Editor’s Perspective

Registry Studies for Improving the Quality of Cardiovascular Care

The Role of Variance Components

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In this issue of Circulation: Cardiovascular Quality and Outcomes, 2 seemingly unrelated articles appear that utilize clinical registry data: Curtis et al1 utilize the American College of Cardiology’s CathPCI Registry to calculate hospital-specific 30-day risk standardized mortality rates following percutaneous coronary intervention whereas Likosky and colleagues2 exploit the Northern New England Cardiovascular Disease Study Group’s cardiac surgery registry to identify factors associated with patient-specific low output failure after coronary bypass grafting surgery. The former is concerned with estimating between-hospital variation in patient outcomes and the latter aims to quantify between-surgeon and between-patient variations in patient outcomes. Although the questions are similar, the authors have focused on different statistical summary measures.

Curtis and colleagues use > 100,000 admissions to assess quality of hospital care across 602 hospitals and estimate hospital-specific performance measures using hierarchical (or random effects) logistic regression models. Likosky and colleagues study 12,000 coronary bypass grafting admissions across 32 surgeons also using hierarchical logistic regression models. Both articles capitalize on clinically rich data collected on consecutive patients and both find between-provider (hospitals or surgeons) variation that may impact outcomes.

Initial efforts at assessing quality of care primarily employed tests of excess variation and then shifted to indices of variability (eg, coefficient of variation,3 systematic component of variation).4 These indices were shown to be sensitive to the number of providers, the per-provider sample size, and the underlying event rate.5 Modern methods, as illustrated in these 2 articles, involve the use of hierarchical regression modeling based on clinically rich data sets. The main idea with this approach is to specify a probability model for each “hierarchy” of the data—a model for patients nested within hospitals (or within surgeons) and then a model for hospitals (or surgeons)—thereby partitioning the sources of variation.

In their logistic regression model, Curtis et al report that the odds of 30-day mortality for a hospital 1 SD below average quality is 1.9 times that of a hospital 1 SD above average quality. The odds ratio summary represents a function of residual variation—residual meaning after accounting for the observed patient characteristics and sampling variability associated with percutaneous coronary intervention volume differences among hospitals. They report the estimated variance of the random hospital effects as 0.1024, which is difficult to interpret because it is measured in units of “log-odds of baseline risks,” and hence the reason for transforming this quantity into an odds ratio. Although the Curtis article chronicles the explained variation, this is only reported using the (nonhierarchical) logistic regression model.

In contrast, the Likosky article reports 58% of the explained variation in patient outcomes is attributed to surgeons, concluding that “While preoperative factors certainly help to explain some of the variation in the rates of low output failure, most of the variation is attributed to the surgeon.” The fact that more than half of the explained variation in low output failure is due to surgeon leads the authors to conclude that this may be too much practice variation. However, we do not know how much of the observed variation can be attributed to surgeons. Moreover, the authors restricted their analyses to those surgeons who treated at least 80 patients and so the between-surgeon variation is underestimated.

What is too much variation? Whether this is too much variation is content-specific as it depends on the depth and breadth of the patient characteristics used (and not used) by the authors. The need for partitioning and reporting both observed and explained variation is increasingly important as more detailed clinical registries are utilized to assess quality. It is only by measuring and reporting how much observed variation and how much explained variation may be attributed to the various hierarchies of healthcare providers that we will be able to target and improve cardiovascular quality of care.

Sources of Funding

Dr Normand is supported by Contract DHHS/FDA-22320110172C (The Medical Device Epidemiology Network Methodology Center) from the Center for Devices and Radiological Health, Food and Drug Administration.

Disclosures

In addition to the funding information acknowledged in this article, Dr Normand also receives funding from the Massachusetts Department of Public Health to develop and apply Bayesian hierarchical models for profiling hospitals in the Massachusetts and funding from Yale/Yale-New Haven Hospital Center for Outcomes Research and Evaluation to develop and apply Bayesian hierarchical models to assess quality of care delivered at US hospitals.

The opinions expressed in this article are not necessarily those of the American Heart Association.

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(Circ Cardiovasc Qual Outcomes. 2012;5:e42-e43.)

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Circ Cardiovasc Qual Outcomes is available at http://circoutcomes.ahajournals.org

DOI: 10.1161/CIRCOUTCOMES.112.968792
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Key Words: hospital ◼ quality of care ◼ registries
Registry Studies for Improving the Quality of Cardiovascular Care: The Role of Variance Components
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Circ Cardiovasc Qual Outcomes. 2012;5:e42-e43
doi: 10.1161/CIRCOUTCOMES.112.968792

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