

# Measuring the cost of adverse events in hospital

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**W**hat is the cost of an adverse event? This question, which now underpins many quality improvement efforts, initially interested only medical tort litigators and their clients. In 1991, the Harvard Medical Practice Study I was one of the first systematic attempts to measure the frequency of health care–related adverse events among hospital inpatients.<sup>1</sup> In that seminal study, researchers reviewed patient charts for evidence of adverse events “caused by medical care.” Their approach was soon replicated in the United Kingdom, Australia and New Zealand.<sup>2</sup> While the Harvard study’s initial focus was on identifying negligence, the field evolved to highlight incidents that were potentially preventable.<sup>3,4</sup> In 2014, the landmark Canadian Adverse Events Study reported adverse events in 7.5% of hospital admissions, with 37% of these events deemed preventable.<sup>5</sup>

A decade later, the Canadian Institute for Health Information (CIHI) and the Canadian Patient Safety Institute developed algorithms to identify adverse events using health administrative data ([www.cihi.ca/sites/default/files/document/hospital\\_harm\\_summary\\_en.pdf](http://www.cihi.ca/sites/default/files/document/hospital_harm_summary_en.pdf)). It paved the way for scaled, reproducible measurements of adverse events in Canada. The authors of the CIHI report estimated that \$685 million was spent Canada-wide in 2014–2015 on hospital-based adverse events; however, no detailed costing analysis was included in the report.

A linked study provides estimates of the health system impact of “hospital harm,” as identified using CIHI’s algorithms.<sup>6</sup> Using health administrative data for almost half a million patients in Ontario over a 1-year period (2015–2016), Tessier and colleagues estimated that hospital harm occurred in 5.9% of admissions. The authors compared the length and cost of patient-centred episodes of care (PCEs) for patients who did and did not experience hospital harm.<sup>6</sup> A PCE included all hospital- and community-based medical care, including home care and long-term care, that occurred in the 30 days after discharge from hospital. Across all types of admissions — and after adjusting for sociodemographic variables, type of hospital admission, measures of comorbidity and previous health care usage — admissions to hospital during which harm occurred were a week longer, the PCEs were more than 2 weeks longer and costs were substantially more than for no-harm scenarios.<sup>6</sup>

## KEY POINTS

- Adverse health care events are of growing research and policy interest.
- Some adverse events may not be preventable and can also be naturally occurring conditions.
- Health administrative data allow for scalable and reproducible measurement of adverse events, while lacking the detailed clinical information upon which to assess preventability.
- New research provides essential cost information to inform intervention and policy development, as well as evaluation.

The inclusion of PCEs in an analysis of this kind is novel and valuable, given that hospital-based adverse events can increase health care costs as much as 6 months later.<sup>7</sup> If adverse events trigger greater use of outpatient care and readmissions, then failing to account for these elements would miss much of their total impact to the health care system. In PCE methodology, readmissions occurring within 30 days of discharge are combined into 1 episode. As a result, patients who are readmitted frequently can be expected to have protracted PCEs. Measures of frailty and previous usage of health care are also valuable additions to the statistical model used to measure the cost of adverse events. Accounting for all sources of confounding becomes even more important when comparing PCEs because any residual bias is propagated beyond the index admission.

Reported rates of adverse events are widely considered to be underestimates because the diagnosed (and thus coded) portion may be the proverbial “tip of the iceberg.” Although some adverse events, such as inadvertently leaving a foreign body in a patient, are considered “never events” that are nearly universally preventable, others, such as delirium, are recognized to be sometimes caused by deficiencies in care and other times not. Coded events have good specificity compared with chart review. Yet, health administrative data algorithms do not permit a nuanced assessment of which adverse events could have been prevented by optimized care.<sup>5</sup>

As Tessier and colleagues note,<sup>6</sup> estimates of the degree of preventability vary — from 37% in the Canadian Adverse Events

Study to two-thirds in other reports from outside Canada.<sup>5,8</sup> Furthermore, rates of preventability can also differ depending on the type of adverse event.<sup>5</sup> For this reason, an earlier review by the Canadian Patient Safety Institute restricted its definition of adverse events to conditions with a “high specificity as a measure of [patient safety], as opposed to being a naturally occurring condition.”<sup>9</sup> Its list did not include electrolyte disturbances, urinary tract infection or delirium, the 3 most common adverse events mentioned in the CIHI report. Such conditions can occur naturally, particularly in patients who are older and functionally dependent, and cost estimates may be exaggerated if some naturally occurring events lead to more postacute care or readmissions. Any applications of Tessier and colleagues’ cost estimates must also account for uncertainty in the proportion of adverse events that are preventable.<sup>6</sup> For example, a cost-effectiveness analysis would need to include a preventability coefficient to appropriately scale the predicted effect of any intervention.

Along with adverse events, avoiding hospital readmissions has been a growing focus in the United States and Canada over the past decade. Hospitals in the US are penalized financially under the Hospital Readmissions Reduction Program for above-expected readmission rates and under the Hospital-Acquired Condition Reduction Program for above-expected rates of select adverse events.<sup>10,11</sup>

Although hospital harm is a known contributor to readmissions, other modifiable factors may be equally or more important. Comprehensive, high-quality transitional care has successfully prevented readmissions by improving patient self-management and continuity of care, while reducing adverse drug events after discharge.<sup>13</sup> Efforts aimed at preventing in-hospital adverse events have typically been focused on specific conditions. Given the clinical heterogeneity of adverse events, suitable broad interventions might involve institutional culture shifts or implementation of audit and feedback programs.

The availability of data on the cost of adverse events will undoubtedly draw the attention of Canadian policy-makers, who might consider recovering some of this expense from hospital budgets in the form of penalties. The partial preventability of targeted outcomes limits the beneficial effects of such a policy and could prove counterproductive. For example, much of the drop in (adjusted) readmission rates observed in the US after the introduction of the Hospital Readmissions Reduction Program could be explained by upcoding of patient complexity rather than by improved care.<sup>11</sup> Furthermore, penalties under the Hospital-Acquired Condition Reduction Program were not associated with any improvement in rates of adverse events<sup>10</sup> and disproportionately targeted teaching and safety net hospitals.<sup>12</sup> Hospitals providing higher-quality care were also more likely to face penalties.<sup>12</sup>

The linked study will benefit policy-makers in several ways: the authors have clarified the costs of adverse events in Canada, provided a baseline from which to assess changes over time,

quantified the investment that could be justified to prevent adverse events and offered estimates to be used in economic evaluations of future interventions. Because most interventions target a particular condition, costing by type of adverse event would be a valuable addition.

The substantial costs of adverse events are far reaching and cannot be ignored. An improved understanding of their overall impact can only reinforce our efforts at preventing them.

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