Quality Improvement Initiative and Its Impact on the Management of Patients With Acute Myocardial Infarction

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Background: Wide variation exists in acute myocardial infarction (AMI) management, leading to differences in outcomes.

Objective: To assess the impact of the quality improvement initiative on appropriate management of AMI.

Design: Prospective patient identification, retrospective medical record review.

Patients: All patients with AMI discharged alive (N=497) from our institution between April 1, 1995, and February 28, 1997.

Main Outcome Measure: The effect of quality improvements directed at the patient, nurse, and physician on the adherence to key quality indicators.

Results: The quality improvement initiative correlated with more frequent use of reperfusion therapy (98%), and aspirin use in the emergency department (95%), in ideal eligible patients. Similarly, adherence to discharge quality indicators, including use of aspirin (97%), β-blockers (94%), angiotensin-converting enzyme inhibitors (90%), and lipid-lowering agents (67%); avoidance of calcium channel blockers (93%); a low-fat diet (96%); smoking cessation counseling (94%); and outpatient rehabilitation referral (70%) was higher, including in the very old (those aged ≥80 years) and in women. The use of a patient education tool was associated with a higher adherence to most quality indicators compared with patients in whom this was not used: discharge aspirin (99% vs 96%; P=.02), β-blocker (98% vs 91%; P=.002), angiotensin-converting enzyme inhibitor (95% vs 86%; P=.01), and lipid-lowering agent (71% vs 62%; P=.04) use; outpatient rehabilitation (82% vs 63%; P=.001); and documentation of smoking cessation counseling (98% vs 87%; P=.001).

Conclusions: Implementation of a quality improvement program was associated with a high adherence to quality-of-care indicators for AMI. Patient-directed feedback before discharge improved adherence to key indicators for AMI beyond that achieved with tools only directed at caregivers.

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PATIENTS AND METHODS

QUALITY IMPROVEMENT PROGRAM

A quality improvement initiative for the appropriate management of patients with AMI was instituted at our health care facility in 1994 and consisted of a 3-tiered approach involving the participation of the patients, their nurses and dietitians, and physicians. First, a critical pathway for AMI management was created, incorporating the criteria proposed by the Task Force on Practice Guidelines of the American College of Cardiology and the American Heart Association for AMI management.1 This pathway prespecified important reperfusion and pharmacological therapy, patient education milestones, and guidelines for early in-hospital physical activity and defined ideal patients for such interventions. This was targeted toward nursing and preventive educational activities in the post-AMI period.

Second, we used a patient education tool, which was reviewed by patients and their treating physician just before discharge. This was designed with the purpose of (1) providing patients an opportunity to understand the rationale for their pharmacological therapy, “risk factor” assessment, including measurement of their ventricular function and lipid profile, and denoting the importance of modifications of important coronary risk factors through education regarding smoking cessation and referral for postdischarge cardiac rehabilitation; and (2) providing an opportunity for physicians to stress the goals of lifestyle interventions, pharmacological therapy, and rehabilitation with a goal of thoughtful and timely transition to outpatient care.

Finally, since all patients with AMI were cared for by cardiology faculty and internal medicine house staff, they were pivotal to the successful implementation of the quality initiative. To educate the house staff who rotated through the cardiology service, a monthly lecture on the key AMI goals was delivered, reinforcing how these goals could be achieved by adhering to the tools available for quality improvement. In addition, they were made aware of the critical pathway and the patient education tool and, more recently, have been provided with a pocket card version of the national guideline for AMI published by the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Finally, referring physicians were faxed a copy of the patient’s discharge summaries on the day of discharge to enhance continuity of care.

PATIENT POPULATION

For this study, coronary care clinical nurse collaborators (E.N. and G.K.) prospectively identified 555 consecutive patients with AMI admitted to our 2 cardiology services between April 1, 1995, and February 28, 1997. Four hundred ninety-seven patients were discharged alive from the hospital. The diagnosis of AMI was based on the presence of 2 (or more) of the following criteria: chest pain, diagnostic short-term electrocardiographic changes, and/or elevation of cardiac enzymes. The critical care pathway was implemented in all patients from the time of admission to the time of their hospital discharge. The patient education tool was available to all physicians caring for the patients and was expected to be completed at the time of the patient’s discharge. This tool was used variably by physicians, and its use was not enforced by clinical administration.

DATA COLLECTION AND ANALYSIS

Data collection was retrospective through medical record reviews of all patients with AMI, identified prospectively by nurse coordinators (E.N. and G.K.). These data were acquired on a single page scannable form, and were then scanned into a computing system (Teleform; Cardiff Software, Inc, San Marcos, Calif) for automated data entry. The data were analyzed using statistical software (SAS Institute Inc, Cary, NC). All forms were reviewed by a physician (R.H.M. or T.T.T.) or nurse (E.N. or G.K.) for face validity and completeness. Values are presented as mean ± SD (range) unless stated otherwise. Pearson correlation matrices were used to establish correlates of the quality improvement effort with various components of the key goals of AMI care. P < .05 was required to indicate a significant difference.

Table 2

Patients were divided according to their ages into those younger than 65 years, those aged 65 to 80 years, and those older than 80 years (Table 2). There was no difference in the use of β-blockers, aspirin, and angiotensin-converting enzyme inhibitors; counseling about a low-fat diet; and the use of invasive procedures. Counseling for smoking cessation was similar for the 2 younger groups; however, the only patient who was older than 80 years did not receive advice for quitting smoking. Reperfusion therapy was used less frequently in patients older than 80 years. Lipid profile measurement also did not differ among different age groups. The measurement of left ventricular ejection fraction, the use of lipid-lowering agents, and referral for outpatient rehabilitation were less frequent in the “very old” (those aged ≥80 years). No difference in the quality of care was evident between men and women with AMI (Table 3).

PATIENT EDUCATION TOOL VS NO PATIENT EDUCATION TOOL

Patient review of discharge goals was associated with a higher prescription of most key discharge medications, including aspirin, β-blockers, angiotensin-converting enzyme inhibitors, and lipid-lowering agents, and avoidance of calcium channel antagonists. Most patients received counseling regarding a low-fat diet, and this did not differ in the 2 groups of patients, whereas more patients reviewing discharge goals through the patient education tool had documentation of smoking cessation counseling. Assessment of left ventricular ejection fraction and serum lipid levels and outpatient rehabilitation referral were more frequent in the group who completed the patient education tool (Table 4).
Our study shows a high level of adherence to key quality goals of AMI management at our hospital. These performance levels have been achieved through a series of iterative steps, including the use of a critical pathway for nursing care; frequent, periodic education of physicians providing AMI care; use of a patient education tool; and dissemination of an easy-to-use guideline to house staff, students, fellows, and faculty. Pharmacotherapies unequivocally shown to improve outcomes after AMI for ideal patients, including aspirin, β-blockers, angiotensin-converting enzyme inhibitors for patients with large AMIs, and lipid-lowering agents, were used in a high percentage of patients. Similarly, high proportions of patients had documentation of smoking cessation and dietary counseling, and many were referred for outpatient rehabilitation. Most patients underwent assessment of their left ventricular function with either an invasive or a noninvasive strategy, and most had their lipid profile determined.

For most key performance indicators, the implementation of the quality improvement initiative was equally effective in women and in the very old. However, reperfusion therapy was less frequently used for patients older than 80 years. Several factors may explain this lower use in the very old, including physicians’ concern about risks of complications in these patients with high comorbidity, particularly intracranial bleeding with thrombolytic therapy. There may also have been patient and/or family preferences for conservative management in some situations. Lipid-lowering agent use and referral for outpatient rehabilitation were also less frequent in the very old, reflecting physicians’ uncertainty as to the benefits of such therapy in this cohort despite evidence to the contrary in clinical trials. Estimation of the left ventricular ejection fraction was also less frequent in the very old, but the use of invasive procedures was similar across all age groups and sexes.
The use of the patient education tool was associated with a higher adherence to key quality indicators, pharmacological and nonpharmacological. This higher adherence to quality-of-care indicators in the patient education group persisted over time.

These results reflect a much higher adherence to quality-of-care indicators than observed in prior reports\(^5\)\(^-\)\(^7\)\(^-\)\(^10\)\(^-\)\(^14\) (Table 5). Reports\(^5\)\(^-\)\(^7\) from the Cooperative Cardiovascular Project, which included all patients with AMI whether they received reperfusion therapy, noted a low rate of adherence to such quality indicators in the ideal group of patients for such interventions. Ellerbeck et al\(^5\) showed that use of appropriate therapies at discharge in ideal candidates included aspirin in 77%, β-blockers in 45%, angiotensin-converting enzyme inhibitors in 59%, and thrombolytic therapy in just 15%. Smoking cessation counseling was documented in only 28% of eligible patients. The rate of adherence to quality indicators in the present study was high, even when compared with studies looking at the use of such therapies in thrombolytic agent–treated patients. Patients receiving thrombolytic therapy, by the virtue of having met stringent inclusion criteria, may also be more likely to receive other post-AMI interventions as opposed to those in whom thrombolytic therapy was not administered. Thus, in a report by Rogers et al\(^6\) from the National Registry of Myocardial Infarction, thrombolytic therapy was used in 35.1% of patients. The use of varying therapies in patients with AMI concomitantly with thrombolytic drugs was as follows: aspirin in 84.0%, oral β-blockers in 36.3%, avoidance of calcium channel blockers in 70.5%, and intravenous β-blockers in 17.4%. Invasive procedures in patients receiving thrombolytic therapy included coronary angiography in 70.7%, angioplasty in 30.3%, and bypass surgery in 13.3%\(^a\). Similarly, Pilote et al\(^\ast\),\(^\ast\) reporting for the Global Utilization of Streptokinase and Tissue Plasminogen Activator for Occluded Coronary Arteries (GUSTO-1) investigators (all patients received thrombolytic therapy and aspirin per study protocol), demonstrated substantial regional variability in the use of various therapies in patients with AMI. The adherence to the goals of key quality indicators for AMI care in our study was better than that reported for “America’s Best Hospitals” (Table 5).\(^10\)

Screening for hyperlipidemia in various studies has been shown to be variable. Patients who were older, were white, had known coronary artery disease or cardiovascular risk factors (especially diabetes, hyperlipidemia, and obesity), and/or had private insurance were more likely to be screened.\(^11\) Physician specialty also affected screening, with more lipid level evaluation by cardiologists and internists than family physicians and general practitioners.\(^11\) The rates of screening have been shown overall to be low, varying from 2.8% per visit in patients without hyperlipidemia to 22.8% per visit in patients with reported hyperlipidemia.\(^11\) To our knowledge, there are few prior studies on the adherence to lipid-lowering agents after AMI. The reported use of these agents in various studies\(^11\)\(^-\)\(^14\) varied from 2.4% to 38.9% in patients with known hyperlipidemia and coronary artery disease. Some of these studies were initiated before clinical trials that provided unequivocal proof of the beneficial effects of lipid-lowering agents in reducing long-term complications. Nevertheless, there remains concern that lipid-lowering drugs, which are proved not only effective but cost-effective in the secondary prevention of coronary artery disease, are being underused in infarction survivors. Our rate of use of lipid-lowering agents in patients with a low-density lipoprotein level of 3.23

### Table 4. Management of AMI: Effect of the PET\(^a\)

<table>
<thead>
<tr>
<th>Variable</th>
<th>PET No</th>
<th>PET Yes</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution</td>
<td>48.9</td>
<td>51.1</td>
<td>. .</td>
</tr>
<tr>
<td>Tests</td>
<td>82.4</td>
<td>89.0</td>
<td>.01</td>
</tr>
<tr>
<td>LVEF measurement</td>
<td>88.5</td>
<td>91.0</td>
<td>.47</td>
</tr>
<tr>
<td>Discharge medications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>β-Blockers</td>
<td>90.8</td>
<td>97.6</td>
<td>.002</td>
</tr>
<tr>
<td>Aspirin</td>
<td>96.0</td>
<td>99.0</td>
<td>.02</td>
</tr>
<tr>
<td>ACE inhibitors</td>
<td>86.0</td>
<td>95.0</td>
<td>.01</td>
</tr>
<tr>
<td>No calcium blockers</td>
<td>92.0</td>
<td>90.0</td>
<td>.47</td>
</tr>
<tr>
<td>Lipid-lowering agent</td>
<td>62.0</td>
<td>71.0</td>
<td>.04</td>
</tr>
<tr>
<td>Lifestyle counseling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking cessation counseling</td>
<td>87.1</td>
<td>98.4</td>
<td>.001</td>
</tr>
<tr>
<td>Diet counseling</td>
<td>96.0</td>
<td>96.4</td>
<td>.83</td>
</tr>
<tr>
<td>Outpatient rehabilitation referral</td>
<td>63.0</td>
<td>82.0</td>
<td>.001</td>
</tr>
</tbody>
</table>

\(^a\)Data are given as the percentage of patients unless otherwise indicated. AMI indicates acute myocardial infarction; PET, patient education tool; LVEF, left ventricular ejection fraction; ACE, angiotensin-converting enzyme; and ellipses, data not applicable.

### Table 5. Comparison of Selected Quality Indicators With Prior Reports\(^a\)

<table>
<thead>
<tr>
<th>Quality Indicator</th>
<th>Present Study</th>
<th>Chen et al (Ideal Patients)(^a)</th>
<th>Chen et al (All Patients)(^a)</th>
<th>NRMI (All Patients)(^a)</th>
<th>GUSTO-1 (All Patients)(^a)</th>
<th>Normand et al (Ideal Patients)(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reperfusion therapy</td>
<td>98.1</td>
<td>85.3</td>
<td>61.0</td>
<td>35.1</td>
<td>100.0</td>
<td>70.0</td>
</tr>
<tr>
<td>Aspirin in the emergency department</td>
<td>94.6</td>
<td>90.3</td>
<td>96.2</td>
<td>84.0</td>
<td>100.0</td>
<td>83.0</td>
</tr>
<tr>
<td>Aspirin</td>
<td>97.0</td>
<td>95.1</td>
<td>96.2</td>
<td>94.9</td>
<td>100.0</td>
<td>. .</td>
</tr>
<tr>
<td>β-Blockers</td>
<td>94.3</td>
<td>83.5</td>
<td>75.0</td>
<td>36.3</td>
<td>47-71</td>
<td>45.0</td>
</tr>
<tr>
<td>ACE inhibitors</td>
<td>89.8</td>
<td>48.9</td>
<td>. .</td>
<td>. .</td>
<td>13-18</td>
<td>59.0</td>
</tr>
<tr>
<td>Calcium blocker avoidance</td>
<td>92.6</td>
<td>84.8</td>
<td>70.5</td>
<td>66-76</td>
<td>79.0</td>
<td>. .</td>
</tr>
<tr>
<td>Smoking cessation counseling</td>
<td>94.0</td>
<td>. .</td>
<td>. .</td>
<td>. .</td>
<td>. .</td>
<td>. .</td>
</tr>
<tr>
<td>Lipid-lowering agent</td>
<td>67.4</td>
<td>52.0</td>
<td>. .</td>
<td>. .</td>
<td>. .</td>
<td>28.0</td>
</tr>
</tbody>
</table>

\(^a\)Data are given as the percentage of patients. NRMI indicates National Registry of Myocardial Infarction; GUSTO-1, Global Utilization of Streptokinase and Tissue Plasminogen Activator for Occluded Coronary Arteries; ACE, angiotensin-converting enzyme; and ellipses, data not available.
mmol/L (124.9 mg/dL) or greater (67%), although much better than that reported in the studies previously described, was lower than the use of other key quality indicators. This may have resulted from the fact that some physicians may have initially opted for diet, exercise, and lifestyle modification in the initial control of an elevated cholesterol level, and only if these measures failed did they opt to institute drugs to lower the cholesterol level. Of our patients, 96% received counseling for a low-fat and low-cholesterol diet.

To our knowledge, few studies have evaluated the quality improvement initiatives in improving the care of patients with AMI. Meehan et al15 demonstrated success with a collaborative project in Connecticut to improve the care of patients with AMI. Dissemination of retrospectively abstracted comparative data enabled participating hospitals in Connecticut to prepare a written quality improvement plan based on its unique data profile. These improvement interventions included staff education sessions, development of AMI critical paths and standing orders, storage of appropriate medications in the emergency departments, and empowerment of emergency department physicians to administer thrombolytic therapy. Self-reported data from the hospitals indicated a decrease in the door-to-needle time to 45 minutes, and several hospitals reported an increasing use of thrombolytic therapy, aspirin, and β-blockers to nearly 90% among ideal patients.

Guidry et al16 reported similar success with a simple quality assurance effort in reducing the door-to-needle time for the administration of thrombolytic therapy. Their quality assurance effort began in 1989 when they reviewed the medical records of all patients with AMI presenting to the emergency department of a major tertiary care center and directed special attention to identifying the causes for delay in the door-to-needle times beyond 1 hour of the patient’s arrival. Biannual reports were distributed throughout the hospital and emergency department, providing feedback to nurses, pharmacists, and physicians. This led to the development of protocols for all aspects of the delivery of thrombolytic agents. As a result, the median door-to-needle time was decreased from 46 (1989-1991) to 36 (1992-1994) minutes (P<.01) and fewer patients had a door-to-needle time longer than 60 minutes in the later period (16% vs 35%).

The Clinical Quality Improvement Network Investigators17 reported a significant increase in the use of aspirin (from 89% to 91%), nitrates (from 88% to 90%), and β-blockers (from 62% to 71%) in patients with AMI with the implementation of the “Critical Care Pathway” tool. The use of calcium channel blockers declined (from 35% to 27%), while the use of thrombolytic therapy remained unchanged.

Several other aspects of our care strategies deserve comment. First, all patients with AMI at our institution were cared for by cardiology faculty with internal medicine house officers. Prior studies18,20 have shown that cardiologists are more aware of key advances in the treatment of AMI compared with internists or family practitioners, resulting in better adherence to quality indicators by cardiologists. Educational lectures to house staff every month and regular dissemination of information from clinical trials to all caregivers reinforced key goals for the care of patients with AMI. We believe that the critical care pathway organized the key aspects of treatment by targeting nursing, education, and prevention strategies, thereby reducing any source of human error in the treatment goals. A true collaboration between highly motivated nurses, dieticians, and physicians was instrumental in the higher adherence to key quality indicators. Finally, the patient education tool served as an important document for physician reminder, defining appropriate patient management at discharge. Thus, we believe our relative success in achieving high adherence to key performance goals is most likely the result of the formal, integrated, and convenient process we had initiated.

The tools used in the quality improvement initiative in this report are attractive. They improve patient care by incorporating evidence-based medicine into the usual care of patients with AMI. They also serve as educational and reminder tools not only for the caregivers but also for the patients. We believe that education and reminder of the caregivers leads to continuing success of the quality improvement initiative over a longer time, and not just in the initial period after institution of the improvement initiatives. Patient education offers opportunities for long-term adherence to quality goals, such as compliance with medications, diet, exercise, and smoking cessation. Finally, the tools provide opportunity for all individuals involved in the care of patients with AMI to review the process of care, identify missed opportunities, and strive to correct these deficiencies in optimal patient care.

The present study involved retrospective review of medical records and, therefore, has limitations inherent to any retrospective study. Second, since whites formed most of our patient population, the impact of this quality improvement program could not be assessed in nonwhites. Third, this quality improvement program was implemented in a tertiary teaching hospital, where all patients were cared for by cardiologists. The results or methods may, therefore, not be transferable to community teaching or nonteaching community hospitals where caregivers from various disciplines care for patients with AMI. Fourth, while the patient education tool’s use was associated with higher adherence to quality-of-care indicators, it could not be determined whether this was a mere reflection of physicians’ willingness to conform to management guidelines for treatment or whether this represented a direct impact of this tool itself. Fifth, this study did not have a separate validation of the tools used for quality improvement nor was this improvement analyzed in terms of improving risk-adjusted outcomes. This needs to be addressed in future studies. Finally, the cost-effectiveness of such an intense program needs to be determined.

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