Physician staffing patterns and clinical outcomes in critically ill patients
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Authors' objectives
To examine the effect of intensive care unit (ICU) physician staffing on patient outcomes, in terms of hospital and ICU mortality and length of stay (LOS).

Searching
MEDLINE was searched from 1 January 1965 to 30 September 2001, using the following MeSH terms: 'intensive care units', 'ICU', 'health resources/utilization', 'hospitalization', 'medical staff', 'hospital organization and administration', 'personnel staffing and scheduling', 'length of stay' and 'LOS'. The textwords used were 'staffing', 'intensivist', 'critical', 'care' and 'specialist'. Controlled clinical trials were retrieved using the search strategy proposed by Robinson and Dickersin (see Other Publications of Related Interest no.1). Observational studies were identified using the MeSH terms 'case-control study' and 'retrospective study'. Searches were also made of EMBASE, HealthSTAR, HSRProj (via Internet Grateful Med) and The Cochrane Library (Issue 3, 1998), which contains the CENTRAL Register of Controlled Trials, DARE and the Cochrane Database of Systematic Reviews. In addition, the 'related articles' feature of PubMed was used to identify related articles. Non-English language citations were searched for, but the subsequent article review involved publications in the English language only. The abstract proceedings from the annual scientific assemblies of the Society of Critical Care Medicine, the American College of Chest Physicians, and the American Thoracic Society were handsearched from 1 January 1994 to 31 December 2001.

Study selection
Study designs of evaluations included in the review
Randomised or observational controlled trials were eligible for inclusion in the review. Only observational controlled studies were included in the review.

Specific interventions included in the review
Studies of ICU physician staffing strategies were eligible for inclusion in the review. ICU physician staffing was initially classified as:

closed ICU, i.e. the intensivist (primary care physician) is the patient's primary attending physician;

mandatory critical care consultation, i.e. the intensivist is not the patient's primary attending physician, but every patient admitted to the ICU receives a critical care consultation;

elective critical care consultation, i.e. the intensivist is involved in the care of the patient only when the attending physician requests a consultation; and

no critical care physician, i.e. intensivists were unavailable.

ICU physician staffing was then further grouped into high intensity (mandatory intensivist consultation or closed ICU) or low intensity (no intensivist or elective intensivist consultation).

Participants included in the review
Critically ill adults or children in ICUs were eligible for inclusion in the review. The participants in the included studies were medical patients, surgical patients, mixed medical and surgical patients, and paediatric patients.

Outcomes assessed in the review
The outcomes assessed in the review were hospital mortality, ICU mortality, hospital LOS and ICU LOS.

How were decisions on the relevance of primary studies made?
Two reviewers independently reviewed each abstract to confirm its eligibility. If an abstract was selected as eligible, the same authors independently reviewed the respective article, if available, to confirm its eligibility. Any discrepancies were resolved by either consensus or with a third reviewer.

**Assessment of study quality**

Study quality was evaluated as the risk of bias caused by the following.

1. Temporal trends: low if study duration less than 2 years, medium if 2 to 4 years, and high if greater than 4 years.

2. Confounding: low if authors used a validated physiologic method of risk adjustment, medium if authors used selected clinical data, high if authors used no risk adjustment.

3. Incomplete follow-up: low if 90 to 100% complete, medium for 80 to 89% complete, and high for less than 80% complete.

The authors did not state who performed the quality assessment.

**Data extraction**

Data were extracted from the primary studies using a data collection form. All data were extracted independently by each of the two primary reviewers, and verified for accuracy by the third reviewer. Any differences among the reviewers were resolved by discussion. The reviewers were not blinded to the author, institution or journal. The percentage of agreement on study selection, study design and data abstraction was measured before discussion.

Data were extracted on the patient characteristics, study methods and study findings. Quantitative data on interventions, cointerventions, study design and duration, unit of analysis, risk adjustment, degree of follow-up, adjustment of historical trends, and type of ICU, were also extracted. When the data were available, mortality data from each study were summarised with relative risks (RRs) or odds ratios, and their 95% confidence intervals (CIs) were calculated. The LOS data were summarised as a relative reduction. When possible, the unadjusted and adjusted outcomes for baseline severity of illness were recorded. When the absolute rates of hospital mortality were unavailable, the observed-expected mortality rate was recorded, and when the standard deviation of LOS data was unavailable, it was assumed to be equal to the mean. The mean LOS, rather than the median LOS, was used since few studies reported medians. Results were considered significant at a P-value of less than 0.05.

**Methods of synthesis**

**How were the studies combined?**

The data were combined statistically in a meta-analysis. Summary RRs were calculated using the random-effects model of DerSimonian and Laird (see Other Publications of Related Interest no.2). Publication bias was evaluated using a funnel plot.

**How were differences between studies investigated?**

Heterogeneity was investigated both qualitatively and quantitatively (see Other Publications of Related Interest nos.3-4).

**Results of the review**

Twenty-seven studies (n=23,569) were included in the review. There were 22 cohort studies (19 using historical controls, 2 concurrent controls and one using both) and 5 cross-sectional studies with concurrent controls.

The results of the study quality assessment indicated a low risk of bias in most studies. There was no evidence of publication bias on a funnel plot of hospital mortality.

Hospital mortality.

The hospital mortality rate (17 studies) ranged from 6 to 74% in the low-intensity staffing group, and from 1 to 57% in the high-intensity staffing group. Overall, 16 of the 17 studies (94%) showed a decrease in the hospital mortality rate.
for ICU patients with high-intensity physician staffing. In 10 of the 15 studies (67%) that reported unadjusted mortality, and 9 of the 14 studies (64%) that reported adjusted mortality, the decrease was statistically significant. No study reported a statistically-significant increase in hospital mortality with high-intensity ICU physician staffing. The pooled data from 14 studies gave an unadjusted RR of 0.71 (95% CI: 0.62, 0.82) for high- versus low-intensity staffing.

ICU mortality.

Fourteen of the 15 studies (93%) showed a decrease in the ICU mortality rate for ICU patients with high-intensity physician staffing. Nine out of 13 studies found a statistically-significant reduction in the unadjusted ICU mortality rates with high-intensity physician staffing. ICU mortality decreased significantly with high-intensity physician staffing in 9 of the 12 studies (75%) that adjusted for severity of illness. The pooled data from 13 studies gave an unadjusted RR of 0.61 (95% CI: 0.50, 0.75) for high- versus low-intensity physician staffing.

Hospital LOS.

The hospital LOS ranged from 8 to 33 days in the low-intensity group, and from 7 to 24 days in the high-intensity group. Ten out of 13 studies (77%) reported a reduction in LOS with high-intensity physician staffing (range of relative reduction: 5 to 42%). In 6 of these studies, the reduction was statistically significant. One study reported a statistically-significant increase in hospital LOS with high-intensity physician staffing. However, this study compared patients admitted to a neurosurgical ICU with those admitted to a general ICU, and the results were not adjusted for baseline severity of illness. Two of the 4 studies reporting hospital LOS adjusted for baseline severity of illness found a statistically-significant decrease in LOS with high-intensity physician staffing in the ICU; the remaining 2 studies found no significant difference.

ICU LOS.

The ICU LOS ranged from 2 to 13 days in the low-intensity staffing group, and from 2 to 10 days in the high-intensity group. Fourteen of the 18 studies (78%) reported that ICU LOS decreased with high-intensity physician staffing; the result was statistically significant in 11 of these. The study comparing a closed neurosurgical ICU with a general ICU reported a statistically-significant increase in ICU LOS with high-intensity staffing in the neurosurgical ICU. Three of the 18 studies reported higher severity in the low-intensity group, while the remaining 13 studies reported no difference between the groups. In 2 studies adjusting for baseline severity of illness, the ICU LOS favoured high-intensity physician staffing.

Authors' conclusions

Greater use of intensivists in the ICU led to significant reductions in ICU and hospital mortality and LOS across a variety of populations and hospitals. A more rigorous evaluation of the optimal ICU organisation is essential given the variation in ICU physician staffing, and the potential for reduced mortality implied by these studies.

CRD commentary

The review question and the study selection criteria were stated clearly. The literature search seems to have been very comprehensive, although only English language studies were eventually included; this may mean that relevant material was missed. Adequate information was provided on the search, selection, validation and data extraction processes, although the authors neglected to specify how many of the reviewers carried out the validation process. The range of statistical tests employed seems to have been appropriate for the data being analysed, and there was ample presentation and discussion of the study findings. While the authors state that the funnel plot showed no evidence of publication bias, it is, in fact, asymmetrical, suggesting that there may be some bias after all.

The authors' conclusions seem appropriate given the data presented.

Implications of the review for practice and research

Practice: The authors stated that their findings provide evidence to support the recommendations of the Leapfrog Group and Society of Critical Medicine for ICU physician staffing (see Other Publications of Related Interest nos.5-7).

Research: The authors stated that greater use of intensivists in the ICU led to significant reductions in ICU and hospital mortality and LOS across a variety of populations and hospitals. Given the variation in ICU physician staffing and the
potential for reduced mortality implied by these studies, a more rigorous evaluation of the optimal ICU organisation is essential. In particular, determining how to best organise ICU staffing from a multidisciplinary standpoint to optimise patient outcomes, is a high research priority.

Bibliographic details

PubMedID
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http://jama.ama-assn.org/

Other publications of related interest


This additional published commentary may also be of interest. McCarthy ML. Staffing intensive care units with critical care physicians may improve clinical outcomes. Evidence-based Healthcare 2003;7:63-4.

Indexing Status
Subject indexing assigned by NLM

MeSH
Adult; Child; Critical Care /statistics & numerical data; Critical Illness /mortality /therapy; Diagnosis-Related Groups; Hospital Mortality; Humans; Intensive Care Units /statistics & numerical data; Length of Stay; Outcome and Process Assessment (Health Care); Personnel Staffing and Scheduling

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Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract
contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.