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EVIDENCE SERVICE

Providing the best available knowledge about effective care

Nursing skill mix and staffing levels for safe patient care

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Nursing skill mix and staffing levels for safe patient care

Questions

- In what ways do nurse staffing levels and skill mix affect patient safety outcomes?
- What are the effects of nurse staffing levels and skill mix on the costs of healthcare?

What the evidence suggests

Nursing skill mix and staffing levels

- Nursing is central to considerations about how hospital care should be provided effectively and safely.

Impact on patient outcomes

- Higher nurse staffing levels and a higher proportion of registered nurses are associated with lower rates of mortality and may be associated with lower rates of patient falls and pressure ulcers.
- A higher proportion of registered nurses may be associated with lower rates of some types of hospital acquired infection.
- A lower level of nurse staffing is probably associated with higher rates of drug administration errors and missed nursing care.

Impact on patient care costs

- Lower hospital use is associated with higher nurse staffing levels and possibly with a richer registered nurse skill mix.
- Increases in nurse staffing and/or a richer skill mix have the potential to be cost-effective.

Research sources

This evidence report has examined findings of a review commissioned by NICE (Griffiths, et al., 2014) to address questions about the effects of nurse staffing levels and skill mix on patient safety and economic outcomes. Studies identified by the NICE review were of variable quality and the strength of the evidence is therefore mixed. The studies included in the NICE review were observational (mostly cross-sectional) and reported associations cannot therefore be considered to be necessarily causal.

The discussion of findings below also refers to the results of some other reviews and primary studies.

Main findings

The roles, training, skill mix and staffing levels of those providing nursing care are central to considerations about how healthcare should be provided effectively and safely to achieve the best possible patient outcomes for hospital patients.

This evidence report has examined findings of a review commissioned by NICE (Griffiths, et al., 2014) Studies identified by the NICE review were of variable quality and the strength of the evidence is therefore mixed[1]. The studies included in the NICE review were observational (mostly cross-sectional) and reported associations cannot therefore be considered to be necessarily causal.

Findings of the NICE review (Griffiths, et al., 2014)

Nurse staffing levels/skill mix and patient mortality

There is good evidence that nurse staffing levels and a higher proportion of registered nurses are associated with lower rates of mortality. It should be noted however that mortality rates are also likely to be substantially influenced by other staff groups and organisational factors.

Nurse staffing levels/skill mix and other patient outcomes

There is some evidence suggesting that higher staffing levels and a higher proportion of registered nurses may be associated with lower rates of patient falls and pressure ulcers.

The evidence also suggests that a higher proportion of registered nurses may be associated with lower rates of some types of hospital acquired infection. The review was unable to demonstrate any associations between nurse staffing levels or skill mix and rates of venous thromboembolism, though none of the studies reporting this outcome were rated as good quality.

Nurse staffing levels/skill mix and nursing process measures

There is some strong evidence that a lower level of nurse staffing is associated with higher rates of drug administration errors and missed nursing care, although some contradictory evidence on drug administration errors also exists, with one study of moderate internal validity finding that wards with more nursing staff had significantly higher error rates. A richer registered nurse skill mix was associated with significantly fewer medication errors.

Nurse staffing levels/skill mix and healthcare costs

Increases in nurse staffing and/or a richer skill mix have a potential to be cost-effective. There is strong evidence that lower hospital use is associated with higher nurse staffing levels and possibly with a richer registered nurse skill mix. The review reports that there is limited evidence suggesting that cost of care is increased with higher nurse staffing levels but acknowledges that the picture is mixed with the lowest staffing levels also being associated with increased hospital costs. Costs of increased nurse

[1] Studies included in the NICE review were assessed by the authors using an adapted form of the NICE quality appraisal checklist for quantitative studies reporting correlations and associations from the methods for development of NICE public health guidance.

staffing may not be offset by savings from better patient or system outcomes (such as reduced hospital stays) although some scenarios modelled did suggest additional costs of increased staffing might be more than offset by savings from improved patient outcomes and thus lead to a net saving. Studies examined by the review also suggest that increasing nurse staffing has the potential to be cost-effective in terms of cost per life year saved and, again, this may be associated with the level of registered nurse staffing.

Support from other sources for the findings of the NICE review

The associations between nurse staffing levels/skill mix and patient outcomes in acute care hospitals found by the NICE review were consistent with the earlier findings reported in a major AHRQ systematic review of 96 studies published up to 1996 (Kane, et al., 2007).

The abstract of a systematic review by Shekell (Shekell, 2013) and two recently reported primary studies add support to the findings of the NICE review of an association between nurse staffing levels and some patient safety outcomes, including mortality. The review by Shekell states that the strongest evidence for reduced mortality was based on one longitudinal study in a single hospital. We have not examined the full text or undertaken any quality assessment of this review.

The abstract of a recent longitudinal study of over 18 million discharges from USA hospitals reports that increases in nurse staffing levels were associated with reductions in nursing-sensitive adverse events and length of stay, but did not lead to increases in patient care costs (Martsolf, et al., 2014). The report also suggests that changing skill mix by increasing the number of registered nurses, as a proportion of licensed nursing staff, led to reductions in costs.

A recent observational study of discharge data for 422,730 patients aged 50 years or older who underwent common surgeries in 300 hospitals in nine European countries (a part of the RN4CAST study[2]) reports that increases in a nurses' workload were associated with increased likelihood of patient death and that higher proportions of bachelor's degree nurses were associated with a decrease in this likelihood (Aiken, et al., 2014).

Reference list

Aiken, L. et al., 2014. Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study. *Lancet,* Volume 383, pp. 1824-1830.

Burston, S., Chaboyer, W. & Gillespie, B., 2014. Nurse-sensitive indicators suitable to reflect nursing care quality: a review and discussion of issues. *Journal of Clinical Nursing,* Volume 23, pp. 1785-1795.

Butler, M. et al., 2011. Hospital nurse staffing models and patient and staff-related outcomes. *Cochrane Database of Systematic Reviews,* Issue 7.

[2] The RN4CAST study is being undertaken by a collaboration of 12 countries and aims to determine how hospital nurse staffing, skill mix, educational composition, and quality of the nurse work environment impact hospital mortality, failure to rescue, quality of care, and patient satisfaction.

Griffiths, P. et al., 2014. *The association between patient safety outcomes and nurse / healthcare assistant skill mix and staffing levels & factors that may influence staffing requirements,* London: NICE.

Kane, R. et al., 2007. Nurse Staffing and Quality of Patient Care. *Evid Rep Technol Assess (Full Rep),* pp. 1-115.

Martsolf, G. et al., 2014. Examining the value of inpatient nurse staffing: an assessment of quality and patient care costs.. *Med care,* 52(11), pp. 982-8.

National Institute for Health and Care Excellence, 2014. *Safe staffing for nursing in adult inpatient wards in acute hospitals,* London: National Institute for Health and Care Excellence.

Shekell, P. G., 2013. Nurse-patient ratios as a patient safety strategy: a systematic review. *Annals of Internal Medicine,* 158(5), pp. 404-9.

Simon, M. et al., 2014. *Effectiveness of management approaches and organisational factors on nurse staffing sensitive outcomes,* London: NICE.

Subirana, M., Long, A., Greenhalgh, J. & Firth, J., 2014. A realist logic model of the links between nurse staffing and the outcomes of nursing. *Journal of Research in Nursing,* 19(1), pp. 8-23.

Appendix 1: Methods and results

Methods

Searches - identifying potentially relevant published reports

CINAHL, BNI, Cochrane Library, NICE, AHRQ and the G-I-N database were searched for SRs and evidence-based guidelines relating to nurse education, skills and staffing levels associated with patient safety outcomes[3]. The reference list of the NICE review (Griffiths, et al., 2014) was also searched.

Search terms used for searching databases were: nursing, staffing level, education, skill mix, patient safety, patient outcomes, health service costs.

Inclusion and exclusion of reviews

Each review was assessed for relevance of questions addressed by the review to the target questions. Studies were included or excluded from this report accordingly. Table 1 shows the rationale for decisions to include or exclude reviews.

Quality assessment of systematic reviews regarded as key sources

Quality assessment of the key source was undertaken using the ROBIS tool (see: http://www.robis-tool.info/) (see Table 2).

Findings from key source

The main findings of the source review that were relevant to the target questions were summarised in table 3.

Results

Search results

Two systematic reviews (Griffiths, et al., 2014) and (Simon, et al., 2014) were identified from the NICE website; these were commissioned to support development of a guideline for the NHS in England about safe levels of nurse staffing and skill mix in acute hospital wards (National Institute for Health and Care Excellence, 2014).

One relevant Cochrane Review last updated in 2011 was identified (Butler, et al., 2011)[4] and one important USA study was identified from the AHRQ website (Martsolf, et al., 2014).

No relevant reviews were identified on the AHRQ or G-I-N websites.

[3] The HMC method for identifying relevant publications for a Rapid Appraisal report is as follows: Use one or two bibliographic databases and sites chosen according to topic[3] and stop once recent, relevant systematic reviews (SRs) or 'rapid reviews' are identified. Start with last five years and limit to English language and SRs - extend if necessary.

[4] We have contacted the Cochrane group responsible for the review seeking information about intentions to update the review. At the time of writing, no substantive reply has been received.

Four potentially relevant articles were identified from other searches, two of which (Shekell, 2013) and (Kane, et al., 2007) were cited by one of the NICE reviews. The two later reviews (Subirana, et al., 2014) (Burston, et al., 2014) were published after the NICE reviews.

Selection of published reports

Table 1 lists the six reviews identified and provides explanations for excluding the other five reviews from the main findings of this report. One of the reviews published by NICE in 2014 (Griffiths, et al., 2014) is highly relevant to the topic and has been selected as the primary source for this Rapid Appraisal report.

The scope of the NICE review selected as the primary source for this report (Griffiths, et al., 2014) is described in box 1.

Box 1: Scope of NICE review

The first of the NICE reviews (Griffiths, et al., 2014) investigated three broad questions:
1) which patient safety outcomes are associated with nurse and healthcare assistant staffing levels and skill mix
2) how the ward environment, including physical layout and diversity of clinical disciplines, affect safe staffing requirements, and
3) what patient factors affect nurse and healthcare assistant staffing requirements at different times during the day.

Quality of reviews

The selected NICE review was assessed using the ROBIS tool and determined to have low risk of bias (see table 2).

Findings from reviews and other selected sources

Table 3 summarises the findings of the review (Griffiths, et al., 2014) as they relate to the questions for this report, ie the effects of nurse staffing levels and skill mix on patient safety outcomes and economic outcomes. The findings are considered further in the discussion section.

Appendix 2: Tables

Table 1: Published reviews included and excluded from this report based on relevance

The table shows all reviews identified by the searches. Each review was assessed for **relevance** of questions addressed by the review to the target questions. Studies were included or excluded from this report accordingly. The table shows the rationale for decisions to include or exclude reviews.

Author(s)	Title	Year	Relevance to target questions[5]			Include/ exclude
			Skill mix (Qu 1)	Staffing levels (Qu 2)	Service costs (Qus 3)	
(Griffiths, et al., 2014)	The association between patient safety outcomes and nurse / healthcare assistant skill mix and staffing levels & factors that may influence staffing requirements	2014	Yes	Yes	Yes	I
(Simon, et al., 2014)	Effectiveness of management approaches and organisational factors on nurse staffing sensitive outcomes	2014	Focus on effectiveness of management approaches and organisational factors on nurse staffing sensitive outcomes (see discussion)			E
(Butler, et al., 2011)	Hospital nurse staffing models and patient and staff-related outcomes	2011	This review was covered and cited by the NICE reviews (see discussion).			E[6]
(Subirana, et al., 2014)	A realist logic model of the links between nurse staffing and the outcomes of nursing	2014	Focus on mechanisms: Study grounded within the principles of realist evaluation, realist review and logic modelling. The authors suggest mechanisms through which nurse staffing levels may result in adverse patient outcomes in the acute sector (see discussion).			E

[5] Target questions: 1. In what ways do nurse staffing levels and skill mix affect patient safety outcomes? 2. What are the effects of nurse staffing levels and skill mix on the costs of healthcare?

[6] Decisions to exclude made on basis of abstracts. Full text of articles not examined (other than the two NICE reviews).

Author(s)	Title	Year	Relevance to target questions[5]			Include/ exclude
			Skill mix (Qu 1)	Staffing levels (Qu 2)	Service costs (Qus 3)	
(Shekell, 2013)	Nurse-patient ratios as a patient safety strategy: a systematic review	2013	This review was covered and cited by the NICE reviews (see discussion).			E
(Burston, et al., 2014)	Nurse-sensitive indicators suitable to reflect nursing care quality: a review and discussion of issues	2014	Focus on validity of indicators. Review's conclusion: Evidence for the nurse-sensitivity of some commonly used indicators is inconsistent due to the disparity in definitions used, data collection and analysis methods. (see discussion)			E
(Kane, et al., 2007)	Nurse Staffing and Quality of Patient Care	2007	This review was covered and cited by the NICE reviews (see discussion).			E

Table 2: Quality assessment of systematic review regarded as key sources

Quality assessment of the selected review (Griffiths, et al., 2014) was undertaken using the ROBIS tool[7], which is designed to assess risk of bias in systematic reviews. The table below summarises assessments for the four domains of the ROBIS tool and gives an overall judgement about risk of bias for the review.

Review reference	Domain 1 Study eligibility	Domain 2 Identification and selection of studies	Domain 3 Data collection and study appraisal	Domain 4 Synthesis and findings	Risk of bias
(Griffiths, et al., 2014)	Eligibility criteria fully described and appropriate to scope and pre-defined objectives of review.	Comprehensive search that included good range of databases, examination of references, and justified use of previous reviews.	All included studies were assessed and rated for risk of bias using NICE quality appraisal checklist for quantitative studies reporting correlations and associations. Assessments by two reviewers.	Data were extracted to tables. This was a narrative synthesis of previous reviews and primary studies.	Low

[7] See: http://www.robis-tool.info/

Table 3: Outcomes/findings of selected review (Griffiths, et al., 2014)

Qu 1: In what ways do nurse staffing levels and skill mix affect patient safety outcomes?

Patient safety outcome	Nurse staffing variable	Quality of studies[8]	Summary findings (extracted from review)
Mortality	All staffing level (registered and HCA)	Good quality (all ++)	Hospitals / units with higher nurse staffing have lower rates of mortality and failure to rescue
	HCA staffing level	Moderate to low quality (+,-)	No association shown between health care assistant (HCA) staffing levels and mortality or 'failure to rescue' rates.
	Ratio of registered nurses to HCAs	Good quality (all ++)	Higher proportion of registered nurses associated with significantly lower rates of mortality and 'failure to rescue'.
Hospital acquired infection (HAI)	All staffing level (registered and HCA)	Mixed quality (reported by type of infection)	Mixed evidence of association between nurse staffing levels and HAI. Difficult to draw conclusions.
	HCA staffing level	No studies	No studies
	Ratio of registered nurses to HCAs	Mixed quality (++,++,-)	Higher proportion of registered nurses associated with lower rates of pneumonia, surgical site infection and post-op sepsis. (One study of low internal validity, however, showed higher ratio of registered nurses associated with higher rate of pneumonia.)
Patient falls	All staffing level (registered and HCA)	Good or moderate quality (+ or ++)	Higher nurse staffing levels associated with lower rates of falls.
	HCA staffing level	Moderate to low quality (+,-)	Higher HCA staffing levels associated with higher rates of falls.
	Ratio of registered nurses to HCAs	Mostly good to moderate quality (++,+,+,-)	Higher proportion of registered nurses associated with significantly lower rates of falls.

[8] See http://www.nice.org.uk/article/pmg4/chapter/appendix-g-quality-appraisal-checklist-quantitative-studies-reporting-correlations-and-associations for a description of the quality rating scheme.

Patient safety outcome	Nurse staffing variable	Quality of studies[8]	Summary findings (extracted from review)
Pressure ulcers	All staffing level (registered and HCA)	Mixed quality (+,-,-)	Mixed evidence of association but two studies of high internal validity indicate higher nurse staffing levels probably associated with lower rates of pressure ulcers.
	HCA staffing level	One weak study (-)	Higher HCA staffing levels associated with lower rates of pressure ulcers.
	Ratio of registered nurses to HCAs	Three weak studies (all -)	Higher proportion of registered nurses associated with lower rates of pressure ulcers.
Venous thromboembolism (VTE)	All staffing level (registered and HCA)	Variable quality (-,-,++)	No evidence of association between higher nurse staffing levels and VTE.
	HCA staffing level	Not reported	Not reported
	Ratio of registered nurses to HCAs	Two weak studies (both -)	No evidence of association between skill mix and rates of VTE.

Qu 2: What are the effects of nurse staffing levels and skill mix on the costs of healthcare?

Economic outcome	Nurse staffing variable	Quality of studies	Summary findings (extracted from review)
Hospital use (length of stay; readmission)	All staffing level (registered and HCA)	Some good quality studies (++, ++, +, + and -).	Strong evidence that lower hospital use is associated with higher nurse staffing levels
	HCA staffing level		No studies
	Ratio of registered nurses to HCAs	Two weak studies (-,-)	A richer registered nurse skill mix might be associated with lower resource use in terms of hospital stay
Health service costs	All staffing level (registered and HCA)	States 'limited evidence'	Limited evidence suggests that cost of care is increased with higher nurse staffing levels although the picture is mixed with the lowest staffing levels also associated with increased hospital costs. The costs of increased nurse staffing may not be offset by savings from better patient or system outcomes (such as reduced hospital stays) although some scenarios modelled did suggest additional costs of increased staffing might be more than offset by

Economic outcome	Nurse staffing variable	Quality of studies	Summary findings (extracted from review)
			savings from improved patient outcomes and thus lead to a net saving
	HCA staffing level		No studies
	Ratio of registered nurses to HCAs	Two weak studies (-,-)	A richer registered nurse skill mix might be associated with lower resource use in terms of total nursing hours and overall cost of nursing hours
Patient life years saved	All staffing level (registered and HCA)	Not stated	Studies suggest that increasing nurse staffing has the potential to be cost-effective in terms of cost per life year saved
	HCA staffing level		Not reported
	Ratio of registered nurses to HCAs	Not stated	Increasing registered nurse staffing (rather than licensed practical nurse staffing) on general (medical/surgical) wards (rather than ICU) may be more cost effective than the alternatives.

Appendix 3: About HMC Evidence Service and Rapid Appraisal Reports

Hamad Medical Corporation and Evidence Synthesis

The vision of Hamad Medical Corporation is to provide the safest, most effective and compassionate care to each and every one of our patients. A service to provide evidence summary reports about the effectiveness of healthcare has been established to support local Qatar healthcare providers in applying the best available knowledge to healthcare decisions at organisational, team and individual clinician levels. Summaries of available evidence are also essential to identify gaps in our knowledge about locally important questions and to indicate what new research might be of value.

Rapid Appraisal Reports

A Rapid Appraisal report is a short evidence report stating the issue and specific question(s) of importance to HMC organisations and staff, and providing brief evidence-based answers where high quality and reliable research exists that can easily be assembled. Only robust systematic reviews are used as source documents and these are critically appraised. Where individual studies are identified, these will not usually be critically appraised. Rapid Appraisal reports may also include proposals for further evidence review as appropriate.

Appendix 4: HMC core sources for identifying systematic reviews and evidence-based guidelines

Name of database	Link	Description
PubMed (incl Medline) and PubMed Health	http://www.ncbi.nlm.nih.gov/pubmed	PubMed comprises over 24 million citations for biomedical literature from MEDLINE, life science journals, and online books.
NICE Evidence Search	https://www.nice.org.uk/	Indexed evidence-based information from multiple trustworthy and accredited sources.
The Agency for Healthcare Research and Quality (AHRQ) (and Evidence-based Practice Centers – EPCs)	http://www.ahrq.gov/research/findings/index.html	Reports providing comprehensive, science-based information on common, costly medical conditions and new health care technologies and strategies. The EPCs review all relevant scientific literature on a wide spectrum of clinical and health services topics.
G-I-N International Guideline Library	http://www.g-i-n.net/library/international-guidelines-library	Over 6,400 guidelines, evidence reports and related documents (Nov 2014), which have been developed or endorsed by organisational members of G-I-N.
Cochrane Library	http://www.cochranelibrary.com/	Contains Cochrane Reviews, abstracts of other reviews (DARE database), and information from the Economic Evaluations Database (EED) and Health Technology Assessment (HTA) database. Also provides access to the 'Central' register of controlled trials.