EDITORIAL COMMENT

30-Day Readmission Rate Following Percutaneous Coronary Intervention

Much More Than a Binary Variable*

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Few situations in clinical medicine are as disheartening to patients, family, healthcare providers, and healthcare systems as readmission to the hospital shortly after discharge. Such events lead to a not-unexpected plethora of questions. From the patient and family: “What went wrong?” From the provider: “What did I do wrong?” From the healthcare system: “How do we prevent this from happening again?” “How much will this cost us?” Whereas the last question is now highly relevant (1,2), its origins are contentious (3). Nevertheless, readmissions, in general, and following percutaneous coronary intervention (PCI), in particular, represent a significant clinical (4,5) and economic (6) burden to our healthcare system. The identification of “preventable admissions,” “vulnerable patients,” and measures of performance and quality now occupy an ever-increasing fraction of our ever-decreasing available time as clinicians. The limited accuracy, precision, and reliability of complex statistical models designed to predict the risk for readmission (at both patient and hospital levels) no doubt reflect our inadequate understanding of the many covariates that have been correlated with vulnerability, performance measures, process of care, systems of care, and other powerful sociodemographic variables (7,8).

Over the past several years, a number of groups have analyzed 30-day readmission rates following PCI (Table 1) (9–16).

Understanding what these rates tell us, and what they do not, is crucial to understanding the problem at hand. First, the data in Table 1 are hospital-specific rates and not the risk of readmission for an individual patient. Second, with the exception of the study of Yeh et al. (10), the reported rates are crude: that is, they are unadjusted for the many differences in patient, facility, and system characteristics. Thus, any attempt to compare or contrast these rates is ingenious. Third, although most study designs ensured meaningful ascertainment, that is, >90% clinical follow-up following hospital discharge, concerns regarding population demographics, competing risk for death, variable site-specific criteria (or lack thereof) for readmission, and incompletely described concomitant cardiovascular disease remain. The latter, in particular, needs rigorous study because virtually all patients undergoing PCI have underlying cardiovascular disease and add to the difficulty in deciding whether to admit such patients presenting to an emergency department with protean complaints following PCI. The current study of Yost et al. (16) is an important step in this direction and highlights the difficulty in defining appropriate covariates for the analysis of this problem.

Important, what the studies in Table 1 do tell us is that patients who are readmitted are characterized by a greater disease burden, notwithstanding similar degrees of procedural success; they are at higher risk for late-term adverse outcomes, including death, even after adjusting for differences in disease severity/burden; and that patients who are readmitted are characterized by active coronary and non-coronary heart disease, by modifiable and nonmodifiable associated conditions, and to a significant degree “other” conditions. The current report by Yost et al. (16) as well as the reports from Curtis et al. (9) and Yeh et al. (10) make this point painfully clear. It is this “other” category that defies clinicians, statisticians, health policy experts, and regulators and that may be an important source of the unexplained variance in the readmission rate estimator. Hidden within “other” may well be further clues to understanding the impact of “process,” “place,” and “system.” It is ironic to posit that the declining length of in-hospital stay for PCI over the last several decades (17), in large part “encouraged” by altered reimbursement programs, may have contributed to this 30-day readmission quagmire. Longer in-hospital stay allows for additional opportunity to provide meaningful patient-centric care, such as education and attention to comorbidities often overlooked in the urgency of the PCI setting, whereas shorter lengths of stay may compromise these aspects of quality care and result in early post-discharge events leading to readmission (18). However, facilities providing such higher quality care resulting in lower mortality rates may put themselves at increased risk for readmission of patients (19).

In summary, 30-day readmission rates following PCI vary within and among recent studies with, on average, between...
1 in 8 and 1 in 12 patients readmitted for any cause and considerably fewer patients readmitted for a procedure-related reason. Where reported, models fail to account for a significant portion of the variance in readmission rates. Readmitted patients generally have higher disease burden, and, even after adjusting for baseline differences in disease burden, mortality risk at 1 year is higher for those readmitted. Modifiable factors, with a few notable exceptions, appear to be a minority among covariates associated with risk of readmission. What matters greatly are the numerous, and at present, imponderables and unknowns that reflect “process,” “system,” “quality,” and “place.”

Unfortunately, at the present time, we are unable to accurately and reliably encode these entities. Without such quantitative information the true risk for readmission, and its determinants, should remain a matter for further study rather than legislative fiat.

**Table 1. Day Readmission Rates Following PCI**

<table>
<thead>
<tr>
<th>First Author (Ref #)</th>
<th>Date/Study Design</th>
<th>Sample Size (No. of Sites)</th>
<th>30-Day Readmission Rate, % (Cause)</th>
<th>Range, %</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curtis et al. (9)</td>
<td>2005/claims based, retrospective cohort</td>
<td>315,241 (1,108)</td>
<td>14.6 (AC)</td>
<td>8.9–22</td>
<td>25% had repeat PCI</td>
</tr>
<tr>
<td>Yeh et al. (10)</td>
<td>2005–2008/prospective registry</td>
<td>36,060 (24)</td>
<td>12.4 (AC)</td>
<td>9.5–17.9</td>
<td>17.8% had repeat PCI</td>
</tr>
<tr>
<td>Khaejava et al. (11)</td>
<td>1998–2008/prospective registry</td>
<td>15,498 (1)</td>
<td>9.4 (AC)</td>
<td>NR</td>
<td>4.2% had repeat PCI</td>
</tr>
<tr>
<td>Meadows et al. (12)</td>
<td>2006/prospective MCO claims database</td>
<td>6,687 (NR)</td>
<td>11.1 (AC)</td>
<td>NR</td>
<td>47.6% had repeat revascularization</td>
</tr>
<tr>
<td>Harjai et al. (13)</td>
<td>2001–2009/prospective registry</td>
<td>4,262 (1)</td>
<td>11.4 (AC)</td>
<td>NR</td>
<td>27.5% had repeat PCI</td>
</tr>
<tr>
<td>Hannan et al. (14)</td>
<td>2007/prospective registry</td>
<td>37,234 (52)</td>
<td>15.6 (AC)</td>
<td>NR</td>
<td>32.2% had repeat revascularization</td>
</tr>
<tr>
<td>Ricciardi et al. (15)</td>
<td>1997–2006/prospective registry</td>
<td>10,965 (27)</td>
<td>4.6 (DS)</td>
<td>0–14.3</td>
<td>34.5% had repeat PCI</td>
</tr>
<tr>
<td>Yost et al. (16)</td>
<td>2007–2010/prospective registry/administrative database</td>
<td>3,255 (1)</td>
<td>8.0 (AC)</td>
<td>NR</td>
<td>5.0% had repeat PCI</td>
</tr>
</tbody>
</table>

**AC** = all-cause; **DS** = disease-specific; **MCO** = managed care organization; **NR** = not reported; **PCI** = percutaneous coronary intervention.

### REFERENCES


**Key Words:** percutaneous coronary intervention • readmission.