Where Does Risk-Adjusted Mortality Fit Into a Safety Measurement Program?

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Perspective

Much attention is being focused worldwide on identifying and using robust, easy to collect, and universally applicable measures of hospital safety. The risk-adjusted hospital mortality rate (R-AHMR)—and its various incarnations including the hospital standardized mortality ratio (HSMR) and the standardized hospital mortality indicator (SHMI)—is one such measure. The commonly used HSMR is a ratio of the observed number of in-hospital deaths to the number expected based on the hospital's case mix. Ratios greater than 1 (or 100 depending on how the ratio is reported) are seen to suggest unsafe care, while ratios less than 1 (or 100) are seen to suggest safe care. These measures have become popular as screening tools for hospital safety in the United Kingdom, Sweden, Netherlands, Canada, United States, and Australia.(1,2)

It's easy to see why R-AHMRs have become popular: they relate to a hard end-point that everyone would consider important; they are easy to assemble from routinely collected administrative datasets; they are amenable to powerful statistical analyses; they enable comparisons between institutions; and their graphical formats are seemingly easy to interpret. Advocates contend R-AHMRs shed public light on unsafe hospitals and spur them on to improve much faster than would occur by their own introspection or through public reporting of less tangible measures.

Flaws in the looking glass

But as indicators of unsafe hospitals, R-AHMRs possess some basic flaws.(3) First, they deal with an outcome—death—that is comparatively rare (5% to 10%) among contemporary hospitalized patients. Moreover, when in-hospital deaths are subjected to forensic clinical analysis, studies show that only 5% can be attributed to unsafe care.(4) Because of these low frequencies, mathematical modeling suggests that among 100 hospitals with a R-AHMR above average, only 8 will truly be more unsafe than the average hospital.(5) Conversely, 10 out of 11 hospitals that are actually more unsafe than average would demonstrate an average or below average R-AHMR, given that most quality problems, while associated with injury and prolonged hospital stays, do not cause death.(5) Consequently, as a screening tool for safety, R-AHMRs are limited by low sensitivity (most unsafe practices do not cause death) and low specificity (most deaths do not reflect unsafe care).

Sensitivity may be increased by enlarging the number of evaluable deaths by including those occurring up to 30 days after admission, on the premise that, as a result of today's short hospital stays, unsafe inpatient care may not manifest as death until after discharge.(6) But when is postdischarge patient mortality more likely due to poor hospital care than to poor community-based care or simple natural history of disease—is it after 7, 10, 30, or even 90 days? Specificity may be increased by excluding those deaths that can reasonably be attributed to advanced disease with a poor prognosis, despite the very best care. But this presupposes that terminally ill or palliative patients are managed in much the same way and reliably coded across all hospitals. Some Canadian hospitals were able to reduce their HSMR from "very bad" (more than 100) to "really good" (less than 100) in just 12 months just by recoding palliative care patients—without any change in the quality of care.(7) And what do we do with the patient rendered "palliative" by some rare but egregious medical misadventure?(8)

The second major flaw relates to risk adjustment. Despite best efforts to homogenize hospital patient populations, when using R-AHMRs as a screening tool, we must adjust for differences between hospitals in patient-related prognostic factors that are independent of safety. But the outputs of risk adjustment regression models depend on the input variables, which can vary considerably.(9) Certain comorbidities that impact on mortality (such as morbid obesity, dementia, and heart failure) are inconsistently recorded in hospital statistics, as is the level of frailty and disability.(10) Comorbidities present at the time of admission must be reliably differentiated from new diagnoses arising during hospitalization, which may reflect avoidable complications.(11) Removing vague or undetermined diagnoses may render risk adjustment more accurate, but as these account for around 20% of all hospital deaths in Canada and the United Kingdom (12,13), this further limits R-AHMR sensitivity. Different risk adjustment models also produce substantially different R-AHMRs, with 1 large US study involving 83 acute care hospitals showing that when 4 different but commonly used risk-adjustment models were applied to mortality data from each hospital, 12 out of 28 hospitals with high R-AHMRs as classified by 1 model had low R-AHMRs when classified by 1 or more of the other models.(14)

The third major flaw is the weak and inconsistent correlation between hospital-wide R-AHMRs and explicit quality indicators. In a chart review of 378 patients who died from stroke, myocardial infarction, or pneumonia in 11 outlier hospitals with elevated HSMRs, no differences were seen compared to hospitals with lower HSMRs in adherence rates for 31 recommended processes of care.(15) A systematic review of 36 similar studies concluded that R-AHMRs are poor predictors of unsafe hospital care.(16)

Effects of misunderstood mortality rates

If their limitations are not appreciated, R-AHMRs can mislead and have unintended effects. Unfavorable rates arising from erroneous data or analyses can trigger external inquiries that stigmatize individual hospitals, lower morale and public confidence, and encourage "gaming"—for example by upgrading risk assessments—or the pursuit of inappropriately aggressive care. Moreover, HSMRs by themselves do not drive quality improvement. Although the Mid-Staffordshire hospital system in the UK had elevated HSMRs for years, it was whistleblowers among staff and patients who attracted the public attention that led to the 2009 inquiry, while 21 other UK hospitals with similarly elevated HSMRs escaped attention.(13) In addition, most of the subsequent decrease in the Mid-Staffordshire HSMR (from 127 to 90) occurred during the course of the inquiry as a result of patient deselection and coding changes, before the completion of any substantial remedial work.(17)

Other studies have shown that movements in HSMR, either up or down, are more often due to random variation, regression to the mean, coding variations, and secular trends than to changes in practice safety.(7,9) Even if all hospitals provided a reasonable level of safety, as the HSMR is a relative measure, there will always be hospitals with ratios above 100.(18)

Finally, hospital-wide R-AHMRs do not enable hospital clinicians or administrators to easily pinpoint correctable processes of care at the level of individual units. Even within a hospital whose R-AHMR seems reasonable, individual diagnoses and procedures may demonstrate higher than expected mortality.

Alternative perspective on mortality rates

R-AHMRs may be more suited to monitoring changes in mortality over time within individual hospitals, thus circumventing much of the confounding inherent in between-hospital comparisons. In this way, each hospital serves as its own historical control, assuming no substantive change in coding practices, patient case mix, or service configuration over the short to medium term. But perhaps we should turn our attention away from R-AHMRs to ensuring mandated and timely peer review of every in-hospital death and using continuously monitored risk-adjusted statistical process control methods (19) to flag unfavorable trends in diagnosis-specific mortality at an early stage when only a very small number of excess deaths have occurred.

First do no harm by avoiding faulty statistics and interrogate every death

Hospital-wide R-AHMRs based on routinely collected data are blunt and inaccurate screening tools for identifying hospitals that are putatively more unsafe than others. They can falsely label hospitals as poor performers and fail to detect many others that harbor problems. In contrast, timely review of all in-hospital deaths and continuous monitoring of diagnosis-specific mortality trends within hospitals may provide more productive and acceptable means for identifying and responding to unsafe care.

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