Centre for Innovation and Leadership in Health Sciences

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Nurse staffing levels, missed vital signs observations and mortality in hospital wards: modelling the consequences and costs of variations in nurse staffing and skill mix

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Prepared for the RCN International Research Conference, Oxford UK April 6-8 2017

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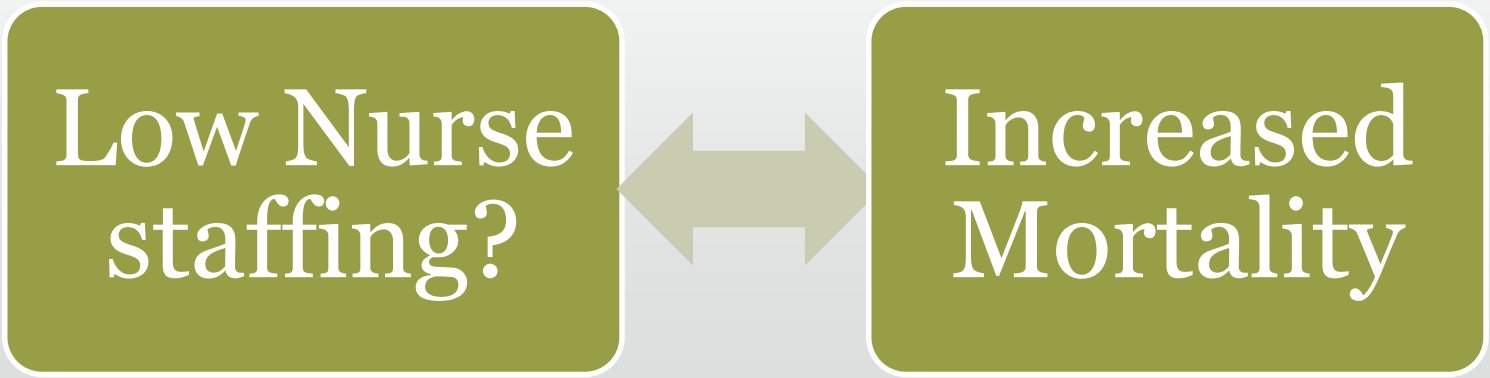
This paper presents independent research funded by the National Institute for Health Research NIHR Health Services & Delivery Research programme (grant number 13/114/17).

The views expressed are those of the author and not necessarily those of the NHS, the NIHR or the Department of Health

Background

- Failure to ensure adequate nurse staffing levels implicated in NHS failures
  - Mid staffs
  - Keogh review
- NICE safe staffing guidelines identified limited direct evidence to guide staffing decisions

- Many studies show an association between nurse staffing levels on hospital wards and patient safety outcomes: primarily mortality.
- Causal relationship is unclear
  - Most studies are cross sectional
  - No direct measures of nursing care / causal path
  - Cause can only be partial



Missed care: the missing link?

- "Missed care" is hypothesised as a mechanism by which short staffing affects outcomes
- *Specifically missed or delayed opportunities to identify and intervene when patients deteriorate*
  - Holds promise as a safe staffing indicator (NICE)
- Research exploring missed care largely limited to (nurse) self report
- Increasingly, electronic recording of nursing activities may allow us to fill the gap…

Aims

- …to provide a basis for identifying the nurse staffing levels and skill mix required to ensure adequate patient surveillance
  - Examine the relationship between ward nurse staffing and adverse events assessed in terms of cardiac arrest calls, unanticipated ICU admissions and mortality.
  - Explore whether associations between nurse staffing and missed observations can provide a useful indicator of workforce adequacy to

Methods

- Single-site retrospective longitudinal observational study using routine data
- General medical surgical wards in a large (800 bed) general hospital (NHS Trust)
- Database linking patient details, vital signs observation and ward level nurse staffing at different levels.
    - Nursing Hours per patient day
    - Staffing below threshold *for that ward*

Data sources

- Electronic Rostering system, directly linked to payroll + Bank & agency shift
  - calculated HPPD
- PAS
  - Patient details, calculated patient level risk, mortality
- VitalPac
  - Derived measures of compliance with observations against a vital signs observations protocol based on an EWS

Setting and data

- 1 hospital
- 32 general medical / surgical wards including care of older people (exclusions maternity, ICU, paedicatrics)
- 1 095 study days (1st April 2012 – 31st March 2015)
- 107, 014 patients (at least 16 years old, who were admitted after study start date and discharged before study end date and spent some time on one of the study wards)
- 698, 506 staff shifts

Key independent ‘control’

- Patient route of admission (early / elective)
- Patient SHMI risk (based on age, diagnosis, comorbidity – national model)
- Patient Acuity on Admission (validated Early Warning Score based on first vital signs)
- Ward (31 dummy variables 1/0 for each ward)

Key independent variables

- Patient exposed to Low staffing (RN & HCA Hours per patient day *below the mean for the ward in*) during first five days of stay (cumulative sum)
- Nurse staffing level relative to ward mean (+/- NHPPD)
- *High patient turnover relative to staffing (admission per nurse >125% of mean for ward)*
- *Patient exposed to high bank and agency staff (1.5 hours or more per patient day)*

Outcomes

- Patient: died vs discharged alive
- Ward (day) number of vital signs observations late vs ‘on time’ (ie within 2/3 of the time until *next* observation due
  - e.g if the EWS scheduled an observation in 1 hour the observation was classified as *missed* once 1 hour 40 minutes had elapsed

Patient profile

- Age: (median/IQR): 61 (33.3) Gender M/F: 53%/47% Number of patients: 107 014
- Admissions: 82% emergency, 18% elective
- Overall mortality: 4% (Elective admissions < 1% Emergency 5%)
- Total length of stay (median/IQR): 2.1 (4.5)
- Charlson Co-morbidity index (median/IQR): 0 (8)
- Number of different SHMI groups represented: 138
- Number of different medical/surgical admission specialties: 60

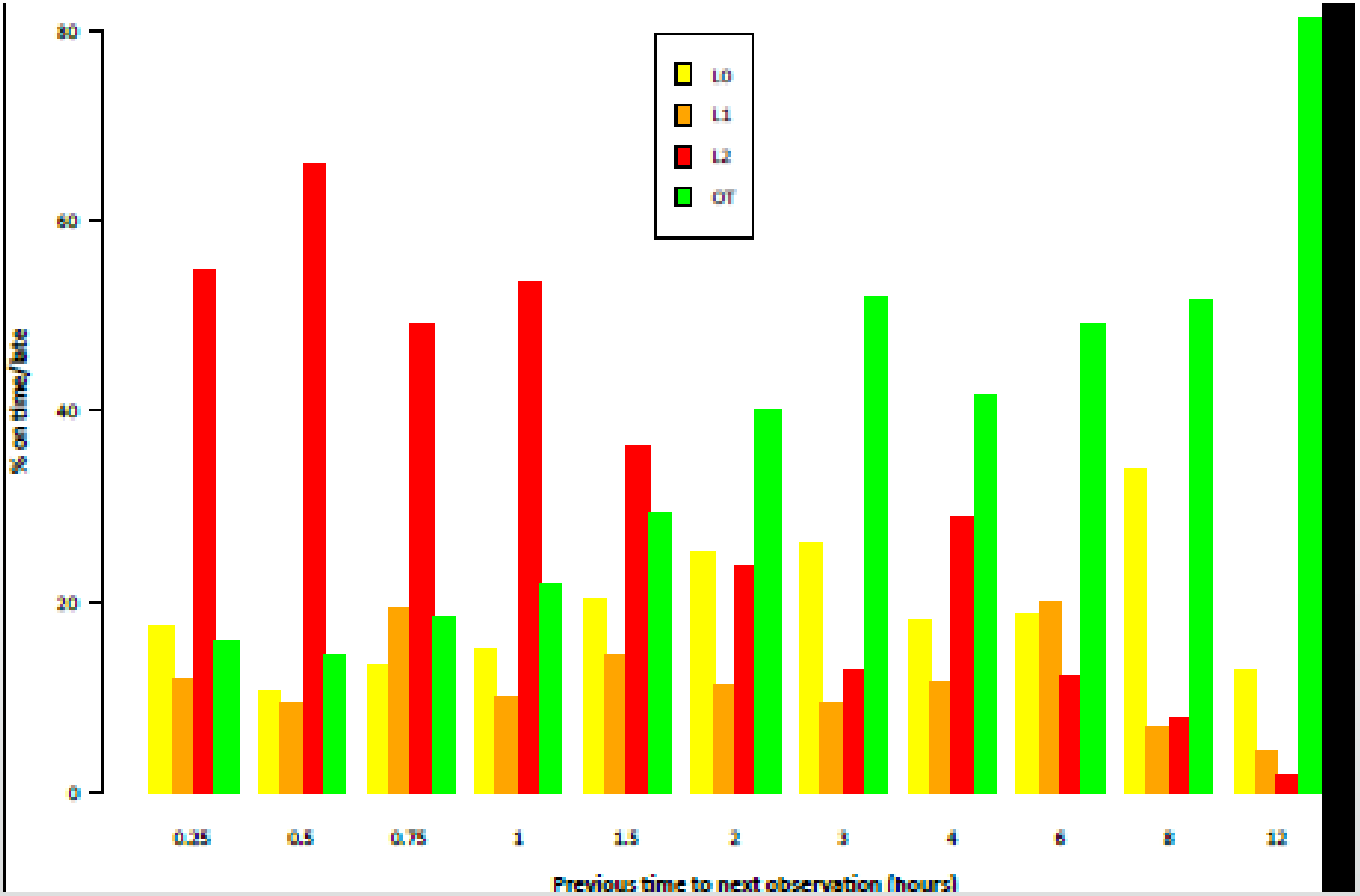
Staffing levels

- 4.7 RN HPPD Unweighted average (ward level)
  - approx. 5.6 patients per nurse
    - Respiratory 8.2
    - Renal High care 2.5

1.4 HCA HPPD Unweighted average (ward level)

- approx. 8.6 patients per HCA
  - CCU 17.2
  - Older people medicine 5.6

Missed Observations (by acuity / frequency category)



Survival analysis

Effects of staffing in the first 5 days

	HR	p	LCL	UCL
Low RN staffing (below ward mean per day)	1.03	0.015	1.01	1.05
Low HCA staffing (below ward mean per day)	1.04	0.001	1.02	1.07
High admissions per RN (>125% mean per day)	1.05	0.019	1.01	1.10
High admissions per HCA (>125% mean per day)	1.00	0.820	0.95	1.04

Controlling for ward, Acuity (first EWS), emergency admission & SHMI risk

Temporary staffing

	HR	p	LCL	UCL
Days with more that 1.5 temp RN Hours per patient day	1.12	0.006	1.03	1.21
Days with more that 1.5 temp HCA Hours per patient day	1.04	0.023	1.01	1.07
Low RN staffing (below mean per day)	1.03	0.023	1.00	1.05
Low HCA staffing (below mean per day)	1.05	0.000	1.02	1.07
High admissions per RN (>125% mean per day)	1.05	0.038	1.00	1.09
High admissions per HCA (>125% mean per day)	1.00	0.907	0.96	1.04

Controlling for ward, Acuity (first EWS), emergency admission & SHMI risk

Survival analysis

Missed observations (in high acuity patients EWS≥6 – 4 hourly or more frequent observations)

Variable	IRR	UCL	LCL	p-value
RN HPPD	0.98	0.998	0.965	0.026*
HCA HPPD	0.99	1.019	0.971	0.678
Turnover (APN)	1.0	1.010	0.985	0.660
Nursing/HCA Interaction	1.0	1.004	0.996	0.943

- Current missed obs (median) 40%
- Adding an additional 2 RNHPP on average would be associated with a drop to 38.5%

Missed vital signs as a mediator?

Limitations

- Hours include supervisory time, breaks
- Non recording of staff redeployments
- Strengths
  - Few previous studies show prospective relationships and direct link between staffing and patients at individual level

Conclusions

- Low staffing associated with missed vital signs obs and increased mortality
- Associations significant but relatively weak
- Causal evidence
  - But role of missed obs still uncertain
- Risk associated with heavy use of bank and agency
  - But ? Off set
- Risk also independently associated with low HCA staffing
- Staffing changes need to be targeted
  - But these are not the only outcomes!

Implications

- Economic analysis & mediation to come but…
  - Most missed obs are NOT down to staffing levels
  - Unlikely to be able to use absolute levels of missed obs to guide staffing decisions
  - *Changes* can act as warning sign