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Temporary staffing and patient death in acute care hospitals: A retrospective longitudinal study

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ABSTRACT

PURPOSE: To explore the association between the levels of temporary nurse staffing and patient mortality. Achieving adequate nurse staffing levels plays a vital role in keeping patients safe from harm. The evidence around deploying temporary staffing to maintain safe staffing levels is mixed, with some studies reporting no adverse effects on patient mortality.

DESIGN: A retrospective longitudinal observational study using routinely collected data on 138,133 patients admitted to a large hospital in the South of England. Data were collected between April 2012 and April 2015.

METHODS: We used multilevel survival models to explore the association between in-hospital deaths and daily variation in registered nurse (RN) and nursing assistants (NA) temporary staffing, measured as hours per patient per day. Analyses controlled for unit and patient risk.

FINDINGS: Use of temporary staffing was common, with only 24% (n=7529) of the 30,980 unit-days having no temporary RN staff and 13% (n= 3951) having no temporary NAs. The hazard of death was increased by 12% for every day a patient experienced high levels (1.5 hours or more per day) of RN temporary staffing (adjusted Hazard Ratio (aHR) 1.12, 95% CI 1.03 - 1.21). The hazard of death was increased on days when NA temporary staffing was more than 0.5 hours per patient (aHR: 1.06; 95% CI: 1.03 - 1.08).

CONCLUSIONS: Days with more than 1 hour and 30 minutes per patient of temporary RNs and days with more than 30 minutes per day of temporary NAs were associated with increased hazard of death.

CLINICAL RELEVANCE: Heavy reliance on temporary staff is associated with higher risk of patients dying. There is no evidence of harm associated with modest use of temporary registered nurses, as required staffing levels can be maintained.

KEY WORDS: nurse staffing; temporary staffing; patient mortality

INTRODUCTION

The nursing workforce has long been recognised as an essential component in achieving quality and safety of care in hospital units (Stanton, 2004). Of particular importance to achieve optimal patient outcomes are registered nurse (RN) staffing levels and skill mix. When RN staffing levels and skill mix are low, patients are more likely to die in hospital (Aiken et al., 2017; Aiken et al., 2014; Griffiths et al., 2016; Griffiths, Maruotti, et al., 2018). While there is a worldwide rising demand for healthcare, resources are limited (Araujo, Evans, & Maeda, 2016); healthcare systems are facing increasing nursing shortages worldwide (Johnson, Butler, Harootunian, Wilson, & Linan, 2016; World Health Organization, 2016). A recent report from England's National Health Service (NHS) highlighted that demand for nurses still exceeds supply, with 40,000 vacant registered nurses positions, corresponding to a 11.8% vacancy rate across England, 9% higher than in 2017 (NHS Improvement, 2018).

Establishing the most efficient approach to matching limited nursing resources to the often variable demand for care on hospital units is an important priority, and resorting to temporary staffing has been adopted as one of the solutions. If nurses are deployed to units where the demand is greatest, the negative consequences for patients when staffing falls below the required level might be avoided. On the other hand, use of temporary staff potentially represents an expensive solution for hospitals (Hurst & Smith, 2011) with substantial charges and increased pay rates incurred when employing staff. Furthermore, there are some safety concerns related to the use of temporary staff, such as potential for less familiarity with unit practices and disruptions to continuity of care and team communication (Aiken, Xue, Clarke, & Sloane, 2007).

The evidence around temporary staffing is mixed. While studies have found that increased use of temporary staffing is associated with increased patient falls with injury (Bae, Kelly, Brewer, & Spencer, 2014) and shortcomings in quality of care (Wu & Lee, 2006), other studies found no significant differences in quality and safety when temporary staff are deployed (Aiken et al., 2007; Alvarez, Kerr, Burtner, Ledlow, & Fulton, 2011; Bae, Brewer, Kelly, & Spencer, 2015; Xue, Aiken, Freund, & Noyes, 2012).

While these studies have looked at the effect of temporary staffing on adverse patients and nurse outcomes, most rely on subjective nurse reports. We are aware of only one study investigating the association of temporary staffing and mortality. This was a large cross-sectional study carried out in the US by Aiken and colleagues, with a sample of 40,356 RNs in 665 hospitals; they found that higher use of temporary staff was not associated with increased mortality (Aiken, Shang, Xue, & Sloane, 2013). This somewhat limited evidence comes from cross-sectional studies, with associations measured at the hospital level, which make determining cause and effect difficult. Therefore, the aim of this study was to examine the association between the levels of temporary staffing individual patients were exposed to and risk of death using a longitudinal design.

METHODS

This was a retrospective longitudinal observational study using routinely collected data from a single acute care hospital in England. This study used measures of patient mortality derived from administrative records and unit level staffing data from an electronic rostering system. We were able to directly link patient outcomes to temporary staffing levels experienced by the patient on every unit and for each day and nursing shift of their hospital stay. The study was approved by the National Research Ethics Service, East Midlands – Northampton Committee Ref: 15/EM/0099.

Setting

The study was undertaken from April 2012 to March 2015 using data from staff and patients admitted to all 32 adult medical and surgical units (approximately 800 beds in total) of a large acute care general NHS hospital in the south of England.

Data Sources

Nurse staffing data was accessed from an electronic rostering system. The database contained records of shifts worked, location, hours (dates, start and end time), unit and grade for all nurses employed by the hospital. A second database recorded all bank (extra contractual work within the hospital by staff employed by the hospital) and agency shifts (shifts worked by staff employed through an external agency). We considered shifts worked on adult medical and surgical units. Intensive care units, paediatric and maternity services were not included. Shifts with codes indicating sick leave or other absence, non-unit based or non-clinical roles (e.g. clerks) or study leave were removed prior to calculating unit staffing levels. A small number of shifts by staff working at an unknown grade (n = 1608) were also removed because the human resources department and senior nursing managers advised that these staff would be unlikely to have been clinical nursing staff. Shifts by permanent staff and shifts by temporary staff were recorded and managed in separate databases, linked to payroll and agency billing systems. The shift data were therefore subject to extensive checks and validation by the hospital prior to transfer, as these are used as the source of data for payments to staff / the agency. Patient data were extracted from the hospital's patient administration system (PAS). PAS data comprised of patient demographic and diagnostic information including reason for admission and comorbidities, used to control analyses for patient level risk factors, and detail of transfers within the hospital, which were used to determine the units where a patient received care.

Study Variables

Our patient outcome was in-hospital mortality, determined from the patient administration system (PAS). For each unit, the nursing hours for each day were calculated from the electronic rostering system with all hours between the shift start time and end time contributing; these were summed for each unit for each day.

The daily number of patients for each unit was calculated using the admission, discharge and transfer information over a 24-hour period. For each unit on each day, we calculated patient-days, which is equivalent to one patient occupying one bed for 24 hours. The total of patient-days represents the average number of occupied beds in a 24-hour period.

Combining this with the staffing variables, we calculated RN hours per patient day (RN HPPD) and NA hours per patient day (NA HPPD) as the sum of hours worked by each group divided by patient days. Using the same approach, we were able to calculate hours provided by temporary nursing staff employed via the hospital's bank or from an outside agency. The number of care hours per patient day provided by temporary staff was calculated for each day in each unit. The hospital 'bank' is a pool of hospital employees who are available to take temporary assignments. Some staff may undertake work through the bank in addition to their contracted hours, subject to limitations imposed by the European working time directive, which limits the working week to 48 hours. Agency shifts are covered by staff who are supplied to a hospital by a private agency. Because of how our database was built, we could not split bank staff and agency staff in the main analysis.

Data Analysis

We measured the association between temporary staffing and patient mortality with hierarchical mixed-effects survival models. Patient mortality was assessed at the patient level, with patients being exposed to varying HPPD of temporary staffing throughout their stay in hospital. Following the approach by Needleman and colleagues (Needleman et al., 2011), we performed our analysis of the association between temporary staffing levels and patient mortality to consider the effect of staffing experienced over the first five days of the hospital stay. Thus analysis focussed on the period of hospital stay when the patient is most likely to be acutely ill (Needleman et al., 2011), while still including staffing levels experienced by the majority of patients for the majority of their stay.

We considered the effect of Registered Nursing and Nursing Assistant staffing as discrete variables in the models, reflecting the distinct contribution of each staff group. Exposure to temporary staffing was expressed as a time varying co-variate representing the cumulative sum of days exposed to high temporary staffing. Because previous research had shown no overall association in cross sectional measures considering temporary staffing as a linear variable, we considered three different thresholds for HPPD of temporary nurse staffing: 0.5 HPDD or more; 1 HPPD or more; 1.5 HPPD or more. To control for the overall staffing levels we also included days of low staffing in the model, expressed as the sum of days when staffing fell below the mean for the unit which, in turn, corresponded closely to the planned staffing level. We additionally considered nursing workload by adding a variable that calculated whether the number of admissions to the unit per staff member was >125% of the unit mean.

We controlled for patient condition and risk, including patient age and comorbidities, using risk coefficients derived from the nationally validated Summary Hospital Mortality Indicator (SHMI) model (Campbell, Jacques, Fotheringham, Maheswaran, & Nicholl, 2012). We also controlled for the National Early Warning Score (NEWS) at admission as a measure of patient acuity, and for the mode of admissions (i.e. elective vs emergency). All analyses were performed at the unit-day level using the Stata Statistical Software: Release V.14 using the xtstreg command.

RESULTS

Our sample consisted of 138,133 patients admitted to the study hospital and spending one or more days on general medical / surgical units between April 2012 and April 2015. Hospital mortality was 4.1%. The median age was 67, and the majority (79%) were admitted as an emergency. Forty percent had 3 or more comorbidities (Charlson comorbidity index = 3+). More detail on patient characteristics and nurse staffing can be found in the parent study report (Griffiths, Ball, et al., 2018). A total of 761,946 shifts were worked by 1944 nursing staff members, of which 1244 staff members were registered nurses and 700 were classified as nursing assistant. 633,525 shifts were rostered to permanent staff (RNs and NAs) and 128,421 to temporary staff (RNs or NA employed via the bank or agency). 41,897 temporary shifts (33%) were filled in by agency staff, while 67% (n= 86,524) were covered by bank staff. Table 1 shows the distribution of bank and agency shifts according to staff type.

(Table 1 here)

Nursing assistants worked the majority of temporary shifts (n= 83,892, 65%), and most temporary NAs were deployed from the hospital bank. The majority of registered nurses (n= 34,683, 78%) was deployed from the bank, with only 12% of RN temporary shifts filled by agency RNs.

Use of temporary staffing was common, with only 24% (n=7529) of the 30,980 unit-days having no bank or agency RN staff and 13% (n= 3951) having no bank or agency NAs. The majority of unit-days had at least half hour per patient day worked by temporary RNs (76%) and NAs (87%). However, use of high numbers of temporary staff was relatively rare with 4% of days (n= 1217) having 1.5 or more temporary RN HPPD and 15% of days (n= 4625) with 1.5 or more NA HPPD (Figure 1). Use of temporary staff varied by unit, with some units showing less than 1% of days with no temporary staff (see online supplementary material).

(Figure 1 here)

Temporary staffing was associated with significant increases in the hazard of death, particularly at higher levels (Table 2).

(Table 2 here)

In the adjusted models there was an association between HPPD of temporary RN staffing and patient mortality. When patients experienced days with 1.5 or more HPPD of temporary RN staffing, the hazard of death was increased by 12% (Adjusted Hazard Ratio (aHR): 1.12; 95% CI: 1.03 – 1.21). When a lower threshold of 30 minutes per day or more was used, exposure to temporary RN staffing was not associated with increases in the hazard of death (aHR: 0.99). The hazard of death was increased with exposure to days with 30 minutes or more of temporary NA staffing (aHR 1.06; 95% CI: 1.03 – 1.08). Exposure to days with 1.5 HPPD or more of temporary NA staffing was associated with a similar increase in hazard of death (aHR 1.05; 95% CI: 1.02-1.08). For the full models, please see online supplementary material.

DISCUSSION

When patients spent time on units where high amounts of nursing hours were provided by temporary staff, their risk of dying was increased. We found that for each day a patient was exposed to more than 1.5 hours temporary registered nurse staffing, the hazard of death was substantially elevated (12%). While most previous studies focused on registered nurses only, our study also explored the effect of temporary staffing by NAs. We found that temporary NAs staffing at any level was associated with increased risk of patients dying, although the effect of high levels of temporary NA staffing was much smaller than that of RNs.

While one US study using cross sectional hospital level data found no association between use of external agency registered nurses and mortality after controlling for the hospital's work environment, (Aiken et al., 2013) we explored patient level exposures to temporary staff with different thresholds rather than as a linear variable. For RNs we observed adverse effects only at levels of temporary staff that were much higher than typically observed in Aiken's study. Our results highlight the beneficial effect of deploying low amounts of temporary RNs because they maintain staffing levels, but reveal that there is elevated risk at high levels of temporary RN staffing. This is consistent with results from a modelling study, which found that both unconditional use of temporary staffing and a "no tolerance" policy led to lower quality of care and staff job dissatisfaction, while a limited amount of temporary staffing could improve outcomes (Maenhout & Vanhoucke, 2013).

The trade-off between the benefits of more staff and the adverse consequences of their temporary nature requires further exploration. Our study and previous literature point to a relative inefficiency of temporary staff, but the mechanism by which temporary staff may be less effective remains unexplored.

The finding that only high amounts of RN temporary staffing were associated with increased mortality, while any NAs temporary staffing significantly impacted the hazard of death, raises some questions. There is evidence that in England temporary NAs are often deployed to fill in RN shortfalls (NHS Improvement, 2016). Therefore, our findings on NAs may reflect this mismatch in the replacement of RNs with temporary NAs, suggesting that the negative effect on mortality may be due to an inappropriate type of staff substitution, rather than their temporary nature, although our analyses showed that the negative effect was additional to any effect from low registered nurse staffing. The finding that mortality rates are insensitive to temporary RN staffing until it reaches very high levels is consistent with RNs teams being more adaptable and able to maintain patient safety even if some staff are unfamiliar with unit practices and patients.

A major strength of our study is the use of objective data, which were analysed longitudinally. Moreover, we were able to assess the temporary staffing levels experienced by individual patients and we showed that exposure to high temporary nurse staffing precedes increased risk of death. Nonetheless, this study has some limitations. While our study overcame several shortcomings from previous research, it is observational, so causal inference does not follow. Although our study was undertaken in a large general hospital, results may not generalise. Bank staff may be more familiar with the unit and hospital than agency staff, but due to the complexity of our analysis and database, we could not treat them separately. This could attenuate the apparent negative effect of temporary staffing on patient mortality if, as seems likely, one mechanism for adverse effects from temporary staffing arises from unfamiliarity with ward or hospital procedures, because some of the hours that we attribute to temporary staff are provided by staff who are familiar with the hospital or ward. Indeed, some staff classified as "bank" may have been employees of the same unit where they had opted to work extra shifts, so in this case, an apparent effect of temporary staffing by these nurses could be confounded by the effect of overtime working, which has been shown to have negative associations with quality of care (Griffiths et al., 2014). Future studies should shed light on the impact of different bank and agency configurations on risk of patient death.

CONCLUSION

Our findings demonstrate the potential consequences of nurse staffing shortages if hospitals have to resort to heavy reliance on temporary staff. This is the first study to show substantial increase in risk associated with high levels of temporary staffing independently of overall staffing levels, calling into question flexible staffing policies that rely substantially on temporary staff to meet variable patient need. Temporary NA staffing over 30 minutes per patient day was associated with a moderate increase in the risk of death. Temporary RN staffing at a low threshold (30 minutes per patient per day) was not associated with increased risk and may be important for maintaining patient safety, while high levels are associated with substantially increased risk.

CLINICAL RESOURCES

NHS Improvement – Workforce https://improvement.nhs.uk/improvement-hub/workforce/

NHS Improvement - Making effective use of staff banks: toolkit

https://improvement.nhs.uk/documents/2058/Making_effective_use_of_staff_banks_toolkit.pdf

Royal College of Nursing – Safe and Effective Staffing: Nursing Against the Odds

https://www.rcn.org.uk/professional-development/publications/pub-006415

World Health Organisation - Health Workforce – Governance and planning

https://www.who.int/hrh/governance/en/

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TABLES AND FIGURES

Table 1 Number of bank and agency shifts by staff grade

Staff Grade	**Agency Filled**	**Bank Filled**	**Total**
Registered Nurses	9846	34683	44529
Nursing Assistants	32051	51841	83892

Table 2 Hazard of death associated with HPPD of temporary staff during the first 5 days of stay

Days with HPPD by temporary staff±	Unadjusted HR	p-value	95% CI		Adjusted± HR	p-value	95% CI	
≥0.5 HPPD RN staffing	1.02	0.01**	1.00	1.04	0.99	0.53	0.97	1.01
≥0.5 HPPD NA staffing	1.07	<0.001**	1.06	1.09	1.06	<0.001*	1.03	1.08
≥1 HPPD RN staffing	1.01	0.35	0.98	1.04	1.03	0.14	0.99	1.06
≥1 HPPD NA staffing	1.03	0.001**	1.01	1.05	1.02	0.05*	1.00	1.05
≥1.5 HPPD RN staffing	1.07	0.53	1.00	1.15	1.12	0.006**	1.03	1.21
≥1.5 HPPD NA staffing	1.05	0.001**	1.02	1.07	1.05	0.003**	1.02	1.08

* Statistically significant (p<0.05) ** (p<0.01)

±Models controlling for NEWS on admission; SHMI Risk score; emergency vs elective admissions; admissions per RN>125% of unit mean; admissions per NA>125% of unit mean; RN staffing below unit mean; NA staffing below unit mean

Figure 1 *Levels of temporary staffing*

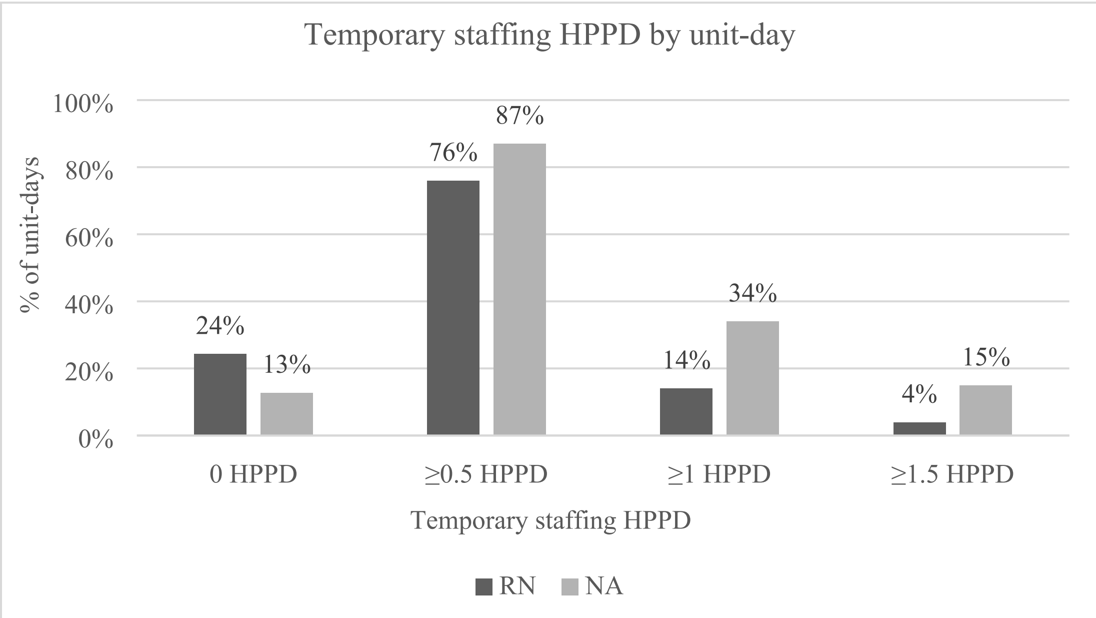

Table a Use of temporary staffing by unit

Unit	days of data (n)	RN				NA			
		n(%) days 0 HPPD	n(%) days ≥0.5 HPPD	n(%) days ≥1 HPPD	n(%) days ≥1.5 HPPD	N(%) days 0 HPPD	n(%) days ≥0.5 HPPD	n(%) days ≥1 HPPD	n(%) days ≥1.5 HPPD
CANCER	1095	39 (4%)	708 (65%)	237 (22%)	56 (5%)	92 (8%)	494 (45%)	68 (6%)	1 (0%)
MED/SURG CARDIAC	1095	353 (32%)	427 (39%)	106 (10%)	24 (2%)	249 (23%)	581 (53%)	270 (25%)	102 (9%)
MED-ADM	1095	80 (7%)	483 (44%)	64 (6%)	3 (0%)	20 (2%)	569 (52%)	93 (8%)	5 (0%)
MED-GASTRO	1095	73 (7%)	657 (60%)	223 (20%)	53 (5%)	4 (0%)	1014 (93%)	879 (80%)	657 (60%)
MED-GEN1	1095	281 (26%)	227 (21%)	18 (2%)	1 (0%)	23 (2%)	913 (83%)	528 (48%)	236 (22%)
MED-GEN2	494	21 (4%)	331 (67%)	109 (22%)	15 (3%)	10 (2%)	440 (89%)	340 (69%)	202 (41%)
MED-GEN3	1046	40 (4%)	682 (65%)	226 (22%)	42 (4%)	6 (1%)	861 (82%)	365 (35%)	111 (11%)
MED-OP1	1040	109 (10%)	521 (50%)	153 (15%)	30 (3%)	114 (11%)	601 (58%)	245 (24%)	76 (7%)
MED-OP2	197	1 (1%)	191 (97%)	159 (81%)	86 (44%)	0 (0%)	197 (100%	181 (92%)	147 (75%)
MED-OP2	1095	84 (8%)	521 (48%)	68 (6%)	4 (0%)	22 (2%)	844 (77%)	357 (33%)	128 (12%)
MED-OP3	1095	66 (6%)	668 (61%)	239 (22%)	45 (4%)	25 (2%)	901 (82%)	546 (50%)	247 (23%)
MED-OP4	864	96 (11%)	577 (67%)	213 (25%)	48 (6%)	37 (4%)	750 (87%)	602 (70%)	443 (51%)
MED-RENAL	894	286 (32%)	340 (38%)	97 (11%)	17 (2%)	143 (16%)	515 (58%)	144 (16%)	25 (3%)
MED-RENAL HC	1095	250 (23%)	825 (75%)	582 (53%)	371 (34%)	327 (30%)	747 (68%)	464 (42%)	168 (15%)
MED-RESP1	854	64 (7%)	383 (45%)	70 (8%)	6 (1%)	29 (3%)	675 (79%)	264 (31%)	37 (4%)
MED-RESP2	1095	241 (22%)	390 (36%)	56 (5%)	3 (0%)	15 (1%)	861 (79%)	469 (43%)	213 (19%)
MED-STROKE	1027	120 (12%)	438 (43%)	65 (6%)	3 (0%)	14 (1%)	835 (81%)	382 (37%)	106 (10%)

MED-SURG	694	305	(44%)	347	(50%)	247	(36%)	102	(15%)	188	(27%)	461	(66%)	306	(44%)	128	(18%)
REHAB-NEURO	1044	330	(32%)	607	(58%)	208	(20%)	45	(4%)	163	(16%)	837	(80%)	553	(53%)	288	(28%)
REHAB-STROKE	794	301	(38%)	223	(28%)	23	(3%)	0	(0%)	24	(3%)	630	(79%)	373	(47%)	142	(18%)
SURG-ADM	1095	564	(52%)	178	(16%)	29	(3%)	2	(0%)	176	(16%)	449	(41%)	152	(14%)	38	(3%)
SURG-EL/ORTHO2	1083	341	(31%)	269	(25%)	36	(3%)	6	(1%)	228	(21%)	518	(48%)	179	(17%)	51	(5%)
SURG-EM/HIP	1095	204	(19%)	459	(42%)	113	(10%)	15	(1%)	57	(5%)	771	(70%)	402	(37%)	160	(15%)
SURG-EM/ORTHO2	1017	468	(46%)	346	(34%)	134	(13%)	25	(2%)	329	(32%)	542	(53%)	297	(29%)	127	(12%)
SURG-EM/ORTHO2	1047	239	(23%)	476	(45%)	141	(13%)	19	(2%)	60	(6%)	806	(77%)	559	(53%)	301	(29%)
SURG-GEN1	1095	502	(46%)	98	(9%)	2	(0%)	0	(0%)	18	(2%)	742	(68%)	226	(21%)	37	(3%)
SURG-GI	1095	425	(39%)	204	(19%)	12	(1%)	0	(0%)	242	(22%)	441	(40%)	123	(11%)	21	(2%)
SURG-GI	1095	139	(13%)	404	(37%)	57	(5%)	0	(0%)	178	(16%)	305	(28%)	53	(5%)	8	(1%)
SURG-GYNAE	874	275	(31%)	430	(49%)	152	(17%)	46	(5%)	140	(16%)	667	(76%)	498	(57%)	276	(32%)
SURG-H&N	1092	530	(49%)	204	(19%)	43	(4%)	4	(0%)	240	(22%)	495	(45%)	149	(14%)	39	(4%)
SURG-HC	1095	599	(55%)	411	(38%)	145	(13%)	46	(4%)	762	(70%)	301	(27%)	98	(9%)	33	(3%)
SURG-RENAL	494	103	(21%)	316	(64%)	180	(36%)	100	(20%)	16	(3%)	454	(92%)	218	(44%)	72	(15%)
ALL	30980	7529	(24%)	13341	(43%)	4207	(14%)	1217	(4%)	3951	(13%)	20217	(65%)	10383	(34%)	4625	(15%)

Table b Staffing below the mean & temporary staffing during the first five days: hazard of death (full model)

More than 0.5 HPPD	HR	p-value	95% Confidence Interval (CI)	
NEWS on admission	1.24	<0.001	1.23	1.26
SHMI Risk score	1.82	<0.001	1.78	1.87
Emergency	1.08	0.475	0.87	1.35
Admissions per RN>125% of ward mean	1.03	0.124	0.99	1.08
Admissions per NA>125% of ward mean	1.00	0.854	0.96	1.05
RN staffing below ward mean	1.02	0.194	0.99	1.04
NA staffing below ward mean	1.05	<0.001	1.02	1.07
Days with more than 0.5 HPPD temporary RN staffing	0.99	0.536	0.97	1.01
Days with more than 0.5 HPPD temporary NA staffing	1.06	<0.001	1.03	1.08
More than 1 HPPD				
NEWS on admission	1.24	<0.001	1.23	1.25
SHMI Risk score	1.82	<0.001	1.78	1.87
Emergency	1.10	0.395	0.88	1.37
Admissions per RN>125% of ward mean	1.04	0.051	1.00	1.09
Admissions per NA>125% of ward mean	1.00	0.950	0.96	1.04

RN staffing below ward mean	1.03	0.018	1.00	1.05
NA staffing below ward mean	1.05	<0.001	1.03	1.08
Days with more than 1 HPPD temporary RN staffing	1.03	0.149	0.99	1.06
Days with more than 1 HPPD temporary NA staffing	1.02	0.051	1.00	1.05
More than 1.5 HPPD				
NEWS on admission	1.24	<0.001	1.23	1.25
SHMI Risk score	1.82	<0.001	1.78	1.87
Emergency	1.10	0.390	0.88	1.37
Admissions per RN>125% of ward mean	1.04	0.055	1.00	1.09
Admissions per NA>125% of ward mean	1.00	0.988	0.96	1.04
RN staffing below ward mean	1.03	0.016	1.01	1.05
NA staffing below ward mean	1.05	<0.001	1.03	1.08
Days with more than 1.5 HPPD temporary RN staffing	1.12	0.006	1.03	1.21
Days with more than 1.5 HPPD temporary NA staffing	1.05	0.003	1.02	1.08