



King's Research Portal

DOI:
[10.1111/jan.12976](https://doi.org/10.1111/jan.12976)

Document Version
Publisher's PDF, also known as Version of record

[Link to publication record in King's Research Portal](#)

Citation for published version (APA):

Ball, J., Griffiths, P., Rafferty, A. M., Lindqvist, R., Murrells, T. J., & Tishelman, C. (2016). A cross sectional study of 'care left undone' on nursing shifts in hospitals. *Journal of Advanced Nursing*, 72(9), 2086-2097.
<https://doi.org/10.1111/jan.12976>

Citing this paper

Please note that where the full-text provided on King's Research Portal is the Author Accepted Manuscript or Post-Print version this may differ from the final Published version. If citing, it is advised that you check and use the publisher's definitive version for pagination, volume/issue, and date of publication details. And where the final published version is provided on the Research Portal, if citing you are again advised to check the publisher's website for any subsequent corrections.

General rights

Copyright and moral rights for the publications made accessible in the Research Portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognize and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the Research Portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the Research Portal

Take down policy

If you believe that this document breaches copyright please contact librarypure@kcl.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

ORIGINAL RESEARCH: EMPIRICAL RESEARCH –
QUANTITATIVE

A cross-sectional study of ‘care left undone’ on nursing shifts in hospitals

Jane E. Ball, Peter Griffiths, Anne Marie Rafferty, Rikard Lindqvist, Trevor Murrells & Carol Tishelman

Accepted for publication 24 February 2016

Correspondence to J.E. Ball:
e-mail: Jane.ball@soton.ac.uk

Jane E. Ball BSc RN
Principal Research Fellow/Doctoral Student
National Institute for Health Research
Collaboration for Leadership in Applied
Health Research and Care (NIHR
CLAHRC), Wessex, Southampton, UK and
Medical Management Centre (MMC),
Department of Learning, Informatics,
Management and Ethics (LIME), Karolinska
Institutet (KI), Stockholm, Sweden
@JaneEBall

Peter Griffiths BA PhD RN
Professor of Health Services Research
University of Southampton & NIHR
CLAHRC, Wessex, UK

Anne Marie Rafferty BSc DPhil (Oxon) RN
Professor of Nursing Policy
Florence Nightingale Faculty of Nursing and
Midwifery, King's College London, UK

Rikard Lindqvist PhD RN
MMC, LIME Karolinska Institutet,
Stockholm, Sweden

Trevor Murrells BSc MSc
Statistician/Research Data Manager
Florence Nightingale Faculty of Nursing and
Midwifery, King's College London, UK

Carol Tishelman PhD RN
Professor of Innovative Care
KI MMC, LIME KI & Innovation Centre,
Karolinska University Hospital, Stockholm,
Sweden

[The license statement for this article was
changed on 30 August 2016 after original
online publication.]

BALL J.E., GRIFFITHS P., RAFFERTY A.M., LINDQVIST R., MURRELLS T. & TISHELMAN C.
(2016) A cross-sectional study of ‘care left undone’ on nursing shifts in hospitals.
Journal of Advanced Nursing 72(9), 2086–2097. doi: 10.1111/jan.12976

Abstract

Aims. To determine factors associated with variation in ‘care left undone’ (also referred to as ‘missed care’) by Registered Nurses (RNs) 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 RNs.

Design. Cross-sectional survey to explore the association of RN 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 RNs working on general medical and surgical wards in 79 acute care hospitals in Sweden (January–March 2010).

Results. Seventy-four per cent 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 RN care for six patients or fewer compared with shifts where they care for 10 or more.

Conclusion. The previously observed relationship between RN staffing and care left undone is confirmed. Reports of care left undone are influenced by RN 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.

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

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 (RN) involvement in care provision, role and time of shift may also be associated with variation in ‘care left undone’ by RNs.

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 (RN) staffing remains a significant predictor of care being left undone.
- Support worker staffing levels have little effect in mitigating care left undone by RNs.

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.

Introduction

Research in both the USA (Kalisch *et al.* 2011) and Europe (Ausserhofer *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 *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 *et al.* 2011). More recently, a review undertaken for the National Institute of Health & Care Excellence (NICE) reported that there was evidence from several 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 recognized as predictors of care quality and the avoidance of patient harm but have also been consistently linked to nurse job satisfaction (Shepherd *et al.* 2005) and propensity to leave their jobs or the nursing profession (Heinen *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 *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 *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 organizational factors in 12 European countries (Ausserhofer *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 *et al.* 2014). On a day shift, the mean number of patients cared for was 7.8 per RN and at night, 10.9. Eighty-six per cent 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 (Kalisch *et al.* 2011, Ball *et al.* 2014, Ausserhofer *et al.* 2014). 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 *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 - March 2010, the survey was sent out by 'Statistics Sweden' and respondents were given the option of answering either a web survey or a postal survey ($N = 33,083$). After three reminders, the response rate was 70% ($n = 23,087$). Of these, 10,174 respondents were identified as working on inpatient 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 comprises RNs and unregistered nurse support workers, who in Sweden are Enrolled Nurses (3 years of training) and auxiliary nurses (1 year of 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

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 who 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 and strongly agree). Four of the items in the Practice Environment Scale related specifically to nurse staffing and resourcing.

These were excluded to avoid overlap (i.e. 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 to 4, where 1 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' and 'often' (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

Box 1: Other activities undertaken and activities left undone

Transferrable activity undertaken by RNs

- Delivering and retrieving food trays
- Performing activities that should be done by other staff groups
- Arranging discharge referrals and transportation
- Routine phlebotomy/blood draw for tests
- Transporting of patients within hospital
- Cleaning patient rooms and equipment
- Filling in for non-nursing services not available on off-hours
- Obtaining supplies or equipment
- Answering phones, clerical duties

Activities left undone (Schubert *et al.* 2008)

- Adequate patient surveillance
- Adequate documentation of nursing care
- Administering medication on time
- Comfort/talk with patients
- Develop or update nursing care plans/care pathways
- Educating patients and/or family
- Frequent changing of patient's position
- Oral hygiene
- Pain management
- Planning care
- Preparing patients and families for discharge
- Skin care
- Undertaking treatments/procedures

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?' (Box 1).

Validity and reliability

The questionnaire survey (and measures in it) is described in more detail elsewhere (Sermeus *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 *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 *et al.* 2013).

Data analysis

Statistical analysis was performed using SPSS version 20 (Guildford, Surrey, UK). 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 in 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 was 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 per cent 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 'neces-

Table 1 Profile of nurse respondents.

Characteristics	Value	SD	<i>n</i>
Age	39.7 (mean) 18-59 (min-max)	11.0	10043
Gender			
Female	93.1%		9374
Male	6.9%		694
Education			
Trained in Sweden	97.8%		9843
Holds a bachelor's degree in nursing	58.8%		5879
Working hours			
Full time	59.9%		6024
Part time	40.1%		4028
Last shift worked			
Day	56.4%		5601
Afternoon/evening	19.7%		1952
Night	23.9%		2371
Role (on last shift)			
I provided most of the care myself	27%		2625
I supervised the care by others and provided some myself	55%		5358
I provided only limited care and most direct care was carried out by others	18%		1739
Length of service (mean years)			
Nursing career	11.4	10.3	10026
Current hospital	9.6	9.1	9959

Table 2 Nurses reporting activities ‘left undone’ by time of shift; RN staffing by care undone.

	Day	Afternoon	Night	All shifts	Mean number of patients per RN (day shift)	
					Not reported as undone	Reported as undone
	%	%	%	%		
1. Adequate patient surveillance	20	23	19	20	5.7	6.7
2. Skin care	27	31	15	25	5.7	6.4
3. Oral hygiene	34	37	21	31	5.6	6.4
4. Pain management	6	6	5	6	5.8	7.0
5. Comfort/talk with patients	49	51	34	46	5.5	6.4
6. Educating patients and family	31	30	12	26	5.7	6.4
7. Treatments and procedures	6	6	4	6	5.9	6.5
8. Administer medications on time	26	27	22	25	5.7	6.5
9. Prepare patient and families for discharge	19	20	7	16	5.8	6.6
10. Adequately document nursing care	27	29	18	25	5.7	6.6
11. Develop/update nursing care plans/care pathways	41	38	16	34	5.7	6.3
12. Planning care	12	14	7	11	5.9	6.4
13. Frequent changing of patient position	20	22	19	20	5.8	6.5
Any care missed	79	80	59	75	4.8	6.2

Table 3 Descriptive results by time of shift.

Characteristics	Day			Afternoon			Night			All		
	%	<i>n</i>		%	<i>n</i>		%	<i>n</i>		%	<i>n</i>	
I provide most care myself	19	1017		20	383		52	1210		27	2625	
I supervise the care by others and provide some myself	57	3089		63	1202		44	1019		55	5358	
I provide only limited care and most direct care was carried out by others	24	1297		17	330		4	99		18	1739	
	Mean	SD	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD	<i>n</i>
Number of ‘transferrable’ activities often undertaken	2.64	1.99	5552	2.38	1.99	1948	1.66	1.68	2365	2.35	2.0	9865
Total number of patients per ward/unit	21.4	8.9	5465	21.7	10.3	1920	22.0	9.0	2347	21.6	9.2	9803
Patients per RN providing care	5.5	3.1	5350	7.0	3.6	1876	11.4	5.6	2188	7.2	4.6	9482
Patients per nursing support worker	6.5	4.0	5186	8.2	4.4	1852	16.9	7.5	1743	8.9	6.4	8781
Patients per member of nursing staff	2.9	1.4	5400	3.7	1.7	1910	7.9	4.1	2341	4.2	3.2	9651
Number of patients individual RN directly responsible for	5.9	3.5	5571	7.6	4.1	1943	11.9	5.8	2365	7.6	4.9	9956
Number of own patients requiring assistance with all ADLs	2.3	2.1	5319	2.9	2.5	1879	4.0	3.5	2325	2.8	2.7	9595
% ‘high dependency’ patients	33%	24	4683	34%	23	1743	32%	22	2223	33%	23	8716

sary 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 hypothesized 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 per cent 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).

Table 4 Transferrable activities done 'often' by time of shift and by role (percentages).

	Day	pm	Night	All shifts	Most care	Some care	Limited care
1. Delivering and retrieving food trays	23	24	2	18	40	23	9
2. Performing non-nursing care	24	25	25	25	39	24	14
3. Arranging discharge referrals and transportation (including long-term care)	41	22	4	29	29	38	40
4. Routine phlebotomy/blood draw for tests	43	31	43	41	50	39	34
5. Transporting of patients within hospital	18	15	8	15	25	16	11
6. Cleaning patient rooms and equipment	21	19	18	20	45	17	9
7. Filling in for non-nursing services not available on off-hours	6	8	9	7	9	7	5
8. Obtaining supplies or equipment	23	22	21	22	35	21	18
9. Answering phones, clerical duties	66	73	38	61	65	67	72
Mean number of transferrable activities 'often' done (SD)	2.64 (1.99)	2.38 (1.98)	1.66 (1.99)	2.35 (1.96)	3.34 (2.25)	2.51 (1.96)	2.10 (1.60)

Many of the factors examined appear to be interrelated. For example, RNs providing 'most care' themselves are working on shifts with 4.9 patients per RN in the day, while 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 that 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 with those with 10 or more. Where shifts are staffed with six or fewer patients per RN, the odds of care being left undone are more than halved compared with shifts on which there are 10 + patients per RN (OR 0.466, $P < 0.001$). RN staffing of fewer than four 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 four patients per support worker. Where support workers cared for fewer than four 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 rela-

Table 5 Multilevel models: amount and incidence of missed care.

	Number of items of missed care observed during a shift Mixed model Poisson regression				Shifts where at least one item of missed care was observed Mixed model logistic regression			
	RR	Confidence interval		P	OR	Confidence interval		P
		L95%	U95%			L95%	U95%	
Level 1 – Hospital-level variables								
Practice Environment Scale (PES-28)	0.516	0.393	0.677	<0.001	0.300	0.143	0.629	0.001
Level 2. Shift-level variables								
Shift (global) (F[2,8511], P)	(251.292, <0.001)							
Day	1.776	1.687	1.869	<0.001	5.747	4.634	7.127	<0.001
Afternoon/evening	1.671	1.590	1.758	<0.001	3.778	3.046	4.686	<0.001
Night	1.000				1.000			
Assistance with daily living (% patients high dependency)	1.006	1.005	1.006	<0.001	1.016	1.014	1.019	<0.001
Frequent monitoring (% patients)	1.002	1.001	1.002	<0.001	1.004	1.002	1.006	<0.001
No. of transferrable activities often done	1.087	1.080	1.094	<0.001	1.241	1.198	1.285	<0.001
Own involvement in care delivery (global) (F[2,8511], P)	(77.353, <0.001)							
Deliver most care	0.753	0.720	0.788	<0.001	0.563	0.459	0.691	<0.001
Some	0.899	0.870	0.930	<0.001	0.916	0.770	1.090	0.323
Limited	1.000				1.000			
Nurse staffing variables								
Patients per RN (global) (F[7,8511], P)	(84.914, <0.001)							
Best (<4)	0.520	0.491	0.551	<0.001	0.148	0.115	0.191	<0.001
4-4.99	0.629	0.596	0.663	<0.001	0.271	0.210	0.350	<0.001
5-5.99	0.713	0.679	0.750	<0.001	0.348	0.271	0.447	<0.001
6-6.99	0.760	0.723	0.798	<0.001	0.466	0.364	0.597	<0.001
7-7.99	0.811	0.768	0.856	<0.001	0.554	0.426	0.720	<0.001
8-8.99	0.845	0.798	0.895	<0.001	0.684	0.521	0.897	<0.001
9-9.99	0.880	0.823	0.941	<0.001	0.721	0.535	0.972	0.006
Worst (10 or more)	1.000				1.000			
Patients per nursing support worker (global) (F[8,8511], P)	(11.089, <0.001)							
Best (<4)	0.885	0.818	0.958	0.003	0.714	0.536	0.951	0.021
4-4.99	1.085	1.007	1.170	0.033	1.029	0.763	1.387	0.852
5-5.99	1.091	1.014	1.173	0.019	1.000	0.750	1.332	0.998
6-6.99	1.090	1.013	1.172	0.021	1.091	0.818	1.455	0.554
7-7.99	1.142	1.058	1.232	0.001	1.236	0.904	1.690	0.183
8-8.99	1.110	1.025	1.202	0.011	1.037	0.749	1.435	0.829
9-9.99	1.156	1.056	1.264	0.002	1.010	0.692	1.474	0.960
Worst (10 or more)	1.119	1.052	1.189	<0.001	1.071	0.872	1.315	0.516
No HCSW	1.000				1.000			
Random variance								
Hospitals (n = 79)	σ	L95%	U95%	P	σ	L95%	U95%	P
	0.027	0.018	0.041	<0.001				

tionship 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 *et al.* 2014) and across Europe (Ausserhofer *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, provide an opportunity for us to consider the factors beyond staffing level that have an association with care that

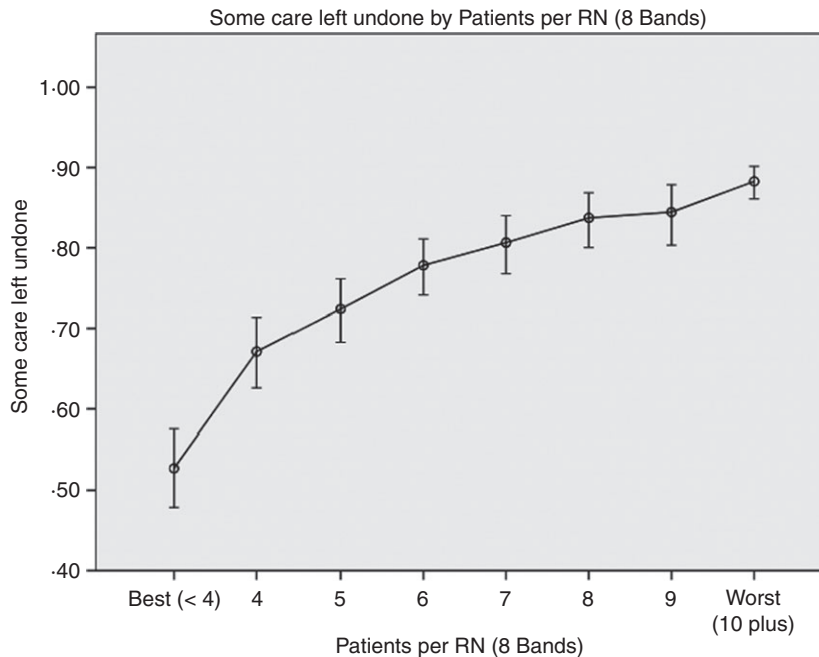


Figure 1 Care left undone by RN staffing (based on multilevel regression analyses presented in Table 5).

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, recognizing that care and activities undertaken at night are different from those in the day (Ball *et al.* 2014). 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 with 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 & Beckett

2011, de Cordova *et al.* 2014, Yiu *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 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 in Sweden reported that they often undertake such activities compared with 49% in England. This suggests that there could be a difference in the way 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.

While 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 where 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 we undertake, report and interpret international research that endeavours to explore the relationship between RN 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 four 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 six patients 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 RN 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 *et al.* 2014) 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 healthcare 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 *et al.* 2009, Kessler *et al.* 2014). While in this present study we saw a small benefit when support worker staffing was at its highest level (compared with having no assistants), the effect was modest compared with 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 *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 RNs 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 & 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. While 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 on the role that RNs 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 RNs. 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. While 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.

Funding

This article draws on a project that was funded by the European Union 7th framework (FP7/2007–2013, grant agreement no. 223468), and is part of the larger international RN4Cast project, led by Prof Walter Sermeus and Prof Linda Aiken, in association with the RN4Cast consortium (15 countries). Additional support in Sweden was provided by Karolinska Institutet's National Research School of Health Care Sciences, the Swedish Research Council for Health, Working Life and Social Research (FAS grant number 2011-0403 and Forte grant number 2014-4758), the Karolinska Institutet Strategic Research Programme in Care Sciences, the Swedish Association of Health Professionals and the Regional Agreement on Medical Training and Research (ALF) between Stockholm County Council and Karolinska Institutet (ALF Medicine grant number 20110531). The research in Sweden was led by Carol Tishelman at the Medical Management Centre, LIME, Karolinska Institutet. Additional funding support has been provided by the National Institute for Health Research Collaboration for Leadership in Applied Health Research and Care (NIHR CLAHRC) Wessex.

Conflict of interest

No conflict of interest is declared by the authors.

Author contributions

All authors have agreed on the final version and meet at least one of the following criteria [recommended by the ICMJE (<http://www.icmje.org/recommendations/>)]:

- substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data;
- drafting the article or revising it critically for important intellectual content.

References

Aiken L.H., Sloane D.M., Bruyneel L., Van den Heede K., Griffiths P., Busse R., Diomidous M., Kinnunen J., Kózka M. & Lesaffre E. (2014) Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study. *The Lancet* 383(9931), 1824–1830.

Alenius L.S., Tishelman C., Runesdotter S. & Lindqvist R. (2013) Staffing and resource adequacy strongly related to RNs' assessment of patient safety: a national study of RNs working in acute-care hospitals in Sweden. *BMJ Quality & Safety* 23(3), 242–249.

Ausserhofer D., Zander B., Busse R., Schubert M., De Geest S., Rafferty A.M., Ball J., Scott A., Kinnunen J. & Heinen M. (2014) Prevalence, patterns and predictors of nursing care left undone in European hospitals: results from the multicountry cross-sectional RN4CAST study. *BMJ Quality & Safety* 23(2), 126–135.

Ball J.E., Pike G., Griffiths P., Rafferty A.M. & Murrells T. (2012) 'RN4Cast Nurse survey in England'. *National Nursing Research Unit Report*. King's College London.

Ball J.E., Murrells T., Rafferty A.M., Morrow E. & Griffiths P. (2014) 'Care left undone' during nursing shifts: associations with workload and perceived quality of care. *BMJ Quality & Safety* 23(2), 116–125.

Carville, O. Overworked nurses ration patient care. *The Press*. 27th May 2014. Retrieved from <http://www.stuff.co.nz/the-press/news/10079520/Overworked-nurses-ration-patient-care> on 17 February 2015.

de Cordova P.B., Phibbs C.S., Schmitt S.K. & Stone P.W. (2014) Night and day in the VA: associations between night shift staffing, nurse workforce characteristics, and length of stay. *Research in Nursing & Health* 37(2), 90–97.

Fasoli D.R. & Haddock K.S. (2010) Results of an integrative review of patient classification systems. *Annual Review of Nursing Research* 28, 295–316.

Gordon C.F. & Beckett D.J. (2011) Significant deficiencies in the overnight use of a Standardised Early Warning Scoring system in a teaching hospital. *Scottish Medical Journal* 56(1), 15–18.

Griffiths P., Ball J., Drennan J., James L., Jones J., Recio A. & Simon M. (2014) *The Association between Patient Safety Outcomes and Nurse/Healthcare Assistant Skill Mix and Staffing Levels and Factors that may Influence Staffing Requirements* (NICE evidence review). University of Southampton Centre for Innovation and Leadership in Health Sciences, Southampton.

Heinen M.M., van Achterberg T., Schwendimann R., Zander B., Matthews A., Kózka M., Ensio A., Sjetne I.S., Casbas T.M. & Ball J. (2013) Nurses' intention to leave their profession: a cross sectional observational study in 10 European countries. *International Journal of Nursing Studies* 50(2), 174–184.

Kalisch B.J., Tschannen D. & Lee K.H. (2011) Do staffing levels predict missed nursing care? *International Journal for Quality in Health Care* 23(3), 302–308.

Kane R.L., Shamliyan T.A., Mueller C., Duval S. & Wilt T.J. (2007) The association of registered nurse staffing levels and patient outcomes: systematic review and meta-analysis. *Medical Care* 45(12), 1195–1204.

Kessler I., Spilsbury K. & Heron P. (2014) Developing a high-performance support workforce in acute care: innovation, evaluation and engagement. *Health Services and Delivery Research* 2(25), Retrieved from <http://www.ncbi.nlm.nih.gov/books/NBK259944/>.

Lake E.T. (2002) Development of the practice environment scale of the Nursing Work Index. *Research in Nursing & Health* 25(3), 176–188.

Needleman J., Buerhaus P., Pankratz V.S., Leibson C.L., Stevens S.R. & Harris M. (2011) Nurse staffing and inpatient hospital mortality. *New England Journal of Medicine* 364(11), 1037–1045.

- News in English. Sweden lures nurses back. *Views and News from Norway*. 5 March 2014. Retrieved from <http://www.newsenglish.no/2014/03/05/sweden-lures-nurses-back/> on 17 February 2015.
- Rafferty A.M., Clarke S.P., Coles J., Ball J., James P., McKee M. & Aiken L.H. (2007) Outcomes of variation in hospital nurse staffing in English hospitals: cross-sectional analysis of survey data and discharge records. *International Journal of Nursing Studies* 44(2), 175–182.
- Schubert M., Glass T.R., Clarke S.P., Aiken L.H., Schaffert-Witvliet B., Sloane D.M. & De Geest S. (2008) Rationing of nursing care and its relationship to patient outcomes: the Swiss extension of the International Hospital Outcomes Study. *International Journal for Quality in Health Care* 20(4), 227–237.
- Sermeus W., Aiken L.H., Van den Heede K., Rafferty A.M., Griffiths P., Moreno-Casbas M.T., Busse R., Lindqvist R., Scott A.P. & Bruyneel L. (2011) Nurse forecasting in Europe (RN4CAST): Rationale, design and methodology. *BMC Nursing* 10(1), 6.
- Sheward L., Hunt J., Hagen S., Macleod M. & Ball J. (2005) The relationship between UK hospital nurse staffing and emotional exhaustion and job dissatisfaction. *Journal of Nursing Management* 13(1), 51–60.
- Sochalski J. (2004) Is more better?: the relationship between nurse staffing and the quality of nursing care in hospitals. *Medical Care* 42(2), II–67–II–73.
- Squires A., Aiken L.H., van den Heede K., Sermeus W., Bruyneel L., Lindqvist R., Schoonhoven L., Stromseng I., Busse R. & Brzostek T. (2013) A systematic survey instrument translation process for multi-country, comparative health workforce studies. *International Journal of Nursing Studies* 50(2), 264–273.
- Wakefield A., Spilsbury K., Atkin K., McKenna H., Borglin G. & Stuttard L. (2009) Assistant or substitute: exploring the fit between national policy vision and local practice realities of assistant practitioner job descriptions. *Health Policy (Amsterdam, Netherlands)* 90(2), 286–295.
- Yiu C.J., Khan S.U., Subbe C.P., Tofeek K. & Madge R.A. (2014) Into the night: factors affecting response to abnormal Early Warning Scores out-of-hours and implications for service improvement. *Acute Medicine* 13(2), 56–60.

The *Journal of Advanced Nursing (JAN)* is an international, peer-reviewed, scientific journal. *JAN* contributes to the advancement of evidence-based nursing, midwifery and health care by disseminating high quality research and scholarship of contemporary relevance and with potential to advance knowledge for practice, education, management or policy. *JAN* publishes research reviews, original research reports and methodological and theoretical papers.

For further information, please visit *JAN* on the Wiley Online Library website: www.wileyonlinelibrary.com/journal/jan

Reasons to publish your work in *JAN*:

- **High-impact forum:** the world's most cited nursing journal, with an Impact Factor of 1.741 – ranked 8/109 in the 2014 ISI Journal Citation Reports © (Nursing (Social Science)).
- **Most read nursing journal in the world:** over 3 million articles downloaded online per year and accessible in over 10,000 libraries worldwide (including over 3,500 in developing countries with free or low cost access).
- **Fast and easy online submission:** online submission at <http://mc.manuscriptcentral.com/jan>.
- **Positive publishing experience:** rapid double-blind peer review with constructive feedback.
- **Rapid online publication in five weeks:** average time from final manuscript arriving in production to online publication.
- **Online Open:** the option to pay to make your article freely and openly accessible to non-subscribers upon publication on Wiley Online Library, as well as the option to deposit the article in your own or your funding agency's preferred archive (e.g. PubMed).