

More ward nursing staff improves inpatient outcomes, but how much is enough?

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The issue of the adequacy of nurse staffing in hospitals and its impact on patient outcomes remains contentious. While there have been a large number of studies demonstrating an association of staffing levels and skills mix on a wide range of outcomes, including mortality, hospital-acquired infections and overall length of stay in patients in hospitals, the vast majority of these studies have been conducted comparing high-staffed hospitals to low-staffed hospitals.^{1–6} Concerns have been raised that other factors than staffing also differ between high-staffed and low-staffed hospitals that might contribute to the observed differences, and that staffing plays a smaller role than is suggested by these studies.

Settling the issue through a study by randomly assigning different staffing levels to hospitals or units seems very unlikely to occur on logistic grounds. And given the existing body of work research ethics committees would probably not approve such a study. What has proven feasible is utilising day-to-day variations in staffing and census across units within hospitals to assess the impact of low staffing on patient outcomes. Prior to the study by Griffiths *et al* in this issue of *BMJ Quality & Safety*,⁷ two published studies have used this methodology. Needleman *et al*⁸ identified shifts by units with substantial shortfalls in professional nurse staffing from targets established by a large academic medical centre's staff projection system, and examined the association of cumulative exposure to low-staffed shifts on patient mortality over a 5-year period for 40 units. They found a substantial increase in mortality associated each low-staffed shift to which a patient was exposed. They also found that the hazard of mortality was increased for shifts with

substantially higher than average patient turnover, as turnover was not incorporated into the staffing system. Fagerström *et al*⁹ used data from 36 units in four Finnish hospitals and a standardised system for assessing optimal staffing. On days on which staffing was lower than optimal, adverse safety events and mortality levels were higher.

Griffith and colleagues⁷ now report a third study using this general approach. It differs from the prior studies in several significant ways. First, it uses the mean staffing on the units studied as the benchmark of appropriate staffing, rather than a target derived from a staffing patient acuity system. Across all wards the mean staffing levels were 4.75 Registered Nurse (RN) hours per patient per day and 2.99 nursing assistant hours per patient per day, approximately five patients per RN and eight per nursing assistant over a 24-hour day. The mean RN hours per patient per day varied from 2.91 (a general medical respiratory ward) to 9.61 (renal high care). Second, it measures variations in staffing continuously around this reference, measuring for each patient accumulated exposure to above or below standard staffing, and allowing higher staffing on some days to offset lower staffing on other. Third, it examines the association of nursing assistant staff with outcomes in a similar manner, treating these staff not as substitutes for professional nurses (as prior studies examining skill mix do) but as complements. They examine the independent effect of professional nurse staffing and nursing assistant staff on patient mortality, finding significant effects, and the potential for interactions between low professional nurse staffing and nursing assistive staffing, finding none. As in the Needleman *et al* study, they find an increase in mortality associated with higher than average turnover.



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Several aspects of these findings by Griffith *et al* merit specific comment. One is the consistent relationship of improved staffing, including staffing over the mean, in reducing mortality. The authors do not find a cap or top of the curve effect. Is the lack of a top of the curve effect unique to this hospital, perhaps because even the mean level of staffing is below the optimal level needed to provide safe and reliable care? Does this suggest that high staffing levels, perhaps above those typically observed are needed to keep patients safe?

While no U-shaped or top of the curve effect is observed for professional nursing, Griffith *et al* do observe a U-shaped relationship between nursing assistant staffing and mortality. That is, as staffing for nursing assistants increases from low staffing levels, mortality declines. At higher levels, however, Griffith *et al* find mortality increases as staffing increases. This is an exceptional finding. There is one study that reports a similar U-shaped relationship between RN staffing and mortality,¹⁰ and while we might expect to observe a top of the curve effect, actually seeing mortality increase with increased staffing merits further study and analysis. There are several possible explanations that should be explored. One is that it is due to diffusion of effort or responsibility as nursing assistant staffing increases. But if this is the case for nursing assistant staffing, why is it not observed for professional nurses on the wards included in this study? Another possible explanation is that there is unmeasured risk of mortality or need for nursing assistant services among patients at higher risk of mortality (eg, they are more likely to be bedridden) that is in fact being staffed for by the units, thus making the association of higher nursing assistant staffing and mortality endogenous. The authors explore this but more needs to be done to examine the issue.

Third is the observed lack of interaction between shortfalls in professional nursing and shortfalls in nursing assistant staffing. There is some literature that suggests that low support staffing increases the workload of professional nurses.¹¹ Given this, one might expect an interaction to exist. Future work should examine whether the finding here is specific to this study or more general.

All three of the studies using within hospital day-to-day or shift-to-shift variation in staffing⁷⁻⁹ come to broadly similar conclusions—that professional staffing below target or typical levels increases the risk of mortality (and in the case of the Fagerström study, adverse safety events). Differences in the basis for measuring low staffing and methods used prevent direct comparisons of the results, but collectively they add to body of literature demonstrating an association of low professional nurse staffing and adverse outcomes. Because studies using day to day within unit variations in staffing controls for many of the other potential sources of variation present in the high-staffed

and low-staffed hospital comparisons (physicians, technology, quality programme, other staffing), these studies provide strong support for the assertion that the association between staffing and outcomes is causal.⁶

In addition to differences in measures of low staffing and study methods, these studies have examined limited types of outcomes—typically just mortality. They are also all relatively small studies, understandable given the high demands for data that allows tracking of shift-to-shift unit-to-unit variations in staffing and assignment of patients to units on a shift-by-shift basis. There is a need for replication of these studies, preferably in a large multisite study, but even additional small or single hospital studies would provide evidence of how typical or unusual the findings from this study and the two prior studies are. These replications need to further examine some of the distinctive findings of these studies but also extend the work beyond them. Key issues that future studies need to pursue include the following:

- ▶ Is the finding of the Griffith's study of no top of the curve dampening of the impact of professional nurse staffing generalisable or is it driven by the specific typical staffing levels of the hospital examined? Is top of the curve impacts of high staffing observed in other hospitals with higher baseline or average staffing?
- ▶ If there is no top of the curve effect for nurse staffing, more will always be better. So, how do we define standards for minimally appropriate staffing levels? It is infeasible to have a nurse for every hospitalised patient. Yet, it is also arbitrary to set the existing mean staffing level as the standard if higher staffing levels improves major outcomes for patients.
- ▶ Is the U-shaped relationship of nursing assistant staffing observed in other studies? Can the cause, including the possible association of high unobserved need, be identified?
- ▶ Is an interaction of low professional nurse staffing and low nursing assistant staffing, not observed here, observed in other sites and settings?
- ▶ Are these results observed for other important outcomes beyond mortality—for instance, fall-related injuries, pressure ulcers, healthcare-acquired infections, readmissions to hospital?

Multisite replications and linkages to other data collection would also allow for exploration of other issues beyond the association of staffing levels and outcomes, including:

- ▶ What are the mechanisms by which nurse staffing influences outcomes? Missed care has been identified as one possible mediator^{12 13} but is it the only one?
- ▶ How do differences in the level of education, professional qualifications and role of nursing assistant staff across countries influence the relationship of nursing assistant staffing to patient outcomes and the interaction of nursing assistant staffing and professional nurse staffing in assuring patient safety and delivering reliable care?

- ▶ How do differences in education and experience of professional nurses and nursing assistant staff modify the level of staffing needed to assure safe and reliable care? To what extent do education, nurse specialty training, years of experience and tenure on a unit allow staffing at lower levels with comparable degrees of safety?
- ▶ How does work environment, measures of teamwork and care organisation influence the association of staffing and outcomes, measuring these across hospitals or units, as has been previously done,¹⁴ but measuring the effect of staffing levels using within unit variation?

The limitations of these studies notwithstanding, we believe the existing evidence is sufficient to reach the general conclusion that nurse staffing levels are causally related to important health outcomes for patients in general medical wards. What is needed now is an understanding of what is the threshold of professional nurse staff and complementary staff needed to achieve optimal outcomes, and how are these levels influenced by patient nursing acuity and the education, experience, organisation and work environment of the nurse workforce.

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