Clinical Interventions to Reduce Preventable Hospital Readmission After Percutaneous Coronary Intervention

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Abstract—Hospital readmissions are common and costly and, in some cases, may be related to problems with care processes. We sought to reduce readmissions after percutaneous coronary intervention (PCI) in a large tertiary care facility through programs to target vulnerabilities predischarge, after discharge, and during re-presentation to the emergency department. During initial hospitalization, we assessed patients' readmission risk with a validated risk score and used a discharge checklist to ensure access to appropriate medications and close follow-up for high-risk patients. We also developed patient education videos about chest discomfort and heart failure. After discharge, we established a new follow-up clinic with cardiology fellows. A computerized system was developed to automatically notify cardiologists when patients presented to the emergency department within 30 days of PCI to enhance patient access to cardiology care in the emergency department. Early cardiologist assessment and assistance with triage was encouraged, and the emergency department used a risk stratification algorithm derived from a local database of patients to triage patients presenting with chest discomfort after PCI. We tracked the number of patients readmitted after PCI to our hospital. With our interventions, from 2011 to 2015, the index hospital readmission rate has declined from 9.6% to 5.3%. This program could provide tangible structural changes that can be implemented in other healthcare centers, both reducing the cost of care and improving the quality of care for patients with PCI. (Circ Cardiovasc Qual Outcomes. 2016;9:600-604. DOI: 10.1161/CIRCOUTCOMES.116.003086.)

Key Words: episode of care inpatient myocardial infarction percutaneous coronary intervention readmission

Hospital readmissions may reflect both the quality of care delivered to patients and a variety of factors about the hospital system and practice patterns.1 Readmission after percutaneous coronary intervention (PCI) is common and costly.2 Provider organizations have a variety of external and internal incentives to reduce hospital readmissions after PCI, including improving patient satisfaction and safety, improving provider performance in contracts that involve incentives for saved costs, and increasing hospital inpatient bed capacity.3 Furthermore, because a substantial proportion of PCI patients have acute myocardial infarction as an indication for PCI, provider organizations have the potential to reduce financial penalties for acute myocardial infarction readmissions under the Hospital Readmission Reduction Program by reducing PCI readmissions.1,4 Unlike acute myocardial infarction, PCI patients are easy to identify during the index episode of care, whereas acute myocardial infarction patients are identified retroactively using billing codes. In this context, the American College of Cardiology and the Centers for Medicare and Medicaid Services created a system for voluntary public reporting of readmission rates after PCI as a means of raising awareness on PCI readmissions.5 Currently, readmission rates vary widely, ranging from 8% to 15%, and within one state, it varied significantly between hospitals, with some having readmission rates to the index hospital as low as 9% and others as high as 22%.6 The cause of this wide variation is likely multifactorial. Certain patient characteristics and clinical factors such as sex, race, discharge to a nursing home, longer length of stay, certain comorbidities, lack of insurance or Medicare or Medicaid use, and peri- and postprocedural complications have been associated with higher risks of readmission.7 Although these factors may not explain the entirety of variation in post-PCI readmission rates, they have been used to create a model that can predict readmissions.2,8 Readmissions have also been shown to be preventable.9 Few readmissions are because of procedural complications, so many PCI readmissions are related to medication choice and management, issues around access to...
outpatient care, and lack of timely assessment on re-presentation. As such, nonprocedural care may substantially affect this procedural metric.

**Goals and Vision of the Program**
Motivated by the need to improve the quality and value of care for PCI patients and improve value in cardiology care, we have created a dedicated clinical effort to reduce PCI readmissions at the Massachusetts General Hospital, the largest hospital in the Partners Healthcare network, which is the largest healthcare system in Massachusetts. The Massachusetts General Hospital has 950 inpatient hospital beds and performs 1000 PCIs per year.

**Design of the Initiative**
Our team worked to reduce preventable readmissions post-PCI with interventions targeting each episode of post-PCI care: (1) during the index hospitalization, (2) the postdischarge and outpatient space, and (3) during any potential re-presentation to the emergency department (Figure 1).

**During Hospitalization**
Before PCI, using a homegrown, personalized, risk assessment program called Procedure Order Entry, a readmission risk score is calculated and presented to the provider (Table). The risk score includes age, sex, admission status, insurance status, and comorbidities such as previous coronary artery bypass grafting, peripheral arterial disease, renal dysfunction, and lung disease. At that time, the risk assessment program also produces estimates for 30-day major adverse cardiovascular events, in-hospital mortality, in-hospital bleeding, acute kidney insufficiency, acute kidney insufficiency requiring dialysis, and maximum recommended contrast dose. In addition to raising awareness of a patient’s individualized risk of readmission, this is intended to entice greater scrutiny of bleeding avoidance strategies, contrast use, and allows upstream implementation of case management and other tactics to reduce readmission.

For patients seen by fellows who may be only transiently caring for a patient while hospitalized, we have instituted a formal note to summarize the hospital course highlighting any specific issues for follow-up. This allows for more rapid understanding of patients’ issues and facilitates seamless transition of care.6,9 As such, nonprocedural care may substantially affect this procedural metric.

**Operational and Strategic Decision Support via Data Analytics**

**Figure 1. Interventions to reduce PCI readmissions. ED indicates emergency department; and PCI, percutaneous coronary intervention.**

Once a patient nears discharge, we have implemented a discharge checklist to improve the transition to outpatient care. Tapper et al implemented a checklist for patients with liver failure to ensure timely and appropriate care to prevent spontaneous bacterial peritonitis and hepatic encephalopathy used in both hand-held and electronic fashions throughout the admission. Our checklist, in contrast, was designed to be implemented at the time of discharge and addresses previous research on the causes and preventability of PCI readmissions. The checklist for post-PCI patients includes a sublingual nitroglycerin prescription and confirmation of insurance coverage of prescribed antiplatelet agents. The checklist also recommends timely follow-up, especially for patients at high risk for readmission either by the readmission risk score or by the subjective assessment of the clinician. The checklist is provided electronically via a central website and in print to clinicians, with regular reminders provided (Figure 2).

In addition, to address specific causes accounting for a high proportion of readmission in post-PCI patients, specific patient instructions around heart failure and diabetes mellitus management were also provided to physicians to deliver to relevant patients. Short-video patient education materials are provided to patients because these have also been shown to reduce readmissions. These videos contain explanations about chest discomfort, how to contact outpatient cardiologists, and manage heart failure symptoms. In the patient education videos, cardiology fellows discuss different types of chest discomfort and explain how patients can contact cardiologists by phone to evaluate low-risk symptoms. Furthermore, the videos provide information about how to use nitroglycerin to treat angina and discuss the role of anxiety after PCI. Finally, the videos include information about managing heart failure symptoms after PCI, including dietary recommendations and the importance of careful monitoring of weight and diuretic use. They are provided as web-based links to patients in their discharge instructions, so that patients can view the videos at home as often as needed.

**After Discharge**
Our efforts were mindful of the evidence that access to care and close follow-up can decrease readmissions. Specialty
care, especially in heart failure, has been shown to be effective in reducing readmissions, but the timing of follow-up has had a debatable effect on readmission rates.13–17 We have been encouraging cardiology providers to see patients within 2 weeks of discharge, and, in keeping with available data, have made continuity and access to the specialist a priority.12–16 An urgent access clinic was established as a mechanism to ensure patient access to busy outpatient providers and provide focused care after acute cardiovascular events. In addition to providing specialist physician care, a pilot using a cardiology pharmacist for medication reconciliation phone calls resulted in identification of several errors or problems with patient receipt of correct medications.

### During Re-Presentation to the Emergency Department

Although many patients are admitted to the hospital with chest discomfort after PCI, stent thrombosis is rare in the modern era.9 Thus, we have developed a triage protocol in the emergency department to assist in distinguishing those with truly low-risk chest pain (Figure 3). A key component of this is early assessment by cardiologists, which has been shown to be helpful in reducing admission.18 To facilitate this, we linked our procedural database to hospital administrative data to create an automatic notification system that identifies patients within 30 days of PCI who present at any emergency department in our integrated health system. To facilitate this, we linked our procedural database to hospital administrative data to create an automatic notification system that identifies patients within 30 days of PCI who present at any emergency department in our integrated health system and identifies the patient’s cardiologist from the prior admission’s discharge summary. As a result, within minutes of registration in the emergency department, the patient’s cardiologist is notified. Rapid automatic notification, along with support from staff cardiologists, has allowed patients to be seen more quickly. In some cases, this assessment allows for discharge directly from the emergency department and averts readmission.

#### Table. Risk Score for Readmission After PCI

<table>
<thead>
<tr>
<th>Variable</th>
<th>Point Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female sex</td>
<td>2</td>
</tr>
<tr>
<td>Previous CABG</td>
<td>1</td>
</tr>
<tr>
<td>Current CHF</td>
<td>2</td>
</tr>
<tr>
<td>Chronic lung disease</td>
<td>2</td>
</tr>
<tr>
<td>Peripheral arterial disease</td>
<td>1</td>
</tr>
<tr>
<td>Cardiogenic shock</td>
<td>2</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
</tr>
<tr>
<td>&lt;50</td>
<td>0</td>
</tr>
<tr>
<td>≥50</td>
<td>−1</td>
</tr>
<tr>
<td>GFR, mL/min</td>
<td></td>
</tr>
<tr>
<td>&lt;30</td>
<td>4</td>
</tr>
<tr>
<td>30–60</td>
<td>1</td>
</tr>
<tr>
<td>&gt;60</td>
<td>0</td>
</tr>
<tr>
<td>Admission status</td>
<td></td>
</tr>
<tr>
<td>Transfer from acute care facility</td>
<td>3</td>
</tr>
<tr>
<td>Transfer from nursing home</td>
<td>4</td>
</tr>
<tr>
<td>Emergency department</td>
<td>4</td>
</tr>
<tr>
<td>Insurance status</td>
<td></td>
</tr>
<tr>
<td>Medicare/state</td>
<td>3</td>
</tr>
<tr>
<td>Unknown</td>
<td>4</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>ALL patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Order pre-discharge EKG</td>
</tr>
<tr>
<td>□ Provide prescription for sublingual nitroglycerin</td>
</tr>
<tr>
<td>□ Prescribe patient education videos</td>
</tr>
<tr>
<td>□ Include instructions for managing heart failure, diabetes, or other secondary diagnoses in the patient instructions.</td>
</tr>
<tr>
<td>□ Ensure voucher/prior authorization in place for brand name anti-platelet agents at patient’s pharmacy of choice. If medication is difficult to fill, provide patient with cardiologist contact info</td>
</tr>
<tr>
<td>□ Contact patient’s cardiologist or regular care provider</td>
</tr>
<tr>
<td>□ Set up follow up appointment with patient’s cardiologist and list contact info clearly in discharge summary</td>
</tr>
<tr>
<td>□ Place Cardiac Rehab Referral Order</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HIGH RISK patients (as identified by Case Manager or by Provider)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Follow up appointment with cardiologist within 2 weeks</td>
</tr>
<tr>
<td>□ If unlikely or unable to follow up with cardiologist, contact patient’s regular outpatient care provider for a follow up appointment</td>
</tr>
</tbody>
</table>

**Figure 2.** Discharge checklist. EKG indicates electrocardiogram.
## Implementation of the Initiative

Given the benefits to our healthcare system and to individual patients, our hospital system and care providers have been eager to engage in these strategies to reduce readmissions. Our team worked with nurses, medical residents, pharmacists, and information technology specialists to create and implement these interventions in full over 1 year. The hospital’s physicians’ organization is incentivized to improve the quality of care and reduce inappropriate and unnecessary utilization because of contracts that involve shared risk. As such, the physicians’ organization has provided financial support through data analysis resources, and the Cardiology Division has provided information technology support as part of ongoing efforts to improve the quality of cardiology care. To provide electronic notifications, we merged procedural data on PCI procedures kept within the cardiology division with administrative data on emergency department registrations from the physicians’ organization. Other staff has been eager to participate as well. Medical residents regularly provide feedback about the usefulness of the discharge checklist. We are able to assess uptake of the discharge checklist through changes in the number of views of our patient education videos. The videos are largely provided to patients through use of the checklist, and 6 months after production, the videos have amassed 256 and 292 views each, with a steady rise in the number of views over time.

## Local Challenges in Implementation

The greatest challenges have been in changing current practice patterns. For example, with electronic notifications when patients present to the emergency department, physicians are now encouraged to see patients more rapidly than they may have previously. In addition, medical residents are not used to a discharge checklist or prescribing videos for their patients to watch at home. Until these practice patterns become more ingrained in operations, we continue to correspond with regular e-mail communication with inpatient teams and manual reminders through e-mail or page to cardiologists when their patients present in the emergency department.

## Successes of the Initiative and Summary of the Experience, Future Directions, and Challenges

We have been tracking presentation of our patients in presenting to the emergency department and readmission to the hospital post-PCI. Because the Partners Healthcare system is the largest in the state, many of the patients who have PCI performed at the Massachusetts General Hospital are likely to return to a Partners hospital. However, knowing that our hospital is also a tertiary care facility, we anticipate that a significant proportion of patients present to local, non-network hospitals. Thus, we also intend to assess readmissions at the state level to leverage increased accuracy in assessing our interventions.

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### Table: Risk Level, Presentation, and Default Recommendations

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Presentation</th>
<th>Default Recommendations</th>
</tr>
</thead>
</table>
| HIGH       | - Cardiac arrest  
- STEMI       | - Activate cath emergency line for STEMI  
- Emergent cardiology consult |
| MEDIUM     | - Diabetes  
- Concerning symptoms  
- Newly (+) or rising troponin | - Discuss with cardiologist and consider admission |
| LOW        | - (-) or decreasing troponin  
- Clinical symptoms low risk on presentation | - EDOU = same-day* cardiology consult to consider admission vs. discharge |

* for presentations after 5 pm, the cardiology consult can occur next morning

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### Figure 3. Emergency department triage algorithm. ED indicates emergency department; and STEMI, ST-segment–elevation myocardial infarction.

### Figure 4. Readmissions to index hospital. ED indicates emergency department; MI, myocardial infarction; and PCI, percutaneous coronary intervention.
We have been tracking the number of patients who present to our institutions’ emergency department and the number of patients who are readmitted after PCI to the index hospital both by manual tracking and confirmation with billing data. From 2011 to 2015, the index hospital readmission rate has declined from 9.6% to 5.3% (Figure 4). Data are collected and assessed monthly.

At our hospital, we have seen an improvement in readmissions after PCI subsequent to the implementation of these initiatives. If successful, this program could potentially provide evidence-based tactics that can be implemented in other healthcare centers, to both reduce the cost of care and improve the quality of care for patients after PCI.

Disclosures


References

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