



Nurse staffing, medical staffing and mortality in Intensive Care: An observational study



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ABSTRACT

Objectives: To investigate whether the size of the workforce (nurses, doctors and support staff) has an impact on the survival chances of critically ill patients both in the intensive care unit (ICU) and in the hospital.

Background: Investigations of intensive care outcomes suggest that some of the variation in patient survival rates might be related to staffing levels and workload, but the evidence is still equivocal.

Data: Information about patients, including the outcome of care (whether the patient lived or died) came from the Intensive Care National Audit & Research Centre (ICNARC) Case Mix Programme. An Audit Commission survey of ICUs conducted in 1998 gave information about staffing levels. The merged dataset had information on 65 ICUs and 38,168 patients. This is currently the best available dataset for testing the relationship between staffing and outcomes in UK ICUs.

Design: A cross-sectional, retrospective, risk adjusted observational study.

Methods: Multivariable, multilevel logistic regression.

Outcome Measures: ICU and in-hospital mortality.

Results: After controlling for patient characteristics and workload we found that higher numbers of nurses per bed (odds ratio: 0.90, 95% confidence interval: [0.83, 0.97]) and higher numbers of consultants (0.85, [0.76, 0.95]) were associated with higher survival rates. Further exploration revealed that the number of nurses had the greatest impact on patients at high risk of death (0.98, [0.96, 0.99]) whereas the effect of medical staffing was unchanged across the range of patient acuity (1.00, [0.97, 1.03]). No relationship between patient outcomes and the number of support staff (administrative, clerical, technical and scientific staff) was found. Distinguishing between direct care and supernumerary nurses and restricting the analysis to patients who had been in the unit for more than 8 h made little difference to the results. Separate analysis of in-unit and in-hospital survival showed that the clinical workforce in intensive care had a greater impact on ICU mortality than on hospital mortality which gives the study additional credibility.

Conclusion: This study supports claims that the availability of medical and nursing staff is associated with the survival of critically ill patients and suggests that future studies should

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focus on the resources of the health care team. The results emphasise the urgent need for a prospective study of staffing levels and the organisation of care in ICUs.

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What is already known about the topic?

- There is a growing consensus, supported by several high quality systematic reviews, that the number of nurses available for patient care improves patient outcomes in acute medical and surgical wards, but there is less agreement that this relationship holds in Intensive Care Units.
- Some evidence, mainly from the United States, suggests that the organisation of medical staff in Intensive Care Units is related to patient outcomes.
- A number of other variables affect patient outcomes in ICUs, including, most importantly, the patient's own condition and the workload of the unit. These variables need to be included in the statistical analyses as control variables.

What this paper adds

- This study shows a statistically significant association between the number of nurses and doctors available in Intensive Care Units and patients' chances of surviving their stay in ICU and for up to 30 days after admission to hospital.
- The size of the nursing workforce in ICUs has the greatest effect on the most severely ill patients, whereas the number of doctors seems to be important across the range of patient acuity, i.e. there is no interaction effect between the size of the medical workforce and patient acuity.
- The workload of the unit had an impact on patient mortality in addition to the number of clinical staff on the unit establishment.

1. Introduction

Intensive care units (ICUs) were introduced in the 1950s based on the idea that the lives of severely ill patients could be saved if they were treated in smaller, well staffed units with access to the most technologically sophisticated equipment. Key features of this new organisational form included triage (patients should only be admitted to ICU if their future is uncertain), surveillance (close and continuous observations by highly skilled staff) and organ support, made possible by innovative new technologies. This model of care diffused rapidly throughout the healthcare systems of higher income countries. However, ICUs were, and are, very expensive to run; staff salaries are the most expensive item of expenditure in most health care budgets and ICUs require a much higher staff/patient ratio than general medical and surgical units. The aim of this study is to investigate whether there is a relationship between the number of staff (nurses, doctors and support workers) that are available in ICUs and

patients' chances of survival. To test this relationship we use the best information that is currently available, provided by two national datasets collected in England around March 1998. These datasets allow us to include important control variables in our analyses, including the patient's own condition and the workload of the unit.

1.1. Background

By the late 1990s, the National Health Service (NHS) of the United Kingdom (UK) was spending a large proportion of its budget on intensive care but while the costs were rising, the perceived need for intensive care was not being met. A tragic incident in 1995 when a boy died while being transferred in search of an intensive care bed, followed by a flu epidemic in 1999 drew further attention to the inadequacies in provision leading to sustained media attention, questions in Parliament and vigorous debate among professional groups (Crocker, 2007).

In 1998, the Audit Commission, a body established by the UK government to conduct value-for-money studies across all public services, published a report on ICUs titled "Critical to Success: The place of efficient and effective critical care services within the acute hospital" (Audit Commission, 1999). This investigation showed that the outcomes of care varied widely across ICUs in ways that that were not easily explained by staffing levels or skill mix. In units with similar workloads, the number of nurses varied by 50 per cent and consultant costs by a factor of three. Nursing costs differed by a third between the top and bottom quartiles. Most importantly, mortality was over 50 per cent in some units. While units varied greatly in staffing costs and in patient outcomes, there appeared to be very little relationship between the two. In other words, higher spending on staff did not always result in better chances of survival for patients. The only staffing variable that the Audit Commission team found to be related to patient mortality was the pattern of consultant cover. Lower than expected patient survival was found in units where each consultant worked a set number of days per week compared to units where consultants worked a shift pattern of one week on, two weeks off. None of the nursing variables were found to be related to patient outcomes. However, the analysis conducted by the Audit Commission is not described in detail in the published report and the authors may not have had access to some of the resources and techniques that are available to analysts today, including better methods of risk adjustment, and statistical methods that allow for the simultaneous inclusion of data from more than one level of analysis. Given that the costs of critical care continue to consume expensive resources and that the evidence for linking staffing inputs to patient outcomes in ICUs remains contentious, there are good grounds for reanalysing these data.

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