Using hospital standardised mortality ratios to assess quality of care — proceed with extreme caution

Ian A Scott, Caroline A Brand, Grant E Phelps, Anna L Barker and Peter A Cameron

ABSTRACT

- Australian Health Ministers have endorsed the hospital standardised mortality ratio (HSMR) as a key indicator of quality and safety, and efforts are currently underway towards its national implementation.
- In the United Kingdom, Canada, the Netherlands and the United States, the HSMR has been used for several years within organisations to monitor performance and response to various quality and safety programs. In the UK and Canada, the HSMR is also publicly reported and used to compare performance between hospitals.
- The validity and reliability of the HSMR as a screening tool for distinguishing low-quality from high-quality hospitals remain in doubt, and it has not yet been proven that HSMR reporting necessarily leads to worthwhile improvement in quality of care and patient outcomes.
- Institutions may respond to an unfavourable HSMR by "gaming" administrative data and risk-adjustment models or implementing inappropriate changes to care.
- Despite its apparent low cost and ease of measurement, the HSMR is currently not "fit for purpose" as a screening tool for detecting low-quality hospitals and should not be used in making interhospital comparisons. It may be better suited to monitoring changes in outcomes over time within individual institutions.

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There is growing interest in assessing Australian hospital performance using routinely collected administrative data. The hospital standardised mortality ratio (HSMR) has emerged as a potentially universal system-level indicator for comparing mortality between hospitals both within and across different jurisdictions (Box). It is presently reported in the United Kingdom, Sweden, Netherlands, Canada, United States and Australia,[1,2] and is being used to gauge success of several large-scale safety campaigns in both the US[3] and Canada.[4] In November 2009, the Australian Health Ministers endorsed the approach recommended by the Australian Commission on Safety and Quality in Health Care for the implementation and reporting of a core set of national indicators of safety and quality that included the HSMR.[5] Working groups are now studying its implementation.[6] Researchers from Flinders University in Adelaide have recently argued the case for using the HSMR as a screening tool for safety and quality in Australian hospitals.[7] In Canada[8] and the UK,[9] there is already public reporting of HSMRs for individual hospitals. In Australia, there is similar political commitment to public reporting of comparative hospital quality and safety performance, with a national reform agenda[10] and the MyHospitals website (http://www.myhospitals.gov.au).

In this article, we argue that the methodology underpinning the all-admission, hospital-wide HSMR is not sufficiently robust for its use as an external, publicly available, cross-sectional screening tool in identifying hospitals associated with above-average mortality, which is then attributed (rightly or wrongly) to lower quality care. Instead, diagnosis-specific HSMRs may serve as more useful tools for monitoring changes in mortality of high-volume, high-risk conditions over time within single institutions as a marker of broad secular trends in care improvement and effects of local quality improvement initiatives.

Problems with using HSMR as a screening tool for detecting poor-quality hospitals

Low signal-to-noise ratio

Death occurs in 5%–10% of all hospitalised patients. Most of these deaths (between 95%[11] and 98%[12]) reflect the natural history of disease, not poor-quality care. Conversely, most quality problems, while associated with injury and prolonged hospital stays, do not cause death. Consequently, the HSMR, as a screening instrument for quality, is limited by low sensitivity (most quality problems do not cause death) and low specificity (most deaths do not reflect poor-quality care). Past simulation studies using mortality data from 190 US hospitals reveal that almost two-thirds of poor-quality hospitals (in which 25% of deaths were classified as preventable) demonstrated no significant increase in HSMR.[13] A further limitation is that, in the absence of data linkage systems, the HSMR will not encompass deaths that occur after discharge or interhospital transfer, some of which may reflect poor-quality inpatient care.[14]

Low criterion validity

The available evidence indicates a weak and inconsistent association between HSMR and other measures of quality of care when performed as between-hospital comparisons. In one review of 378 patients who died from stroke, myocardial infarction or pneumonia in 11 outlier hospitals with substantially higher HSMRs, no differences were seen, compared with hospitals with lower HSMRs, in adherence rates for 31 recommended processes of care.[15] Even differences in risk-adjusted mortality rates for three high-risk clinical conditions — acute myocardial infarction, heart failure and pneumonia — correlated very poorly with variations in 10 condition-specific process measures of quality reported across 3657 US acute-care hospitals.[16] A recent systematic review of 31 studies concluded that risk-adjusted mortality is a poor predictor of preventable complications and quality problems among hospitals.[17]

Adequacy of risk adjustment

In rendering the HSMR more able to distinguish low-quality from high-quality hospitals, much attention is given to optimising statistical models that adjust for differences between hospitals in patient characteristics that increase the risk of death, but which are independent of the quality of care.[18] While risk-adjustment models based on administrative data appear to be equivalent to those

The hospital standardised mortality ratio (HSMR)

- The HSMR compares the observed number of deaths in a hospital with the expected number of deaths based on jurisdictional (state or national) data, using a logistic regression model that adjusts for factors that affect the risk for inhospital death, such as age, principal diagnoses, comorbidities, length of hospital stay, and route of admission.

  HSMR = (No. of deaths among diagnoses included in sample ÷ Expected no. of deaths among diagnoses included in sample) × 100.
- HSMR = 100 indicates that a hospital's observed mortality rate equals that expected on the basis of its casemix.
- HSMR > 100 indicates that a hospital's mortality rate exceeds the expected value (ie, it exceeds the average value for hospitals with the same types of patients).
- HSMR < 100 indicates a lower than expected mortality. The underlying assumption is that excess deaths include potentially avoidable deaths resulting from poor-quality care.
- In most cases, calculating the ratio involves assigning a probability of dying to each patient included in the dataset who has received a diagnosis or undergone a procedure that is one of about 65 conditions and procedures that account for 80% of all hospital deaths. ◆

based on clinical data in predicting risk for selected, well defined primary diagnoses within large datasets,[19] both types of model may not sufficiently adjust for differences in casemix between individual hospitals. Certain comorbidities relevant to risk adjustment — such as obesity, dementia and heart failure — are inconsistently recorded in hospital statistics,[20] as is overall functional status.[21] This means that diagnosis coding may not distinguish full recovery from persistent disability. Accordingly, tertiary hospitals receiving patients with severe, complicated or end-stage disease may be disadvantaged compared with secondary hospitals that retain patients with less severe, uncomplicated disease.[22] The HSMR may be falsely elevated or reduced according to variations in coding of present-on-admission comorbidities versus new diagnoses arising during admission, which may reflect avoidable complications.[23,24] If differences in coding are non-randomly distributed among hospitals, differences in HSMR will reflect these biases rather than quality of care. In a recent US study involving more than 2.5 million discharges from 83 acute care hospitals,[25] four common risk-adjustment models — including the method advocated by researchers at Flinders University[6] — produced substantially different mortality rates. In 2006, 12 out of 28 hospitals with higher than expected hospital-wide mortality as classified by one method had lower than expected mortality when classified by one or more of the other methods. Explanations included disparate statistical methods, differences between hospitals in eligibility and exclusion criteria regarding admissions, and flaws in the hypothesised association between HSMR and quality of care.[25]

Different reference populations

Choosing which diagnoses or patient groups should be included in the reference populations used to generate risk-adjustment models is particularly problematic. Admission practices for unplanned presentations vary across hospitals, with some institutions coding patients who die in emergency departments shortly after presentation as non-admissions. In Canada[8] and the UK,[9] even among coded admissions, hospitals exclude vague or undetermined diagnoses, which account for 20% of all deaths. While this maximises the accuracy of risk prediction, it further limits HSMR sensitivity for detecting quality problems. Conversely, specificity is reduced if models include patients who are receiving palliative or end-of-life care, or who have severe illness with dismal prognosis despite best care. Many of these patients will not be admitted to designated (and easily coded) inpatient palliative care units. In one UK hospital, 37% of admissions were found on case review to be for end-of-life care, compared with the reported coded figure of 22%, resulting in a fall of the HSMR from 105 to 68.[21] In a Canadian study, the HSMR for one hospital over 2 financial years dropped from 148 to 55 after removal of palliative care patients.[12] The HSMR may also vary according to whether a palliative care classification is present-on-admission or applied at various times during an admission that may in fact have involved a quality event.[18]

Small sample size and imprecision

The HSMR becomes more imprecise for small hospitals with fewer deaths as a function of fewer admissions. The resultant wide confidence intervals preclude detection of statistically significant outliers that warrant more detailed investigation. Statistical techniques such as regression to mean, shrinkage estimators and enlarged sample sizes (using multiyear data)[26] can be used to improve precision. However, their application requires further validation, and those dependent on data gathered over several years in the past are less relevant to current practice.

Uncertain stability over time

At the hospital level, HSMRs should be relatively stable over time, and immune to seasonal and annual fluctuations. Although some studies confirm this,[6,27] others show substantial short-term changes in HSMR beyond those reasonably attributable to clinical advances or quality-of-care improvements.[2,12]

Potential to mislead

In the absence of wide awareness of its limitations and careful clinical interpretation, the hospital-wide HSMR can mislead. Unfavourable HSMRs based on incorrect data or analyses can trigger external inquiries that stigmatise individual hospitals, lower morale and public confidence, and encourage "gaming" of data — eg, by upgrading risk assessments[28] — or the pursuit of inappropriately aggressive care.[29] The HSMR also overlooks factors that may account for seemingly better performance, such as greater access to step-down facilities, hospice or residential care, or community health services that reduce length of stay and risk of inhospital death.[30] Compared with HSMRs specific to clinical condition, hospital-wide HSMRs do not enable hospital clinicians or administrators to easily pinpoint correctable processes of care at the level of the individual departments or units that account for most quality problems (eg, surgery at Bundaberg Base Hospital in 2003–2005 and paediatric cardiac surgery at Bristol Royal Infirmary in 1984–1995). Even within a hospital whose overall HSMR is 100 or less, individual diagnoses and procedures may demonstrate higher than expected mortality.

Does the overall HSMR as a screening tool engender quality improvement?

There are relatively few studies (all of which are uncontrolled before–after analyses) assessing whether individual hospitals with initial HSMRs above 100 have responded by implementing quality improvement programs that have then led to subsequent reductions in HSMR.[30,31] In these studies, it remains unclear whether the HSMR was chosen as a quality measure by hospital staff wanting to enact quality improvement in response to other indicators of concern, or whether a pre-existing HSMR was itself the primary catalyst for action. It is also uncertain whether subsequent improvement in HSMR was due to chance, regression to the mean, changes in coding and admission policies, removal of palliative care patients, secular trends, or real effects of local practice optimisation.[12]

In 2009, a UK hospital guide stated that HSMRs had drawn attention to hospitals of concern, most notably Mid Staffordshire NHS Foundation Trust, and that, as a consequence, this hospital subsequently reduced its HSMR from 127 to 93 in just 2 years.[9] However, the HSMR had been elevated for at least 3 years before a public inquiry exposed its poor standards of care, which were already well known to hospital staff.[32] The inquiry, not the reporting of HSMR, was the likely catalyst for remedial action. Most of the decrease in the HSMR (from 127 to 93) occurred very quickly — within 12 months of the inquiry — suggesting that patient de-selection and coding changes were largely responsible for the observed decrease in mortality, not practice change.[32] Moreover, at least 21 other hospitals in the UK have demonstrated HSMRs above 100, of which seven have had HSMRs higher than Mid Staffordshire for at least 5 years.[9] These observations challenge the notion that the HSMR, as a screening tool for quality, can, by itself, predictably drive practice improvement and distinguish local improvement effects from broad secular trends.

Alternative strategies for using the HSMR in improving quality

To be a reliable and trustworthy quality-assessment tool, the HSMR requires comprehensive and valid patient-level data, robust risk adjustment, intimate knowledge of its limitations, and an ability to pinpoint potential quality problems. As none of these criteria are currently being met, we believe that the overall HSMR is not yet sufficiently mature to be applied to all hospitals at one point in time and serve as a useful national indicator of hospital quality.

An alternative strategy worthy of more research might be to use the overall HSMR to monitor changes in mortality over time internally within individual hospitals. This could be complemented by diagnosis-specific HSMRs, again calculated at the hospital level, for well defined, high-volume, high-risk diagnoses associated with evidence-based standardised care processes.[33] Diagnosis-specific HSMRs would allow correctable variances in care to be easily ascertained. Such within-hospital monitoring circumvents much of the confounding inherent in between-hospital comparisons, as each hospital serves as its own historical control, assuming no substantive change in coding practices and casemix over the short to medium term. Health roundtables could be convened wherein different hospitals share information on how they have identified, responded to, and evaluated improvement in care deficiencies with the aid of diagnosis-specific HSMRs.

However, within-hospital HSMRs, even if they are calculated annually, must be accompanied by other tools for the early detection of poor-quality care at the individual hospital level. These include:

- Mandated chart review of all inhospital deaths, and those occurring within 2 weeks after discharge.
- Ongoing audit or registry-based review of evidence-based clinical processes for high-volume, high-risk conditions. While process-of-care indicators must be chosen with care (in terms of patient eligibility criteria and clinical documentation of reasons for exclusion) and audits are more resource intense, they identify deficiencies amenable to quality-improvement strategies that hospitals can readily implement.[34]
- Adverse event screening and targeted case review of all incidents likely to reflect quality problems for which preventive strategies are available (eg, unplanned transfers to intensive care, catheter-related bacteraemias, venous thromboembolism, serious medication errors).[35]
- Use of risk-adjusted control charts that flag unfavourable trends in outcomes of specific diagnoses[36] or patient populations.[37]

Conclusion

The overall HSMR based on routinely collected data can falsely label hospitals as poor performers and fail to identify many that harbour quality problems. The overall HSMR is not yet "fit for purpose" as a quality-screening tool for all hospitals. To avoid inappropriate responses, it should not be used in publicly reported interhospital comparisons. Diagnosis-specific HSMRs, calculated at the level of individual hospitals, are a potentially more fruitful method for monitoring mortality over time for specific diagnoses, which may allow earlier identification of care deficiencies that are responsive to hospital quality improvement programs.

Competing interests

None identified.

Author details

Ian A Scott, MHA, MEd, FRACP, Director[1]
Caroline A Brand, BA, MPH, FRACP, Associate Professor[2]
Grant E Phelps, MBA, FRACP, AFRACMA, Gastroenterologist[3]
Anna L Barker, BPhty, MPhty, PhD, Research Fellow[2]
Peter A Cameron, MB BS, MD, FACEM, Director[2]

1 Department of Internal Medicine and Clinical Epidemiology, Princess Alexandra Hospital, Brisbane, QLD.

2 Centre for Research Excellence in Patient Safety, Monash University, Melbourne, VIC.

3 Ballarat Health Services, Ballarat, VIC.

Correspondence: ian_scott@health.qld.gov.au

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