Nurse staffing levels and hospital mortality in critical care settings: literature review and meta-analysis


CRD summary
This review concluded that there was no reliable evidence about the impact of nurse staffing levels on mortality rates in critical care settings, due to the poor quality of the available studies. The authors' cautious conclusions appear to be reasonable given the limitations of the included data.

Authors' objectives
To investigate the association between patient mortality and staffing levels of nurses in critical care settings.

Searching
The Cochrane Database of Systematic Reviews, MEDLINE, EMBASE, CINAHL and PsycINFO were searched up to October 2005. Search terms were reported. In addition, the reference lists of reviews and in-house reference collections were searched for additional studies. Only studies published in English were eligible for inclusion in the review.

Study selection
Randomised controlled trials (RCTs), controlled trials and observational studies of critically ill patients, undergoing treatment and nursing care in critical care settings, were eligible for inclusion in the review. Studies of neonatal intensive care units were excluded from the review. Eligible studies had to include the primary outcome of mortality, either intensive care unit (ICU) mortality, in-patient (hospital) mortality or 30-day mortality. In order to be included in the review, studies also had to clearly report staffing levels using a quantitative measure such as the nurse-to-patient ratio. Differences in the mix of nursing skills were not considered.

The included studies were all observational studies, the majority using retrospective data, with a median duration of 36 months (range 10 to 60 months). Most of the studies were multi-centre studies based in hospitals with between 10 and 6,668 beds (median 38). Six studies were carried out in the USA, with the remainder from Scotland, Brazil and Austria.

Where stated, the majority of included participants were adults undergoing surgery or admission to ICU. The majority of studies reported hospital mortality rates. Other reported outcomes included ICU mortality, length of stay, complications, postoperative morbidity, 30-day mortality and costs. The reported mortality data was collected between 1990 and 2000. Most studies also reported nurse-to-patient ratios, some specifying values for different shifts (i.e. time of day). Information about the nursing care was presented either as dichotomised data or as continuous variables.

Two reviewers independently screened the retrieved articles for inclusion in the review, using the titles, publication years and abstracts. Discrepancies between reviewers were resolved through discussion and the level of agreement assessed statistically (kappa values). Agreement between reviewers was over 96% (overall kappa was 0.78). The majority of discrepancies were due to incomplete information in abstracts.

Assessment of study quality
The authors stated that the validity of studies was not formally assessed or considered in the analysis, but important study characteristics which may affect study quality were reported. These characteristics included: study design; data collection (retrospective versus prospective); type of analysis; consideration of effect of clustering; investigation of covariates and their interaction; goodness of fit; and involvement of a statistician.

Data extraction
Study data was extracted using a standardised form. Mortality rates, the percentage staffing (high and low intensity), unadjusted and adjusted odds ratios (ORs) and risk ratios (RRs), with 95% confidence intervals (CIs) were reported.
The authors did not state how many reviewers performed the data extraction.

Methods of synthesis
Studies were grouped according to outcome and pooled unadjusted RRs with 95% CIs calculated, using the DerSimonian and Laird random-effects model. Statistical heterogeneity was assessed using the Q-test.

Results of the review
Nine observational studies (n=168,840), three of which collected data prospectively, were included in the review. Seven studies analysed data using multiple regression analysis, one used simple linear regression and one used generalised estimating equations. Five studies used different units of allocation and analysis, one of which did not control for the effects of clustering in its analysis. Only two studies reported investigating potential interactions with covariates and assessing the goodness of fit.

All nine studies assessed hospital mortality. Of those that reported mean mortality rates (seven studies), rates ranged from 4.8% to 34%. Three studies reported an overall standardised mortality ratio ranging from 0.99 to 1.67.

Overall, a statistically significant reduction in mortality was reported in four out of five studies for settings with higher intensive care unit staffing levels, RR 0.65 (95% CI: 0.47, 0.91). However, when adjustments were made for a variety of covariates, only one study reported a statistically significant reduction in mortality associated with higher staffing levels.

Authors’ conclusions
There was no reliable evidence about the impact of nurse staffing levels on mortality rates in critical care settings but many of the included studies were subject to a number of methodological flaws, which are likely to have hindered this assessment.

CRD commentary
This review answered a clear research question with broad inclusion criteria for type of study design. There may be some risk of publication and language bias, as only published English language articles were eligible for inclusion. Steps were taken to reduce the risk of reviewer error and bias when selecting studies, but it is unclear whether similar precautions were taken when extracting the study data. No formal assessment of study validity was carried out, which the authors acknowledge as a limitation, but important aspects of study design, which could affect validity, were reported. The authors also discussed a number of other limitations with respect to the review and the primary data. Overall, in view of the limitations of the included data, the authors’ cautious conclusions and recommendations for further research appear to be reasonable.

Implications of the review for practice and research
Practice: The authors did not state any implications for practice.

Research: The authors stated that further randomised controlled trials and prospective cohort studies, using valid and reliable assessments of nurse staffing levels and skills, in critical care settings are urgently required. Future studies should assess the reliability of data collected over multiple sites and carry out appropriate assessments of all possible covariates. Ideally studies should be conducted in multiple sites, using various unit structures and in different countries.

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