘hands on’ care provided, the greater the number of transferrable activities RNs report are ‘often’ done (Table 4).

The descriptive analysis suggests a complex set of interrelated factors are associated with care left undone. To discern the effect of each on care left undone, and examine in detail the association with staffing, these factors were entered into a multivariate multi-level model (Table 5).

All shifts with RN staffing levels with fewer than 10 patients per RN are associated with reduced odds of care being left undone compared to those with 10 or more. Where shifts are staffed with 6 or fewer patients per RN, the odds of care being left undone are more than halved compared to shifts on which there are 10+ patients per registered nurse (OR 0.466, p<0.001). RN staffing of fewer than 4 patients per RN reduced the odds of care being left undone by 85% (OR 0.148, p<0.001). Figure 1 presents this relationship graphically. By contrast there appeared to be no effect from increasing numbers of support workers until it reached the level of fewer than 4 patients per support worker. Where support workers cared for fewer than 4 patients odds of missing care were slightly reduced (OR 0.714, p=0.021).

Time of shift, patient mix (patient requiring assistance with all activities of daily living, and frequency of monitoring), nurses’ role (direct involvement in care, and undertaking potentially transferable activities), and practice environment, all have a significant relationship with care being left undone and the number of activities identified as not completed (Table 5).

**DISCUSSION**

The time of shift, patient mix, nurses’ role, and practice environment, have all been found to have a significant relationship with care being left undone and the volume of activities not completed. When these factors are added into a multi-level multivariate statistical model the odds of care being left undone are significantly and substantially greater on the worst staffed shifts compared with the best. Thus the same association between staffing and care left undone is found in Sweden, as has been reported using RN4Cast data from England (Ball, Murrells et al. 2013) and across Europe (Ausserhofer, Zander et al. 2014). The effect of nurse support worker staffing however was minimal.

The findings presented from Sweden, where local contextual factors have been explored and described in greater detail, provides an opportunity for us to consider the factors beyond staffing level that have an association with care that is left undone. A reflection on how the findings from Sweden contrast with those reported from the same study but a different country – England - points to differences in the nature of the RN role, and highlights that what RNs do, or do not do, varies as does the context.

For example, in the previous analysis of English RN4Cast data, the time of shift was controlled for in the regression model, recognising that care and activities undertaken at night are different from those in the day (Ball, Murrells et al. 2013). A more detailed examination of the effect of the time of shift in the current analysis has found considerable differences in how wards are staffed, the roles of RNs and in the care left undone at different times. On day shifts Swedish wards have a mean of 5.9 pts per RN, and 3.1 patients per nursing staff including support workers, and thus have levels that are better than the average reported in England (Ball et al 2012). But on night shifts staffing levels in Sweden are dramatically lower than on day shifts, and fall below the England night time average with 11.4 patient per RN, and 7.9 patients per nursing staff including support workers. There are also significant and substantial differences between morning/day and afternoon/evening shifts in Sweden – an average of 7.0 patients per RN on afternoons and 3.7 patients per nursing staff including support workers compared to 5.5 and 2.9 respectively for morning/day shifts. Given evidence from other countries of increased risks and adverse outcomes associated with workload and staffing levels at night range of settings (Gordon and Beckett 2011, de Cordova, Phibbs et al. 2014, Yiu, Khan et al. 2014), this warrants further exploration.

It is not just the patterns of staffing across shift that reveals country differences. In Sweden we have found that on day shifts, 19% of RNs report that they provide most of the direct care for patients themselves. In contrast in England, 31% have been reported as having a primarily direct care role (Ball et al, 2012). This points to a difference in the way in which care is provided and the relative roles of RNs and support workers in the two countries. Swedish nurses are less likely than English nurses to report that they often do the potentially ‘transferrable’ activities listed on the survey. The differences are greatest in relation to ‘non-nursing care’; 25% of RNs is Sweden reported that they often undertake such activities compared with 49% in England. This suggests that there could be a difference in the way in which RNs are deployed, or that RNs’ perspectives on what is within the scope of nursing is different between the two countries. Both undertaking transferrable activities and having a less direct role in direct care provision are associated with increased level of care being left undone in Sweden.

Whilst we see an overall association between staffing and care left undone in both countries, an exploration of the other factors that relate to care being left undone thus points to new insights into the circumstances in which care that is considered necessary, is nonetheless left undone on hospital wards. RNs fulfil different roles and nursing is delivered in different ways in different countries, and these differences impact on what is done, and critically on what is not done. This has implications for the way in which we undertake, report and interpret international research that endeavours to explore the relationship between registered nurse inputs and patient outcomes.

Despite having different balance in RN staffing between day, afternoon and night shifts, and some differences noted in RN roles and the degree to which RNs do transferrable activities, a strong relationship between RN staffing and care left undone is nonetheless found in both countries. Given these differences, the pattern observed is surprisingly similar: for example, staffing of 4 patients per RN in Sweden is associated with a mean of 2.9 items of care left undone compared with 3.0 in England; staffing of 6 pts per RN is associated with 3.5 items of missed care in Sweden, and 3.6 in England. This adds to the growing body of evidence; crucially this study confirms the relationship between registered nurse staffing levels and missed care even after controlling for variation in the roles taken by nurses, patient dependency and the level of staffing by support workers.

In our analysis of data from England we saw no association between levels of support worker staffing and missed care (Ball, Murrells et al. 2013) and hence no evidence that support workers were effectively substituting for RNs. There is a significant interest among policy makers and managers in such substitution. While research suggests that health care support workers can successfully adapt to new and more advanced roles, evaluation has been almost exclusively qualitative and has not focussed on assessing the effectiveness of these substitutions (Wakefield, Spilsbury et al. 2009, Kessler, Spilsbury et al. 2014). While in the present study we saw a small benefit when support worker staffing was at its highest level (compared to having no assistants), the effect was modest compared to the effects of increasing levels of RN staffing. If missed care is regarded as an inverse measure of productivity it is unlikely that substitution would be an efficient approach to reducing it because the marginal gains from increased RN staffing are so much higher than for assistants.

In the evidence review conducted for the NICE safe staffing guidance in England, few studies reported on the relationship between patient factors, nursing roles and the requirements for nurse staffing (Griffiths, Ball et al. 2014). The results from this study suggest that patients’ requirements for frequent observation and assistance with daily living increase the requirements for nursing care staff, specifically registered nurses since as the proportion of patients needing such care increases reports of care left undone also increase (after control for the current size of the nursing workforce). Similarly nurses undertaking potentially transferable tasks such as delivering meal trays, is associated with an increased demand for RN staffing, if necessary care is to be completed. While such assessments may seem largely obvious, the empirical evidence is limited and these factors are often omitted from tools designed to indicate staffing requirements. (Fasoli and Haddock 2010).

**Limitations**

In interpreting these results we need to recognize that the cross sectional design means that whilst we can draw inferences about the possible nature and prevalence of care left undone, the findings cannot be used to make assertions about causation. The measure used to capture ‘care left undone’ is based on nurses’ accounts, and as such is subjective. Individual nurses may have quite different expectations and perceptions of the level and type of care that patients need, and the extent to which they have been able to deliver the required activities. Whilst the care activities needed (and perceived as necessary by nurse respondents) are likely to vary according to the time of shift, the study has endeavoured to take this into account by including time of shift in the regression models. By using a closed question and asking about 13 specific activities we have to some extent been able to limit the potential variation in interpretation.

Nurses on hospital wards typically work in teams; we do not know whether care reported as missed by one nurse may have been done (either at the time or later) by another member of staff. In addition the measure used does not give an indication of the frequency or volume of each activity that was left undone – i.e. distinguishing between an activity missed once or the same activity missed several items during a shift.

**CONCLUSION**

Understanding a range of factors that impinge upon the role that registered nurses play in delivering care is important, as these factors are likely to influence the staffing that is needed in a particular context and at a particular time, to avoid necessary care being left undone by registered nurses. Despite some differences in RN role and activity reported, the overall relationship between RN staffing and care left undone in Sweden is consistent with that reported from England, and across Europe. Whilst completeness of care is a valuable goal in its own right, more research is however needed to test whether care left undone mediates the relationship frequently observed between RN staffing and patient outcomes such as mortality.

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