Observational study of the relationship between nurse staffing levels and compliance with mandatory nutritional assessments in hospital

Abstract

Background/Aims:

In the UK, it is recommended that hospital patients have their nutritional status assessed within 24h of admission using the Malnutrition Universal Screening Tool (MUST). The aim of this study was to examine the association between nurse staffing levels and missed nutritional status assessments.

Subjects/Methods:

Single centre, retrospective, observational study using routinely collected MUST assessments from 32 general adult hospital wards over two years, matched to ward nurse staffing levels. We used mixed-effects logistic regression to control for ward characteristics and patient factors.

Results:

Of 43,451 instances where staffing levels could be linked to a patient for whom an assessment was due, 21.4% had no MUST score recorded within 24h of admission. Missed assessments varied between wards (8% to 100%). There was no overall association between registered nurse staffing levels and missed assessments; although higher admissions per registered nurse were associated with more missed assessments (OR 1.09, $p = 0.005$). Higher Health Care Assistant staffing was associated with lower rates of missed assessments (OR 0.80, $p < 0.001$). There was a significant interaction between registered nurses and health care assistants staffing levels (OR 0.97, $p = 0.011$).

Conclusions:

Despite a written hospital policy requiring a nutritional assessment within 24h of admission, missed assessments were common. The observed results show that compliance with the policy for routine MUST assessment within 24h of hospital admission is sensitive to staffing levels and workload. This has implications for planning nurse staffing.

Introduction

The UK's National Institute for Health and Care Excellence (NICE) defines malnutrition as 'a state in which a deficiency of nutrients such as energy, protein, vitamins and minerals causes measurable adverse effects on body composition, function (including social and psychological) and clinical outcome'[1]. The British Association for Parenteral and Enteral Nutrition (BAPEN) has reported that the overall mean prevalence of malnutrition in admissions to hospitals in the UK is approximately 30%, being higher in patients admitted as an emergency[2]. Malnutrition is associated with longer hospital lengths of stay; increased rates of complications, mortality and hospital readmission[3-5]; and increased overall healthcare costs[5].

Malnutrition is an under-recognised and often under-treated problem[6-9]. Consequently, the National Institute for Health and Care Excellence (NICE) recommends that all hospital inpatients should be screened on admission for malnutrition and the risk of malnutrition using a validated tool such as the Malnutrition Universal Screening Tool[1,10]. Thereafter, inpatients nutritional status should be re-assessed on a weekly basis. MUST is a five-step screening tool which uses body mass index (BMI), a measure of recent unintentional weight loss and the likelihood of future reduced nutritional intake to calculate a MUST score[10], which stratifies malnutrition risk and is then used to direct subsequent care plans for the patient.

Nurses have a vital role in the nutritional assessment of patients admitted to hospital and a responsibility to ensure that patients' nutritional needs are met[11-13]. However, nutritional assessment is but one competing aspect of patient care required of nurses. Research suggests that the quality of patient care on hospital wards deteriorates when there is understaffing[14]. Much less attention has been paid to the mechanisms by which nurse staffing might be linked to the risk of adverse outcomes and the underlying care processes are largely unexamined[15]. However, nurses self-report that aspects of fundamental care including patient assessment and nutrition are more likely to be omitted when nurse staffing is low[14]. For many years, UK guidance for nutritional screening standards is that it should be conducted at initial contact on admission to hospital and then on an ongoing basis[16, 17]. The nutrition policy at the study hospital expects adult in-patients to be screened using MUST within 24h of

admission[18]. Consequently, the aims of this single centre study were to examine the association between levels of nurse staffing and the timely completion of a nutritional assessment.

Methods

Study design and setting

This study formed part of a larger retrospective, longitudinal, observational study of 32 medical and surgical wards in a single large (~800 beds) acute National Health Service (NHS) hospital in the South of England [award details blinded for peer review], for the period 1 April 2012 to 31 March 2015 (hereafter referred to as the 'main' study)[19]. The study was approved by the [blinded for peer review].

The study hospital provides acute services to approximately 650,000 people. It has approximately 5,500 staff and provides all acute services except burns, spinal injury, neurosurgical and cardiothoracic surgery. The hospital's registered nurse (RN) staffing complement is typical of similar sized organisations, with planned daytime staffing varying between wards from four or fewer patients per RN to eight patients per RN.

Data sources

We obtained information relating to patients (e.g. demographics, admission and discharge data, ward transfers, patient outcomes) from the hospital's Patient Administration System (PAS) and used these to calculate bed occupancy and the number of admissions per ward. Data relating to the timing of MUST assessments and their values were obtained from Vitalpac - a bedside electronic software system in routine use in the hospital for the time-stamped documentation of vital signs, MUST scores and other patient variables (System C Healthcare Ltd, Maidstone, Kent)[20]. Vitalpac uses collected raw vital signs data to calculate a National Early Warning Score (NEWS) value (range 0-20), which corresponds to the patient's severity of illness[21]. For the purposes of evaluating the relationship between nurse staffing and missed nutritional assessments, we used NEWS values to identify higher acuity patients (patients with NEWS value $\geq$3).

We derived nurse staffing levels at the hospital from two electronic data sources. For standard contractual shifts, the date, location and the number of hours and grade of each nurse for every shift were extracted from the hospital's electronic rostering system. For bank (extra contractual work by staff employed by the hospital) and agency (staff employed through an external agency) shifts, similar data were a second separate source database. Data for shifts worked by student nurses were not available for analysis since in the UK student nurses are considered supernumerary (Nursing and
Midwifery Council 2010 Standards for Pre-registration Nursing Education) and are not intended to contribute to the ward workforce. We considered shifts worked on adult medical and surgical wards including admissions units and care of older people. Intensive care unit (ICU) was not considered because staffing levels differ from that on general wards and vital signs are recorded on a different electronic system as elsewhere in the hospital. We did not consider paediatric or maternity services for similar reasons (See Figure 1 for a breakdown of records excluded due to eligibility).

Identifiable information for patients and staff was removed at source and internal identifiers were anonymised prior to data transfer to the research database.

The study hospital's policy of requiring adult in-patients to be screened using MUST within 24h of admission came into force in February 2013. Therefore, for the purposes of investigating the relationship between nurse staffing and MUST assessments, we only considered data from 1 April 2013 to 31 March 2015 (See Figure 1 Patient records for MUST assessment & Figure 2 Observation records flowcharts).

Data linkage

For each day of the study, we linked nursing shifts to MUST assessments and admission data using ward location identifiers and Vitalpac time stamps. For each ward, we calculated daily patient occupancy and staffing levels. A theoretical total of 23,360 ward days (365 days x 2 years x

32 wards) was available during the study period. Data from ward days where the patient census fell below 25% of the ward median (usually where one or more of the wards was closed or where patient records and staffing could not be matched) were excluded from further analyses as follows: accounting for (n=1,195) ward closures, 22,165 days of data were potentially available for analysis. After excluding days with low patient census and code mismatches between PAS and electronic staffing roster (n=2,863), a total 19,302 ward-days of data (83%) were included in the analysis. We were unable to link the staffing roster to the specific staff member undertaking the MUST assessments as no standard identifier was available.

Outcome

For each patient, the primary outcome of the study was a failure to document a MUST value in the Vitalpac system within 24h of admission to hospital. We termed this a missed nutritional assessment.

Staffing levels

For each study day on each ward, we calculated the average staffing levels in Hours per Patient Day (HPPD) for both RNs and Health Care Assistants (HCA). Registered nurses are qualified nurses on the Nursing and Midwifery Council Register with university diploma or degree level qualification or equivalent. Health care assistants are nursing assistant personnel with no formal training requirements or registration, typically employed in posts within NHS pay bands 2-3. In order to calculate HPPD we divided the total number of nursing hours worked by the daily bed occupancy for the ward. We calculated daily bed occupancy from the PAS database. A value of one indicates a single bed being occupied continuously for one day. A HPPD of 24 indicates one-to-one nursing. To account for variations in other aspects of nursing workload, we derived two variables - 'patient turnover', calculated by dividing total daily RN staffing in days by the number of new admissions; and an 'acuity variable', this is, the proportion of observations with a NEWS value ≥3, i.e. higher acuity.

Statistical methods

We used mixed-effects logistic regression to examine the relationship between nurse staffing and missed nutritional assessments, controlling for the ward characteristics and patient factors, and accounting for unobserved heterogeneity at the patient and ward levels. All summary measures are reported using median and interquartile range, unless otherwise stated. We removed the co-variate 'admissions per HCA' from our modelling when preliminary testing as part of the main study[19] confirmed that it was not a significant predictor in missed care models.

Analyses were undertaken using the R statistical environment v3.517 and mixed-effects models were fit using the gamlss package[22]. The extent to which the labour inputs from one group might substitute for the other was considered by modelling the effect of each staff group separately. Our interest in a possible interaction between the two main staffing variables (RN and HCA HHPD) in which health care assistants might act as labour complements to enhance the effectiveness of registered nurses was tested by adding a linear interaction term between RN and HCA staffing levels to the model.

Results

From the database of the main study[19], we identified 43,451 instances where it was possible to link staffing levels to a patient for whom a nutritional screening assessment was due within 24h of first admission. Of this group, only 34,139 (78.6%) had a MUST score recorded within 24h of hospital admission. Consequently, the number of missed nutritional assessments was 9,312 (21.4%).

Missed nutritional assessments varied across the hospital from 100% (Rehabilitation - neurological ward) to 8% (surgical – gynaecology; surgical - admissions and medical/ surgical wards) (Figure 3). However, some wards had very few direct hospital admissions and were rarely required to undertake a patient's first MUST assessment.

Whilst there was no overall association between RN staffing levels and timely nutritional screening, shifts with higher patient admissions per registered nurse were associated with more missed assessments (Table 1). However, higher HCA HPPD were associated with lower rates of missed nutritional assessments in the first 24h after hospital admission. Table 1 also demonstrates a significant interaction between RN HPPD and HCA HPPD. In order to understand this interaction we plotted the effect of adding RN HPPD for different levels of HCA HPPD (Figure 4). The rate of missed MUST assessments falls as both HCA HPPD and as RN HPPD increases, however, additional RN HPPD has a more pronounced effect when HCA HPPD is low, but this reduces as HCA HPPD increases.

Discussion

To our knowledge this study is the first to examine the relationship between nurse staffing levels and missed nutritional assessments in hospital admissions. The results show that despite a hospital policy that requires a nutritional assessment is undertaken in adult in-patients within 24h of admission[18], missed or delayed assessments were common. In addition, the percentage of missed assessments varied between wards. The results show that nutritional risk assessments are less likely to take place when nurse staffing is low or demand is high. However, there was also evidence that the effects of low RN staffing are moderated by higher levels of HCA staffing, suggesting that health care assistants may act as a substitute for registered nurses.

Major strengths of the study were that data were obtained from a large, three-year dataset of routinely collected vital signs observation sets and nurse staffing records, recorded in standard electronic formats that were easily interrogated[19]. We used a repeatable, objective outcome of missed nutritional assessment based on compliance with the study hospital's nutrition policy, which was easily retrievable from the hospital's electronic records. Although there have been many studies exploring associations between nurse staffing levels and omissions in care, almost all of these have been cross-sectional hospital / unit level studies and have relied on nurse self-report[23]. Furthermore, none of the studies have focussed on nutritional care.

There are several limitations to the study. It is observational and relies on data from a single acute hospital, where several hospital wards were excluded (e.g. maternity, paediatric, intensive care unit), making transferability of the results difficult. Although every measure was taken to match patient census with staff deployed on the wards, there were limitations in the accuracy of our nurse staffing data because internal redeployments are not recorded at the study hospital. This would tend to attenuate any observed effect of staffing levels because on occasion, some wards with apparently high staffing had donated staff to wards with apparently low staffing. In addition, we were unable to measure actual staffing levels against staffing requirements on a shift-by-shift basis; however, the ward random effects account for differences in average demand by ward (since staffing is planned to reflect patient acuity and dependency). Although our model allowed us to control for patient, ward and staffing factors, the method not readily permit exploration of the nature and causes of differences between wards.

Our finding that 21.4% of nutritional assessments were outstanding 24h after hospital admission is consistent with international findings. For instance, Tangvik et al. reported an average of 27% of nutritional assessments in 14 hospital departments in a single Norwegian hospital were not completed[24] and, in a five-year, three-centre study from the UK, over 20% of patients remained unscreened 24h after hospital admission[25]. However, neither of these compared missed observations with staffing levels.

There is increasing research evidence that low RN staffing is associated with missed nursing care in hospitals[14, 15, 26] and an increased risk of in-hospital death[27] but the precise mechanism for these associations is far from certain and most studies of omitted care have relied on nurses to self-report, which is subject to potential bias and error. Recent research by our group has shown that the adherence to a hospital's vital signs monitoring protocol appears to be sensitive to levels of RN and HCA staffing[28], whilst RN staffing levels are associated with a failure to respond to patients with significant physiological disturbance[29]. In the current study, higher HCA staffing levels were associated with lower rates of missed nutritional assessments. However, there is also a suggestion that the association between RN staffing levels and timely MUST assessments is stronger when HCA staffing is low, perhaps implying that, when HCA staffing levels are higher, health care assistants are

substituting for registered nurses, with registered nurses released to undertake other responsibilities. Overall, the current finding of a relationship between nurse staffing levels and missed nutritional assessments in hospital admissions further strengthens the hypothesis that staffing levels are linked to patient outcomes partly through omissions in care.

The wide variation of missed nutritional assessments has implications for hospital policy and the implementation of nutritional screening across hospital wards. Although our findings demonstrate that staffing levels could be an important factor there is also a clear need to understand the other factors underlying variation and identify those that are modifiable through education and training initiatives which highlight the impact of missed assessments, especially in more vulnerable population (e.g. Medical older people wards).

Future research in this area should explore the reproducibility of our results in other hospitals and clinical settings. In addition, the observed variation in the percentage of missed assessments between wards provides an opportunity to confirm and research the causes of these differences. Other possible areas for study that may add further understanding of why many nutritional assessments were not done on time include the availability of all of the MUST components (e.g., the patient's weight and height) at the time that the assessment was due, the knowledge and attitudes of staff regarding the rationale or need for nutritional assessments, and what other nursing responsibilities or factors may have prevented the undertaking of assessments. Finally, it would also be relevant to investigate if there is an association between nurse staffing levels and the implementation of patient-specific nutritional interventions, as nutritional screening alone is unlikely to have an impact on patient nutrition and outcomes.

Conclusions

Despite a written hospital policy requiring a nutritional assessment within 24h of admission, missed assessments were common. The observed results show that compliance with the policy for routine assessment of MUST within 24h of hospital admission is sensitive to staffing levels and workload. This has implications for future nurse staffing.

Funding or sources of support

[blinded for peer review]

Transparency Declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported. The reporting of this work is compliant with STROBE guidelines. The lead author affirms that no important aspects of the study have been omitted and that any discrepancies from the study as planned [study registry blinded for peer review] have been explained.

Acknowledgements

To be added after review

References

1. National Institute for Clinical Excellence (NICE) (2012). Nutrition Support in Adults QS24. Quality standard Published: 30 November 2012. https://www.nice.org.uk/guidance/QS24 (accessed April 2020).
2. Russell CA, Elia M on behalf of BAPEN and collaborators (2014). Nutrition screening surveys in hospitals in the UK 2007-2011. A report based on the amalgamated data from the four Nutrition Screening Week surveys undertaken by BAPEN in 2007, 2008, 2010 and 2011. BAPEN (British Association of Parenteral and Enteral Nutrition). https://www.bapen.org.uk/pdfs/nsw/bapen-nsw-uk.pdf (accessed 20/04/2020)
3. Santarpia L, Contaldo F, Pasanisi F (2011) Nutritional screening and early treatment of malnutrition in cancer patients. *J Cachexia Sarcopenia Muscle* **2**, 27-35.
4. Kyle UG, Kossovsky MP, Karsegard VL *et al.* (2006) Comparison of tools for nutritional assessment and screening at hospital admission: A population study. *Clinical Nutrition* **25**, 409-417.
5. Elia M (2015) on behalf of the Malnutrition Action Group of BAPEN and the National Institute for Health Research Southampton Biomedical Research Centre. The cost of malnutrition in England and potential cost savings from nutritional interventions (full report). A report on the cost of disease-related malnutrition in England and a budget impact analysis of implementing the NICE clinical guidelines/quality standard on nutritional support in adults. BAPEN (British Association of Parenteral and Enteral Nutrition). https://www.bapen.org.uk/pdfs/economic-report-full.pdf (accessed April 2020)
6. Stratton R, Smith T, Gabe S. (2018) Managing malnutrition to improve lives and save money. BAPEN (British Association of Parenteral and Enteral Nutrition). https://www.bapen.org.uk/pdfs/reports/mag/managing-malnutrition.pdf (accessed June 2020)
7. Suominen MH, Sandelin E, Soini H, Pitkala KH. (2009) How well do nurses recognize malnutrition in elderly patients? *European Journal of Clinical Nutrition* **63**, 292–296.

8. Kaiser MJ, Bauer JM, Ramsch C, Uter W, Guigoz Y, Cederholm T *et al*. (2010) Frequency of malnutrition in older adults: a multinational perspective using the mini nutritional assessment. *J Am Geriatr Soc*. **58**, 1734-8.
9. Francis R. (2013) Report of the Mid Staffordshire NHS Foundation Trust Public Inquiry February 2013 Volume 3: Present and future. Annexes. The Stationery Office Limited.
10. The 'MUST' explanatory booklet. A Guide to the 'Malnutrition Universal Screening Tool' ('MUST') for Adults. (2003) Eds. Todorovic V, Russell C and Elia M on behalf of the Malnutrition Action Group (MAG), a Standing Committee of the British Association for Parenteral and Enteral Nutrition (BAPEN). VBAPEN, Worcestershire. BAPEN (British Association of Parenteral and Enteral Nutrition). https://www.bapen.org.uk/pdfs/must/must_explan.pdf (accessed June 2020)
11. Johnstone C, Farley A, Hendry C. (2006) Nurses' role in nutritional assessment and screening – Part one of a two-part series. *Nurs Times* **102**, 28-29.
12. Evans L, Best C (2015) The nurse's role in patient nutrition and hydration. *Nurs Times*. **111**, 28/29, 12-17.
13. Xu X et al. (2017) Where is the nurse in nutritional care?, *Contemp Nurse*. **53**, 267-270.
14. Griffiths P, Recio-Saucedo A, Dall'Ora C, Briggs J, Maruotti A, Meredith P et al. (2018) The association between nurse staffing and omissions in nursing care: a systematic review. *J Adv Nurs*. **74**, 1474-87.
15. Griffiths P, Ball J, Drennan J, Dall'Ora C, Jones J, Maruotti A *et al*. (2016) Nurse staffing and patient outcomes: strengths and limitations of the evidence to inform policy and practice. A review and discussion paper based on evidence reviewed for the National Institute for Health And Care Excellence safe staffing guideline development. Int J Nurs Stud. **63**, 213-5.
16. BAPEN Organisation of Food and Nutritional Support in Hospitals (2007) Ed. Powell-Tuck J. BAPEN (British Association of Parenteral and Enteral Nutrition). https://www.bapen.org.uk/ofnsh/OrganizationOfNutritionalSupportWithinHospitals.pdf (accessed April 2020)
17. Department of Health. Essence of Care 2010. Her Majesty's Stationery Office, 2010. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/216691/dh_119978.pdf (accessed April 2020)

18. Portsmouth Hospitals NHS Trust. Nutrition Policy (Adults). Available at: https://www.porthosp.nhs.uk/about-us/policies-and-guidelines/policies/Clinical/Nutrition%20Policy.pdf (accessed June 2020)
19. Griffiths P, Ball J, Bloor K, Bohning D, Briggs J, Dall'Ora C *et al*. (2018) Nurse staffing levels, missed vital signs and mortality in hospitals: retrospective longitudinal observational study. Health Serv Deliv Res **6**.
20. Smith GB, Prytherch DR, Schmidt P, Featherstone PI, Knight D, Clements G *et al*. (2006) Hospital-Wide physiological surveillance-a new approach to the early identification and management of the sick patient. Resuscitation. **71**, 19–28.
21. Royal College of Physicians. National Early Warning Score (NEWS): Standardising the assessment of acute illness severity in the NHS (2005) Report of a working party, London: RCP, 2012.
22. Rigby RA, Stasinopoulos DM. (2005) Generalized additive models for location, scale and shape. Appl. Statist. **54**, 507-554.
23. Griffiths, P., Recio-Saucedo, A., Dall'Ora, C., Briggs, J., Maruotti, A., Meredith, P., Smith, G.B., Ball, J. and Missed Care Study Group (2018) The association between nurse staffing and omissions in nursing care: a systematic review. J Adv Nurs, **74**, 1474-1487.
24. Tangvik RJ, Guttormsen AB, Tell GS, Ranhoff AH. (2010) Implementation of nutritional guidelines in a university hospital monitored by repeated point prevalence surveys. Eur J Clin Nutr. **66**, 388–393.
25. Burden ST, Brierley ER. (2014) Evaluation of adherence to a nutrition-screening programme over a 5-year period. Eur J Clin Nutr **8**, 847–852.
26. Recio-Saucedo A, Dall'Ora C, Maruotti A, Ball JE, Briggs J, Redfern OC *et al*. (2018) What impact does nursing care left undone have on patient outcomes? Review of the literature. J Clin Nurs. **27**, 2248-2259.
27. Griffiths P, Maruotti A, Recio-Saucedo A, Redfern OC, Ball JE, Briggs J *et al.* (2019) Nurse staffing, nursing assistants and hospital mortality: retrospective longitudinal cohort study. BMJ Qual Saf. **28**, 609-617.
28. Redfern O, Griffiths P, Maruotti A, Recio-Saucedo A, Smith GB, on behalf of the Missed Care Study Group (2019) The association between nurse staffing levels and the timeliness of vital signs monitoring: a retrospective observational study. BMJ Open **9**, e032157.

29. Smith GB, Redfern O, Maruotti A, Recio-Saucedo A, Griffiths P on behalf of the Missed Care Study Group (2020) The association between nurse staffing levels and a failure to respond to patients with deranged physiology: a retrospective observational study in the UK. Resuscitation **149**, 202-208.

Figure Legends

Figure 1: Patient Administration System records for MUST assessment flowchart

Figure 2: Vitalpac observation records for MUST assessments flowchart

Figure 3: Nutritional risk assessments within 24h of admission, by ward

Figure 4: Interaction between Registered nurse and Healthcare Assistant Hours Per Patient Day (HPPD) and missed nutritional assessment

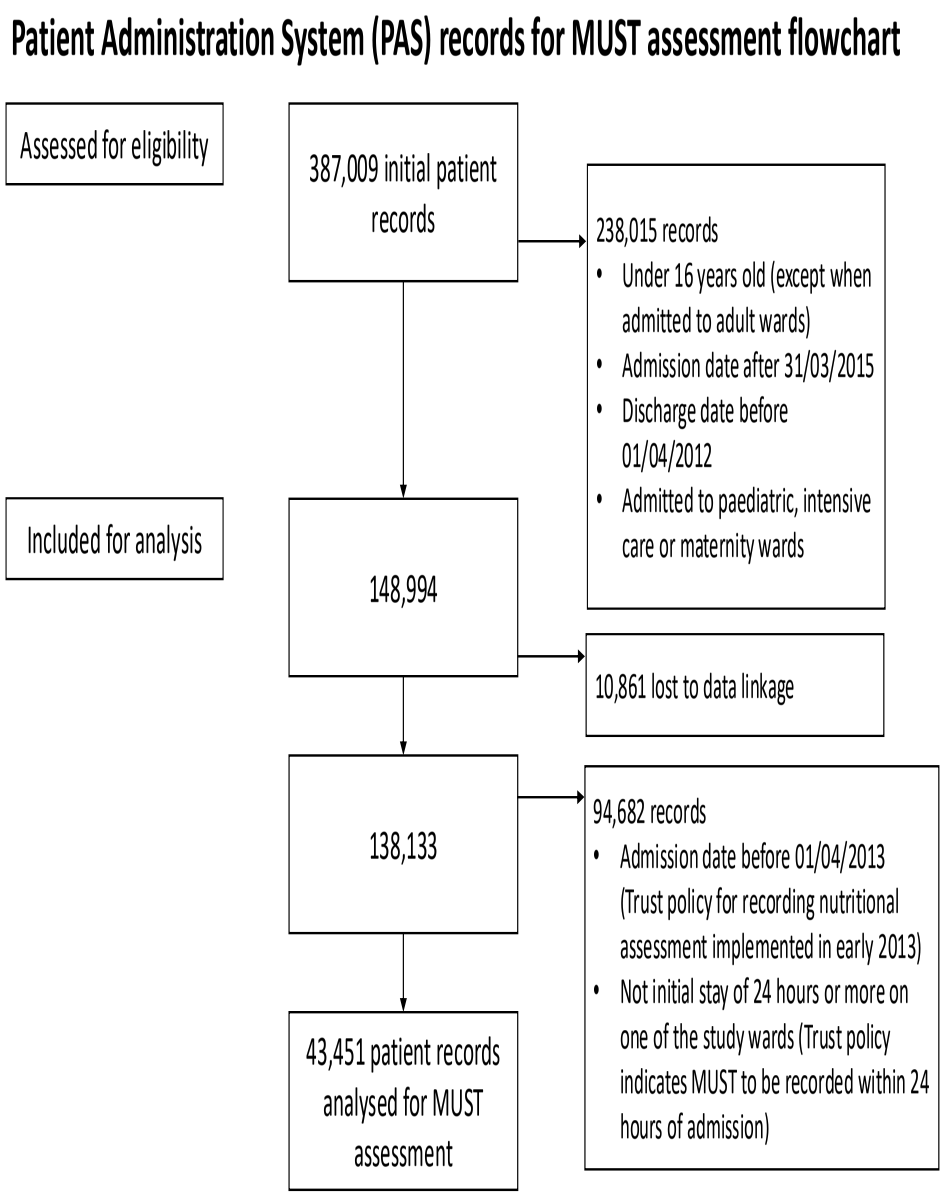
Patient Administration System (PAS) records for MUST assessment flowchart
Assessed for eligibility
387,009 initial patient records
238,015 records
• Under 16 years old (except when admitted to adult wards)
• Admission date after 31/03/2015
• Discharge date before 01/04/2012
• Admitted to paediatric, intensive care or maternity wards
Included for analysis
148,994
10,861 lost to data linkage
138,133
94,682 records
• Admission date before 01/04/2013 (Trust policy for recording nutritional assessment implemented in early 2013)
• Not initial stay of 24 hours or more on one of the study wards (Trust policy indicates MUST to be recorded within 24 hours of admission)
43,451 patient records analysed for MUST assessment

FIGURE 1

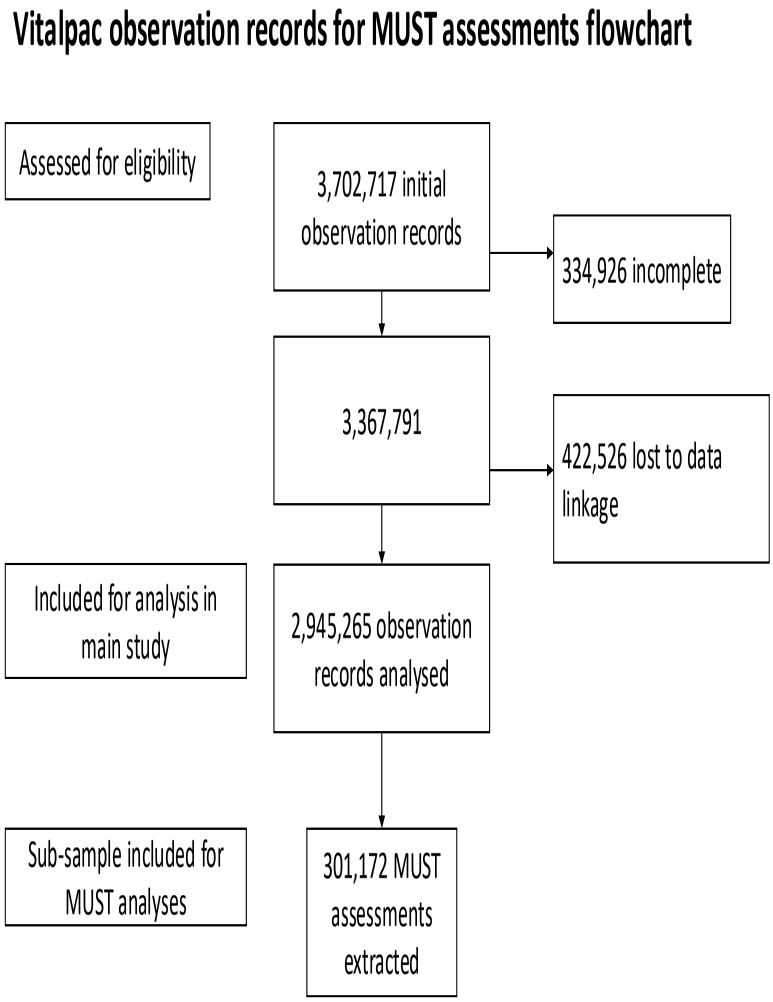
Vitalpac observation records for MUST assessments flowchart
Assessed for eligibility
3,702,717 initial observation records
334,926 incomplete
3,367,791
422,526 lost to data linkage
Included for analysis in main study
2,945,265 observation records analysed
Sub-sample included for MUST analyses
301,172 MUST assessments extracted

FIGURE 2

FIGURE 3

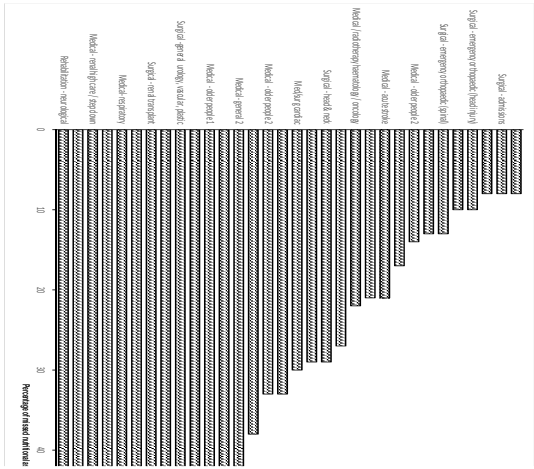
Rehabilitation - new patient
Medical - multiple injuries / polytrauma
Medical - respiratory
Surgical - neck of femur
Surgical - upper GI bleed / varices
Medical - other specialty 1
Medical - general 2
Medical - other specialty 2
Medical - hepatic
Surgical - bowel / gut
Medical / rheumatology / endocrinology
Medical - acute medicine
Medical - other specialty 3
Surgical - emergency vascular (non-aortic)
Surgical - emergency vascular (aortic)
Surgical - colorectal
0
10
20
30
40
Percentage of raised rank if male

FIGURE 4

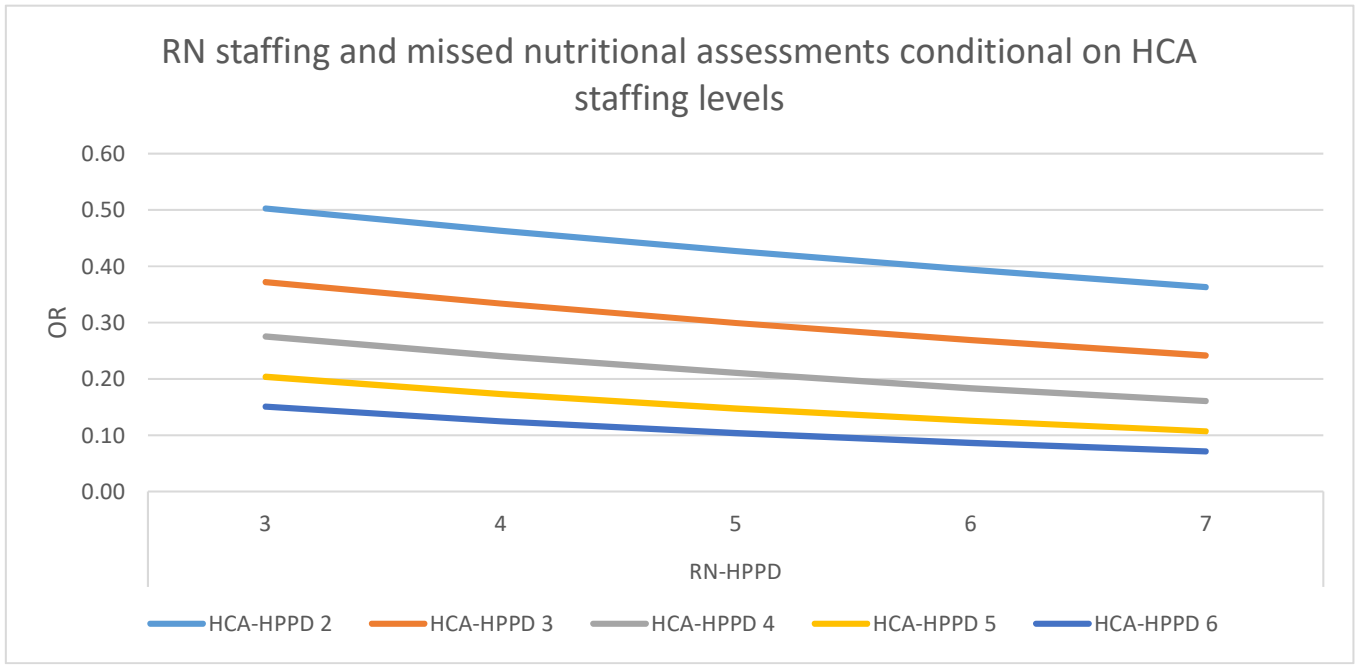
RN staffing and missed nutritional assessments conditional on HCA staffing levels
0.60
0.50
0.40
0.30
0.20
0.10
0.00
OR
3
4
5
6
7
RN-HPPD
HCA-HPPD 2
HCA-HPPD 3
HCA-HPPD 4
HCA-HPPD 5
HCA-HPPD 6

TABLE 1

Variable	OR (95% CI)	p-value
RN HPPD	0.97 (0.94 - 1.01)	0.107
HCA HPPD	0.80 (0.77 – 0.84)	< 0.001
Admissions per RN	1.09 (1.03 – 1.15)	0.005
RN x HCA	0.97 (0.95 – 0.99)	0.011