Concerns About Using the Patient Safety Indicator-90 Composite in Pay-for-Performance Programs

Ravi Rajaram, MD
Surgical Outcomes and Quality Improvement Center (SOQIC); and Department of Surgery and Center for Healthcare Studies, Feinberg School of Medicine, Northwestern University, Chicago, Illinois.

Cynthia Barnard, MBA
Department of Quality Strategies, Northwestern Memorial Hospital, Chicago, Illinois.

Karl Y. Bilimoria, MD, MS
Surgical Outcomes and Quality Improvement Center (SOQIC); and Department of Surgery and Center for Healthcare Studies, Feinberg School of Medicine, Northwestern Memorial Hospital and Northwestern University, Chicago, Illinois.

In 2003, the Agency for Healthcare Research and Quality (AHRQ) released 20 patient safety indicators (PSI) to facilitate measurement of adverse events. Though intended for internal quality measurement and improvement, several PSIs are now being widely publicly reported, including on the Centers for Medicare & Medicaid's (CMS's) Hospital Compare website. Additionally, on October 1, 2014 (fiscal year 2015), CMS began using AHRQ's Patient Safety for Selected Indicators (PSI-90) as a core metric in 2 of its pay-for-performance programs: the Hospital-Acquired Condition (HAC) Reduction program and the Hospital Value-Based Purchasing (VBP) program. PSI-90 is a composite measure consisting of 8 weighted component PSI measures (Table). In the HAC Reduction program, PSI-90 is responsible for 35% of the overall score, and the poorest-performing hospital quartile will have their CMS payments reduced by up to 1% (-$330 million). In the Hospital VBP Program, CMS will reallocate 1.5% (~$1.4 billion) of its diagnosis related group payments to hospitals according to their overall score, 30% of which is composed of PSI-90 and 4 other outcome measures. Thus, the PSI-90 composite measure has been given substantial weight in attempting to align the financial interests of hospitals with the quality of care they provide.

As evidenced by a lack of continued maintenance endorsement from the National Quality Forum in 2014, numerous problems exist with the current PSI-90 composite measure: (1) flawed component measures; (2) clinical areas targeted; (3) accuracy of adverse events identified; (4) adequacy of the risk adjustment; and (5) formulation of the composite measure. These flaws may incorrectly identify problem areas for hospitals to address, unfairly penalize hospitals financially, and adversely influence clinician engagement in quality improvement. However, there are opportunities to improve this measure in hopes of more accurately monitoring hospital performance for potentially preventable complications.

Concerns Regarding PSI-90

First, the PSI-90 measure includes components for which the measurement is flawed. For example, postoperative venous thromboembolism (VTE; PSI-12) measurement is vulnerable to surveillance bias (ie, more testing leads to more detection). In a recent study, as hospital-level rates of VTE diagnostic imaging increased (ie, "looking more for VTE"), there was a stepwise increase in PSI-12 event rates (ie, "finding more VTE"). Moreover, hospitals with higher VTE prophylaxis rates paradoxically had worse risk-adjusted performance on the PSI-12 VTE outcome measure when compared with hospitals with lower rates of VTE prophylaxis. Thus, the inclusion of the VTE outcome metric in PSI-90 may unfairly penalize many hospitals that have a high VTE event rate due to increased vigilance in detection, not poor quality of care. Similarly, other components of PSI-90, such as pressure ulcers (PSI-03), may also be subject to surveillance bias as the intensity of event detection practices may differ from hospital to hospital. Hospitals may be incorrectly directed to focus quality improvement efforts and resources on areas in which they do not actually have poor performance.

Second, PSI-90 is a composite measure that includes numerous component measures redundantly addressed by both the Hospital VBP and HAC Reduction programs. For example, central line–associated bloodstream infections (CLABSI; PSI-07) are effectively being quadruple counted: twice in the Hospital VBP program as a component of PSI-90 and as a separate CLABSI outcome measure based on a different, conflicting data source (National Healthcare Safety Network [NHSN]), and twice in the HAC Reduction program through, again, PSI-90 and the NHSN CLABSI measure. By including so much redundancy in pay-for-performance programs, hospitals are effectively penalized multiple times for the same event.

Third, some PSI-90 component measures are widely criticized for failing to accurately measure clinically relevant complications. The accidental puncture or laceration (PSI-15) component measure uses diagnosis codes of unintentional injury in an attempt to capture iatrogenic patient harm. However, studies suggest the accuracy of this measure to identify cases of meaningful unintentional injury is limited. In a multicenter evaluation of PSI-15 comparing coding with patient chart review, Utter and colleagues found that 9% of cases had no injury, 25% of patients had an "inconsequential" injury (eg, serosal tear), and the positive predictive value of clinically significant injuries was only 68%. Moreover, factors that were not preventable, such as adhesions or scar tissue, were present in more than 40% of the injuries identified. Thus, an appreciable number of PSI-15 events are of limited clinical consequence or are expected in the routine care of patients. Penalizing clinicians and hospitals inappropriately and unfairly undermines the confidence physicians have in quality measures and reduces the likelihood that administrators and clinicians will commit the resources and effort needed to engage in quality improvement.

Fourth, to derive the PSI-90 score for each hospital, patient demographics and comorbidities are used for risk adjustment. However, the quality and number of patient-level risk factors included in administrative data sets...
are limited, and comorbidities are not captured consistently across hospitals.

The final major concern with PSI-90 is the methodological approach used in its design. The component weights of PSI-90 are calculated using numerator weighting. This approach is based on the frequency of each component event in the reference population, with more frequently occurring events receiving higher weighting. For example, in the HAC Reduction program, the 2 problematic outcome measures, VTE (PSI-12) and accidental puncture or laceration (PSI-15), contribute 75% of the total PSI-90 score due to the relative number of events captured (PSI-12 = 0.2579; PSI-15 = 0.4917; Table). Numerator weighting also treats the degree of harm associated with each component measure as equivalent. However, the length of stay, cost, morbidity, and likelihood of mortality differ considerably for each complication (eg, a postoperative hip fracture vs early pressure ulcer).

### Opportunities to Improve PSI-90

Composite measures, such as PSI-90, may be improved in several ways. First, components found to be biased, having limited clinical significance, not actionable from a quality improvement standpoint, or fraught with unintended consequences must be excluded from high-stakes composite measures. Process measures may be a better measure of quality in some instances when the outcome measure is limited by surveillance or detection bias (eg, VTE prophylaxis process measures instead of the PSI-12 VTE outcome measure). Focusing on process measures may also mitigate concerns about inadequate risk adjustment. Iteratively modifying measures to be responsive to emerging evidence is also important for measure validity, stakeholder buy-in, and improving care. For example, several organizations that benchmark health care quality have ceased using VTE (PSI-12) as a quality indicator, in response to recent evidence and longstanding clinical intuition suggesting problems with its current construction. Composite measures used in pay-for-performance programs must be similarly flexible and responsive to empirical evidence.

Additionally, measures should be designed to target a diversity of areas in need of national quality improvement efforts. Redundancy in the use of measures creates a narrow focus that diverts resources to limited areas and may erode clinician engagement in the process. In designing composite measures and quality monitoring programs, stakeholders should look to identify multiple unique clinical opportunities to more broadly improve care.

Finally, excluding biased component measures and ensuring a more equitable weighting distribution will address many of the current methodological issues of concern. Moreover, incorporating the degree of patient harm associated with each type of component event into the weighting schema is necessary when formulating a composite measure of patient safety, and this will improve the acceptability of the measure by clinicians.

As currently constructed, CMS’s use of PSI-90 in pay-for-performance programs falls short in its attempt to accurately and fairly measure patient harm. A composite measure of quality is a useful and laudable aim, but PSI-90 must be improved to be effective in advancing the national priority of safe patient care.

---

### Table. Patient Safety Indicator-90 Composite Measure With Component Measure Weights

<table>
<thead>
<tr>
<th>Component Measures</th>
<th>Description</th>
<th>Weight in Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSI-15</td>
<td>Accidental puncture or laceration</td>
<td>0.4917</td>
</tr>
<tr>
<td>PSI-12</td>
<td>Postoperative pulmonary embolism or deep vein thrombosis</td>
<td>0.2579</td>
</tr>
<tr>
<td>PSI-13</td>
<td>Postoperative sepsis</td>
<td>0.0742</td>
</tr>
<tr>
<td>PSI-06</td>
<td>Iatrogenic pneumothorax</td>
<td>0.0708</td>
</tr>
<tr>
<td>PSI-07</td>
<td>Central line–associated bloodstream infection</td>
<td>0.0652</td>
</tr>
<tr>
<td>PSI-03</td>
<td>Pressure ulcer</td>
<td>0.0226</td>
</tr>
<tr>
<td>PSI-14</td>
<td>Postoperative wound dehiscence</td>
<td>0.0165</td>
</tr>
<tr>
<td>PSI-08</td>
<td>Postoperative hip fracture</td>
<td>0.0011</td>
</tr>
<tr>
<td>PSI-90</td>
<td>Composite sum</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Abbreviation: PSI, patient safety indicators.

* The National Quality Forum is currently reviewing PSI-90 for maintenance endorsement with proposed changes including reweighting of included measures. Components and adding 3 previously excluded component measures: perioperative hemorrhage or hematoma (PSI-09), postoperative physiologic and metabolic derangement (PSI-10), and postoperative respiratory failure (PSI-11).

---

**ARTICLE INFORMATION**

**Published Online:** February 5, 2015.


**Conflict of Interest Disclosures:** All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Dr Rajaram reports support by grant T32HS000078 from the Agency for Healthcare Research and Quality (AHRQ), the American College of Surgeons Clinical Scholars in Residence Program, and an unrestricted educational grant from Merck. Dr Bilimoria reports receiving support from the National Institutes of Health, AHRQ, American Board of Surgery, American College of Surgeons, Accreditation Council for Graduate Medical Education, National Comprehensive Cancer Network, American Cancer Society, Health Care Services Corporation, California Health Care Foundation, Northwestern University, the Robert H. Lurie Comprehensive Cancer Center, Northwestern Memorial Foundation, and Northwestern Memorial Hospital; and honoraria from hospitals, professional societies, and continuing medical education companies for clinical care and quality improvement research presentations. No other disclosures were reported.

**Additional Contributions:** We thank Jeanette Chung, PhD (Northwestern University), and Terri Halverson, MS, RN (Northwestern Memorial Hospital) for their intellectual contributions to this work. They did not receive compensation for their contribution.

**REFERENCES**


