Supplementary Material File 1

[Table 85: Literature review for new studies: sources and brief summary ii](#_Toc17363138)

Literature review papers

Table 85: Literature review for new studies: sources and brief summary

|  | **Source / Reference** | **Main Theme** | **Single centre?** | **Key Points** | **Type of measure** |
| --- | --- | --- | --- | --- | --- |
| 1 | Beswick, S., *et al*. (2010). "Comparison of nurse workload approaches." Journal of Nursing Management **18**(5): 592-598. | Comparison | Single (2 units) | Compared workload measures based on simple HPPD with midnight census vs intra-day measures (no significant difference) vs measure including turnover (significantly increased HPPD) | patient volume |
| 2 | Rivera, K. (2017). A Comparison of a Standardized Method of Identifying Nursing Staff Needs with Measures of Nursing Staff Needs by Patient Acuity. Ann Arbor, The William Paterson University of New Jersey. **10637025:** 58. | Comparison | Single (?) | Compared staffing requirement based on HPPD vs an acuity measure | SNCT / patient volume |
| 3 | Simon, M., *et al*. (2011). "Midnight census revisited: Reliability of patient day measurements in US hospital units." International Journal of Nursing Studies **48**(1): 56-61. | Comparison | Multi (54 Hospitals, 260 Units) | Compared different patient count methods used in calculation hours per patient day and found that while agreement between methods was high there was some evidence of bias but midnight census did not differ substantially from the 'gold standard' (multiple census approach) | patient volume |
| 4 | Fagerström, L., *et al*. (2014). "The RAFAELA system: a workforce planning tool for nurse staffing and human resource management: Lisbeth Fagerström and colleagues describe a method pioneered in Finnish hospitals that aims to uphold staffing levels in accordance with patients’ care needs." Nursing Management 21(2): 30-36. | Description | N/A | Descriptive report which includes some example data from the use of the RAFAELA system | **indicator / professional judgement** |
| 5 | Fenton, K. and A. Casey (2015). "A tool to calculate safe nurse staffing levels." Nursing Times **111**(3): 12-14. | Description | N/A | Descriptive report on the use of the SNCT | SNCT |
| 6 | Kolakowski, D. (2016). "Constructing a nursing budget using a patient classification system." Nurs Manage **47**(2): 14-16. | Description | N/A | Simple description of setting a budget from an unspecified patient classification system. | unspecified PCS |
| 7 | The Shelford group (2014). Safer Nursing Care Tool Implementation Resource Pack, The Shelford Group. | Description | N/A | Manual describing the use of the SNCT. Includes a broad description of the volume of observations that underlie the care multipliers that have been developed  | SNCT |
| 8 | Smith, S., *et al*. (2009). "Developing, testing and applying instruments for measuring rising dependency-acuity's impact on ward staffing and quality." International Journal of Health Care Quality Assurance 22(1): 30-39. | Description & evaluation | Multi (3 hospitals) | Describes the use and development of the SNCT (then AUKUH) instrument including comparison with an existing dependency measure (Crobach's alpha .99)  | SNCT |
| 9 | Taylor, B., *et al*. (2015). "Evaluating the Veterans Health Administration's Staffing Methodology Model: A Reliable Approach." Nursing Economics 33(1): 36-40, 66. | Description & evaluation | N/A | Qualitative evaluation of feedback (broadly positive) on a formal professional judgement and benchmarking based staffing review approach. | professional Judgement |
| 10 | Hurst, K. (2008). "UK ward design: Patient dependency, nursing workload, staffing and quality--An observational study." International Journal of Nursing Studies **45**(3): 370-381. | Descriptive study  | Multi centre (40 hospital / 375 wards) | Calculated average workload associated with various hospital ward designs using Hurst's acuity / dependency / quality measure concluding that some ward designs were associated with higher workloads than others | SNCT |
| 11 | Hurst, K. (2009). Nursing and payment By Results: Understanding the Cost of Care (RCN Policy Briefing: 11/2009). London, Royal College of Nursing. | Descriptive study  | Multi centre (10 hospital / 40 wards) | Calculated average nursing costs associated with various Health Resource Groups (diagnoses) using Hurst's acuity / dependency / quality measure | SNCT |
| 12 | Ferguson-Paré, M. and A. Bandurchin (2010). "The Ontario nursing workload demonstration projects: Rethinking how we measure, cost and plan the work of nurses." Nursing Leadership **23**(Special Issue). | Development | Multi centre (3 sites / 6 units) | Early stage work determining factors to be considered in a staffing system, including timing studies across 12 broad activity areas | indicator |
| 13 | Hurst, K., *et al*. (2008). "Calculating staffing requirements." Nursing Management 15(4): 26-34. | Development & evaluation | Multi-center (3 hospital 16 'care groups') | Describes development and validation of the AUKUH multipliers (determined by professional judgement) by rating against an existing categorisations scheme with underlying observations of time to deliver care on high quality wards | prototype / professional judgement |
| 14 | Hoi, S. Y., *et al*. (2010). "Determining nurse staffing needs: the workload intensity measurement system." Journal of Nursing Management **18**(1): 44-53. | Development & comparison | Single (1500 beds) | Developed an indicator system based on care times associated with a range of nursing diagnoses + associated activities & used this to identify staffing requirements compared to those from a previous (unreported) study. | indicator |
| 15 | Brennan, C. W., *et al*. (2012). "The oncology acuity tool: a reliable, valid method for measuring patient acuity for nurse assignment decisions." Journal of Nursing Measurement 20(3): 155.  | Development & evaluation | Single (1 Unit) | Describes the development of a multi-factor acuity measure + content validation, reliability testing and validation by measures of association with outcome and a direct nurse assessment (expert judgement) of acuity | indicator / professional judgement |
| 16 | Perroca, M. G. (2013). "The new version of a patient classification instrument: assessment of psychometric properties." Journal of Advanced Nursing **69**(8): 1862-1868. | Development & evaluation | Single (10 Units) | Assessed inter-rater reliability and factor structure of a multi-item PCI . Weighted Kappa showed strong agreement | indicator  |
| 17 | Morales-Asencio, J. M., *et al*. (2015). "Design and validation of the INICIARE instrument, for the assessment of dependency level in acutely ill hospitalised patients." Journal of Clinical Nursing **24**(5-6): 761-777. | Development & evaluation | Multi (2 hospitals) | Reports the development of an Instrument based on NOC with reports of inter item correlation and validation by correlation with the Barthel Index. | indicator  |
| 18 | Larson, E. L., *et al*. (2017). "Assessing Intensity of Nursing Care Needs Using Electronically Available Data." Comput Inform Nurs 35(12): 617-623. | Development & evaluation | Single (whole hospital) | Development of a system drawing on data from electronic systems including procedures to develop an intensity index, used professional judgement of nursing care intensity as the criterion measure (showing high correlation) | indicator / professional judgement |
| 19 | Baernholdt, M., *et al*. (2010). "Using clinical data to capture nurse workload: implications for staffing and safety." CIN: Computers, Informatics, Nursing **28**(4): 229-234. | Development | Single (whole hospital) | Describes a measure based on routine clinical data including patient numbers, turnover (admissions and discharges) | patient volume |
| 20 | Gabbay, U. and M. Bukchin (2009). "Does daily nurse staffing match ward workload variability? Three hospitals' experiences." International Journal of Health Care Quality Assurance 22(6): 625-641. | Development / descriptive study  | Multi centre (3 sites / 40 units) | Tracked workforce / workload using simple nurse to patient measures to demonstrate variability in demand and capacity. Intended as preliminary to developing workload management systems | patient volume |
| 21 | De Cordova, P. B., *et al*. (2010). "Using the nursing interventions classification as a potential measure of nurse workload." Journal of Nursing Care Quality **25**(1): 39. | Development | N/A | Consensus exercise on timings associated with NIC domains / interventions | timed task |
| 22 | Myny, D., *et al*. (2010). "Determination of standard times of nursing activities based on a Nursing Minimum Dataset." Journal of Advanced Nursing **66**(1): 92-102. | Development | Multi (18 hospitals 48 units) | Established standard times for 102 nursing activities based on observations and self-report | timed task |
| 23 | Myny, D., *et al*. (2012). "Determining a set of measurable and relevant factors affecting nursing workload in the acute care hospital setting: a cross-sectional study." International Journal of Nursing Studies **49**(4): 427-436. | Development | N/A | Assessed a wide number of factors influencing nursing workload (other than acuity) in the context of developing a workload measure. Most important factors increasing workload are interruptions and patient turnover | timed task |
| 24 | Myny, D., *et al*. (2014). "Validation of standard times and influencing factors during the development of the Workload Indicator for Nursing." Journal of Advanced Nursing **70**(3): 674-686. | Development & evaluation | Multi (4 hospitals 23 units) | Reports cross validation of a measure based on a NMD with nurses direct recording of care time. Found high correlations but significant differences between time as estimated from the two measures | timed task |
| 25 | Brennan, C. W. and B. J. Daly (2015). "Methodological challenges of validating a clinical decision-making tool in the practice environment." Western Journal of Nursing Research 37(4): 536-545. | Evaluation | Single (1 Unit) | Reports on 'methodological challenges' encountered in developing a new tool but content is largely based on perspectives of potential end uses on aspects of the tool including necessary content.  | indicator |
| 26 | Fagerstrom, L., *et al*. (2018). "Nursing workload, patient safety incidents and mortality: an observational study from Finland." BMJ Open 8(4): e016367. | Evaluation | Multi -centre (4 hospitals / 36 units) | Looked at association between OPC per nurse (RAFAELA system) and safety incidents. Showed odds of patient safety incident was increased when staffing was below optimal. However it was decreased by staffing above optimal however effect sizes and model fit were only marginally better than patient/nurse ratios. | indicator / patient volume / professional judgement |
| 27 | Twigg, D., *et al*. (2011). "The impact of the nursing hours per patient day (NHPPD) staffing method on patient outcomes: a retrospective analysis of patient and staffing data." International Journal of Nursing Studies 48(5): 540-548. | Evaluation | Multi (3 hospitals) | Before and after study of implementation of NHPPD method to determine nurse staffing in W. Australian Hospitals. Implementation of staffing according to the system was associated with an increase in staff and reduced mortality | patient volume |
| 28 | van Oostveen, C. J., *et al*. (2016). "Pre-implementation studies of a workforce planning tool for nurse staffing and human resource management in university hospitals." Journal of Nursing Management **24**(2): 184-191. | Evaluation | Multi (2 hospitals 12 wards) | Implementation study of the RAFAELA system found low agreement (absolute) on OPCS measures in some settings and poor completion of the PAONCIL instrument required to determine optimal intensity. Nurses evaluations were mixed | indicator / professional judgement |
| 29 | Junttila, J. K., *et al*. (2016). "Hospital mortality and optimality of nursing workload: A study on the predictive validity of the RAFAELA Nursing Intensity and Staffing system." International Journal of Nursing Studies **60**: 46-53. | Evaluation  | Multi centre (2 hospital / 34 units) | Looked at association between OPC per nurse (RAFAELA system) and mortality. Showed odds death were increased when staffing was below optimal. However it was decreased by staffing above optimal | indicator / professional judgement |
| 30 | Liljamo, P., *et al*. (2017). "Quality of nursing intensity data: inter‐rater reliability of the patient classification after two decades in clinical use." Journal of Advanced Nursing 73(9): 2248-2259. | Evaluation  | Single (32 units) | Inter-rater reliability using OPC (RAFAELA system) showing moderate agreement on overall OPC category although weighted kappa shows strong agreement. Some sub scales show fair agreement only but again generally weighted kappas indicate substantial agreement | indicator  |
| 31 | Griffiths, P., *et al*. (in press). "Nurse staffing levels, missed vital signs observations and mortality in hospital wards: retrospective longitudinal observational study using routinely collected data." Health Services and Delivery Research Journal. | Evaluation  | Single (32 units) | When registered nurse staffing fell below the planned level, determined through periodic review using the SNCT by a PCS mortality was increased. High patient turnover relative to unit mean was also associated with significantly increased mortality | SNCT |
| 32 | Needleman, J., *et al*. (2011). "Nurse staffing and inpatient hospital mortality." New England Journal of Medicine **364**(11): 1037-1045. | Evaluation  | Single (43 Units) | When staffing fell below the target set by a PCS mortality was increased. High patient turnover relative to unit mean was also associated with significantly increased mortality | unspecified PCS |
| 33 | Davis, A., *et al*. (2014). "Nurse Staffing under Demand Uncertainty to Reduce Costs and Enhance Patient Safety." Asia-Pacific Journal of Operational Research 31(01): 1450005. | Operational Research Model linking staffing deployment to workload measure | Multi (2 units / 2 hospitals) | Calculated optimal staffing in the face of variable demand (patient census based only) using a newsvendor model and calculated cost savings (relative to mean) associated with overstaffing according to the model for general.  | patient volume |
| 34 | Kortbeek, N., *et al*. (2015). "Flexible nurse staffing based on hourly bed census predictions." International Journal of Production Economics 161(167–180): 167-180. | Operational Research Model linking staffing deployment to workload measure | Single (4 units) | Compares staffing required based on a predictive tool based on patient census compared to a full (nurses to bed) model & finds that census based models require fewer staff with mixed findings on the use of a flexible staffing pool | patient volume |
| 35 | Maenhout, B. and M. Vanhoucke (2013). "An integrated nurse staffing and scheduling analysis for longer-term nursing staff allocation problems." Omega **41**(2): 485-499. | Operational Research Model linking staffing employment / deployment to workload measure |  | Models different approaches to staffing with varying compositions of ft/ pt / float unit staff based on an unclear workload / demand model, presumed to be a fixed nurse to bed measure. Variations considered appear to be primarily supply | patient volume |
| 36 | Harper, P. R., *et al*. (2017). "Modelling the size and skill-mix of hospital nursing teams." Journal of the Operational Research Society 61(5): 768-779. | Operational Research Model linking staffing employment to workload measure | Single (6 units) | Calculated optimal staffing in the face of variable demand (patient census and acuity / dependency based measures "informed" by Hurst's work) and estimated required WTE equivalent staff as higher, compared to current (average) based approaches | SNCT/ patient volume |