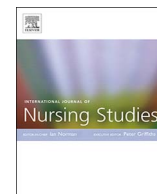




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Post-operative mortality, missed care and nurse staffing in nine countries: A cross-sectional study

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ABSTRACT

Background: Variation in post-operative mortality rates has been associated with differences in registered nurse staffing levels. When nurse staffing levels are lower there is also a higher incidence of necessary but missed nursing care. Missed nursing care may be a significant predictor of patient mortality following surgery.

Aim: Examine if missed nursing care mediates the observed association between nurse staffing levels and mortality.

Method: Data from the RN4CAST study (2009–2011) combined routinely collected data on 422,730 surgical patients from 300 general acute hospitals in 9 countries, with survey data from 26,516 registered nurses, to examine associations between nurses' staffing, missed care and 30-day in-patient mortality. Staffing and missed care measures were derived from the nurse survey. A generalized estimation approach was used to examine the relationship between first staffing, and then missed care, on mortality. Bayesian methods were used to test for mediation.

Results: Nurse staffing and missed nursing care were significantly associated with 30-day case-mix adjusted mortality. An increase in a nurse's workload by one patient and a 10% increase in the percent of missed nursing care were associated with a 7% (OR 1.068, 95% CI 1.031–1.106) and 16% (OR 1.159 95% CI 1.039–1.294) increase in the odds of a patient dying within 30 days of admission respectively. Mediation analysis shows an association between nurse staffing and missed care and a subsequent association between missed care and mortality.

Conclusion: Missed nursing care, which is highly related to nurse staffing, is associated with increased odds of patients dying in hospital following common surgical procedures. The analyses support the hypothesis that missed nursing care mediates the relationship between registered nurse staffing and risk of patient mortality. Measuring missed care may provide an 'early warning' indicator of higher risk for poor patient outcomes.

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What is already known about the topic?

- Research spanning decades has reported that lower registered nurse (RN) staffing is associated with higher levels of case-mix adjusted patient mortality.
- Lower RN staffing is also associated with a greater risk that necessary nursing care is missed due to lack of time.
- Mediation analysis has shown that missed care explains the association between nurse staffing and patient experiences with care.

What this paper adds

- Building on earlier previously published findings from an observational study of 422,730 patients who underwent common surgeries in 300 European hospitals, this paper provides evidence of an association between missed nursing care and post-surgical mortality.
- Missed nursing care is a mediator in the relationship between nurse staffing and mortality.
- The analysis supports the existence of a causal relationship between nurse staffing and patient outcomes; an interpretation of the relationship that has hitherto been contested.

1. Background

Case-mix adjusted mortality rates have become a common indicator of the effectiveness of health care (Goranitis and Fischer, 2015). Even when restricting analysis to a defined group of patients – for example, those undergoing common surgical procedures – wide variations in case-mix adjusted mortality rates are reported between hospitals (Ghaferi et al., 2009). In some healthcare systems complications and mortality rates are used as a performance metric for hospitals or individual surgeons (Lilford et al., 2004). The premise is that if factors related to the patient are taken into account through case-mix adjustment, any remaining differences between hospitals in the odds of patients dying during their hospitalization or within a short period following their discharge may reflect differences in the treatment and care provided. However, it is unclear to what extent the variation in patient deaths across hospitals is related to differences in post-surgical care.

Hospitals with high and low mortality rates are reported to have very similar rates of postoperative complications, whereas the risk of death following complications after surgery varies substantially (Ghaferi et al., 2009). To lower post-operative mortality it may therefore be as important to ensure effective management of complications as it is to reduce the incidence of complications.

In their review of post-operative care following common surgery, the Royal College of Surgeons (RCSE, 2011) in England highlights the importance of adequate ward-based nurse staffing to deliver a “reliable tiered pathway of care” to detect and respond to patients who develop complications. The relevance of adequate nurse staffing to patient outcomes and hospital mortality rates is borne out by research (Kane et al., 2007). Studies report an observed association between higher hospital mortality rates and lower levels of registered nurse staffing. Much of this research has come from hospitals in the US but over the past 10 years the same patterns of association have been reported in studies across Europe and other parts of the world (Aiken et al., 2014; Griffiths et al., 2016a; Twigg et al., 2010).

More recently researchers have shown that missed care is twice as common in some European hospitals as in others, and examined the relationship between nurse staffing levels and missed care (also termed ‘nursing care that is left undone’, ‘incomplete care’, or ‘rationed care’) (Ausserhofer et al., 2014). When registered nurse staffing levels are low, nursing care is more likely to be reported as missed due to lack of time (Ausserhofer et al., 2014; Ball et al., 2014). A higher rate of missed care in turn relates to lower safety grades reported by nurses (Ball et al., 2014), patients being less likely to rate their hospital highly (Bruyneel et al., 2015), and increased risk of falls and other adverse events

(Kalisch et al., 2013). Missed care is thus both an outcome of low nurse staffing as well as a potential predictor of patient experience and outcomes; it may be a key mechanism through which nurse staffing has an effect on patient outcomes (Needleman, 2016). However, this hypothesis that missed care explains the observed relationship between staffing and mortality has remained largely untested, with few analyses directly assessing it by studying both relationships simultaneously. A recent study has confirmed missed care as a mediator for the association between nurse staffing and patient-reported experience. (Bruyneel et al., 2015)

Establishing whether missed care increases the risk of patient deaths following surgery will clearly have important patient safety implications. If it is established as a mediator it might be that reports of missed care could provide a leading indicator of nursing related safety. And if missed care not only relates to risk of death following surgery, but partly explains the relationship between staffing and mortality, it would also support the existence of a causal relationship between nurse staffing and outcomes – an interpretation of the relationship that has hitherto been contested (Griffiths et al., 2016b).

2. Methods

2.1. Study design and participants

This is an observational study exploring the relationship between nurse staffing, missed care and mortality. It seeks to explore whether there is an association between missed care and mortality and, through mediation analysis, determine whether this relationship can explain the association between nurse staffing levels and mortality.

The study uses administrative data on hospital patients and hospital characteristics and a survey of nurses in 300 hospitals in nine European countries (Belgium, England, Finland, Ireland, the Netherlands, Norway, Spain, Sweden, and Switzerland). Information about the 300 hospitals (e.g. bed size, available technology, teaching status) was provided by administrators and supplemented with publically available data. The patient data are based on 422,730 patients aged 50 years or older who underwent common general, orthopedic, or vascular surgeries and were discharged from these 300 hospitals between 2007 and 2009—the year most proximate to the nurse survey in each country for which data were available. The nurse survey data are from 26,516 registered nurses (RNs) in the same 300 hospitals and were collected in 2009–2010. In each country the survey covered a minimum of 30 general acute care hospitals, each with at least 100 beds. The study included most adult acute care hospitals in Norway and Ireland, and geographically representative samples of hospitals in the other countries. In Sweden, all hospitals were included by surveying medical and surgical nurses nationally. The survey response rates averaged 62%. The study protocol (Sermeus et al., 2011) and approach to defining and analyzing patient mortality data⁶ are described in detail in earlier publications.

The study protocol was approved by the ethics committee at Katholieke Universiteit Leuven, which was the coordinating centre for the study, and by the relevant ethical committees in all participating countries. Country level approvals to acquire and analyze patient outcomes data were also obtained.

2.2. Measures

2.2.1. Mortality and related measures

The primary outcome measure is patient mortality following surgery within 30 days of admission. It was measured using administrative data on discharge status (death or survival), length of stay (less than 30 days) and adjusted for surgical procedure undergone (43 dummy variables for the specific surgery types), patient age, sex and admission type (emergency or elective). Established definitions were used for common surgical procedures and comorbidities (Silber et al., 2000).

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