Journal of the American College of Cardiology
© 2004 by the American College of Cardiology Foundation
Published by Elsevier Inc.

Vol. 43, No. 12, 2004
ISSN 0735-1097/04/$30.00
doi:10.1016/j.jacc.2003.08.067

Enhancing Quality of Care for Acute Myocardial Infarction: Shifting the Focus of Improvement From Key Indicators to Process of Care and Tool Use

The American College of Cardiology Acute Myocardial Infarction Guidelines Applied in Practice Project in Michigan: Flint and Saginaw Expansion

Rajendra H. Mehta, MD, MS, FACC,* Cecelia K. Montoye, MSN,† Jessica Faul, MPH,‡ Dorothy J. Nagle, BSN,‡ James Kure, MD, FACC,§ Ethiraj Raj, MD, FACC,‖ Peter Fattal, MD, FACC,¶ Shiraz Sharrif, MD, FACC,# Mohamadali Amlani, MD,** Hameem U. Changezi, MD, FACC,§ Stephen Skorcz, MPH,†† Nancy Bailey, MSN,§ Theresa Bourque, BSN,‖ Mary LaTarte, MSN,# Donna McLean, MBA,** Suzanne Savoy, MN,¶ Paul Werner, MD,# Patricia L. Baker, MS,† Anthony DeFranco, MD, FACC,** Kim A. Eagle, MD, FACC,* on behalf of the American College of Cardiology Guidelines Applied in Practice Steering Committee

Ann Arbor, Farmington Hills, Grand Blanc, Flint, and Saginaw, Michigan; and Bethesda, Maryland

OBJECTIVES This project evaluated if by focusing on process changes and tool use rather than key indicator rates, the use of evidence-based therapies in patients with acute myocardial infarction (AMI) would increase.

BACKGROUND The use of tools designed to improve quality of care in the American College of Cardiology AMI Guidelines Applied in Practice Pilot Project resulted in improved adherence to evidence-based therapies for patients, but overall, tool use was modest.

METHODS The current project, implemented in five hospitals, was modeled after the previous project, but with greater emphasis on tool use. This allowed early identification of barriers to tool use and strategies to overcome barriers. Main outcome measures were AMI quality indicators in pre-measurement (January 1, 2001 to June 30, 2001) and post-measurement (December 15, 2001 to March 31, 2002) samples.

RESULTS One or more tools were used in 93% of patients (standard orders = 82%, and discharge document = 47%). Tool use was associated with significantly higher adherence to most discharge quality indicator rates with increases in aspirin, angiotensin-converting enzyme inhibitors, and smoking cessation and dietary counseling. Patients undergoing coronary artery bypass grafting (CABG) had low rates of discharge indicators. Patients undergoing percutaneous coronary revascularization were more likely to receive evidence-based therapies.

CONCLUSIONS These data validate the results of the pilot project that quality of AMI care can be improved through the use of guideline-based tools. Identifying and overcoming barriers to tool use led to substantially higher rates of tool use. The low rates of adherence to quality indicators in patients undergoing CABG suggest that these patients should be particularly targeted for quality improvement efforts. (J Am Coll Cardiol 2004;43:2166–73) © 2004 by the American College of Cardiology Foundation

From the *University of Michigan, Ann Arbor, Michigan; †Consultant to the American College of Cardiology, Bethesda, Maryland; ‡MPRO, Farmington Hills, Michigan; §Genesys Regional Medical Center, Grand Blanc, Michigan; ‖Hurley Medical Center, Flint, Michigan; ¶Covenant Health Care, Saginaw, Michigan; #St. Mary's Medical Center, Saginaw, Michigan; **McLaren Regional Medical Center, Flint, Michigan; and ††Greater Flint Health Coalition, Flint, Michigan. This initiative was funded by grants from the American College of Cardiology and the Greater Flint Health Coalition, unrestricted research grants from Pfizer Inc. and AstraZeneca, and in cooperation with the Centers for Medicare & Medicaid Services' Sixth Scope of Work Project in Michigan. The analyses upon which this publication is based were performed under Contract Number 500-99-MI02 entitled "Utilization and Quality Control Peer Review Organizations for the State of Michigan," sponsored by the Centers for Medicare & Medicaid Services, Department of Health and Human Services. The content of this publication does not necessarily reflect the views or policies of the Department of Health and Human Services, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government. The authors assume responsibility for the accuracy and completeness of the ideas presented. This article is the direct result of the Health Care Quality Improvement Program initiated by the Centers for Medicare & Medicaid Services, which has encouraged identification of quality improvement projects derived from analysis of patterns of care, and therefore required no special funding on the part of this contractor. Ideas and contributions to the authors concerning experience in engaging with issues presented are welcomed.

Manuscript received March 10, 2003; revised manuscript received June 16, 2003, accepted August 5, 2003.

The American College of Cardiology (ACC) Acute Myocardial Infarction Guidelines Applied in Practice (GAP)

See page 2174

Pilot Project provided a foundation for future projectsaimed at enhancing the quality of care for patients with acute myocardial infarction (AMI) (1,2) and other cardiovascular conditions. The ACC GAP Pilot Project was a response to steady demands on health care providers to increase the

Abbreviations and Acronyms

ACC = American College of Cardiology
ACE = angiotensin-converting enzyme
AMI = acute myocardial infarction
CABG = coronary artery bypass graft surgery
CMS = Center for Medicare & Medicaid Services
GAP = Guidelines Applied in Practice
GFHC = Greater Flint Health Coalition
MPRO = Michigan Peer Review Organization
PCI = percutaneous coronary intervention

quality of AMI care. The pilot project, implemented at 10 southeast Michigan hospitals, incorporated national guidelines (3) into care processes by creating clinical care tools and systems focused on the caregivers and patients that reinforced adherence to evidenced-based pharmacologic, lifestyle, and behavioral goals for the care of patients with AMI. This strategy was successful in enhancing the quality of care of patients with AMI (2). Importantly, evidence of tool use such as standard admitting orders and a standard discharge document was associated with the greatest improvement. In the GAP Pilot Project, clinical care tool use, hereafter labeled "tool use," was documented on the chart only in one-fourth of the patients (2). These findings argued for a strategy emphasizing and monitoring tool use, with continuous attempts to identify and overcome barriers to their use.

Following the GAP Pilot Project, the Greater Flint Health Coalition (GFHC) requested that the ACC support another AMI GAP project, aimed at improving AMI care in the five Flint and Saginaw area hospitals. The ACC partnered with the GFHC and the Michigan Peer Review Organization (MPRO), a state quality improvement organization for the Centers for Medicare & Medicaid Services (CMS). Unlike the GAP Pilot Project, this project focused on the use and concurrent monitoring of care tools with a goal of identifying barriers to their use and strategies to overcome them to maximize quality improvement.

METHODS

Partnership. The ACC AMI GAP Project in Michigan: Flint and Saginaw Expansion, hereafter referred to as the GAP Flint-Saginaw Project, was modeled after the GAP Pilot Project (4). The quality improvement strategies were further enhanced by an adaptation of the Institute for Healthcare Improvement Breakthrough Series Model (5). We included rapid cycle quality improvement with the establishment and support of a collaborative culture of learning and sharing among hospital teams aimed at increasing the use of the AMI standardized tools. This model emphasizes brief, iterative strategies targeting specific goals or barriers in step-by-step improvement. The oversight team, including representatives from the partnership organizations (ACC, MPRO, GFHC), designed, coordinated, and implemented the project. Each organization contributed to the project. The ACC provided professional credibility, clinical expertise, and quality improvement expertise through a physician and nurse investigator team. The ACC nurse investigator was the project manager. The GFHC provided local ownership and support that increased the buy-in by the participating hospitals. The GFHC convened partnership meetings, contributed funding for the project's activities, and obtained additional funding for the non-Medicare data abstraction and analysis. The MPRO provided quality improvement and statistical expertise through a project manager and coordinator, and a data analyst. The MPRO managed data collection and analysis of the Medicare patients through the CMS's Sixth Scope of Work.

The project began in July 2001. A physician champion and a project leader, usually a nurse with expertise in quality improvement, were identified at each hospital. After initial planning, a series of educational sessions were held to support project implementation. These focused on project planning, introduction or hospital kick-off, implementation of standardized tools, monitoring progress, re-measurement (abstraction of charts after the project had been implemented to determine whether adherence to quality indicators had improved), and presentation of the results. Additionally, ongoing support was provided via phone consultations, e-mail communications, and site visits by the partnership leaders.

Project implementation. Like the GAP Pilot Project (1,2), the GAP Flint-Saginaw Project was a multifaceted intervention including a kick-off presentation, customization and implementation of a series of care tools or tool kit based on the ACC/American Heart Association guidelines (3), leadership by a local physician champion and project leader at each hospital, grand round site visits, and pre- and post-measurement of quality indicators. The project was completed within one year. The physician and nurse leaders and the multidisciplinary team at each hospital were expected to customize and implement the ACC AMI Tool Kit that consisted of seven components: 1) AMI standard orders; 2) clinical pathway (particularly targeting daily nursing care); 3) pocket guide/pocket card for AMI from the ACC; 4) patient information form, a one-page document describing key milestones in care; 5) AMI-specific patient discharge form; 6) chart stickers; and 7) hospital performance charts which inform each hospital about their recent rates for key quality indicators. We emphasized the use of standard orders and AMI discharge instructions forms, based on experiences with the GAP Pilot Project (1,2). The five hospitals were already using standard orders. Hospitals were asked to compare their orders with those of the ACC Tool Kit, and to revise their orders to be consistent with the national guidelines. All five hospitals adopted an AMI discharge tool modeled after the one in the ACC Tool Kit. Grand round site visits at each hospital served as the hospital's kick-off event. At grand rounds, the foundation and rationale for the project was explained, the hospital teams introduced their multidisciplinary team,

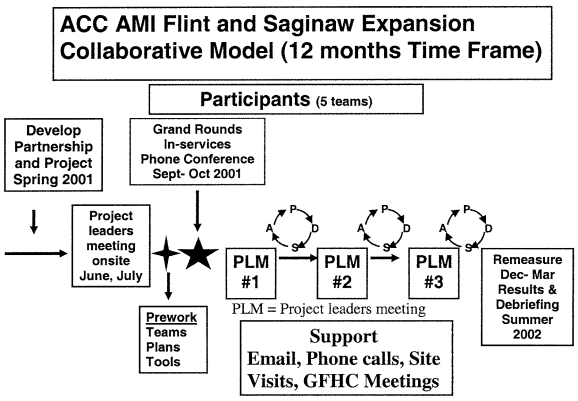

Figure 1. The American College of Cardiology (ACC) Acute Myocardial Infarction (AMI) Guidelines Applied in Practice Project: Flint and Saginaw Expansion Collaborative Model. GFHC = Greater Flint Health Coalition.

explained their plans and timeline for clinical care tool use implementation, showed the customized tools, and clarified process changes. The ACC and MPRO project managers also provided in-service educational opportunities particularly targeting those who were unable to attend the grand rounds.

Based on the lessons learned from the GAP Pilot Project, the GAP Flint-Saginaw initiative provided consistent and enhanced support from the ACC physician liaison and project manager and the MPRO project manager and coordinator. This was particularly directed at the quality improvement phases of planning, tool use implementation, monitoring tool use, and re-measurement with a repeating focus on tool use and monitoring tool use in all phases of the project (Fig. 1). To do this, four group meetings with the hospital project leaders and various team members were convened, as well as frequent e-mail and phone contact. Enhanced mentoring, communication, and collaboration facilitated early identification of process changes, barriers, and resistance to change and the development of new strategies for a rapid response to barriers experienced by the hospital teams.

Study sample and data collection. The impact of the quality improvement strategies in this project was evaluated using measurement of pre-implementation and post-implementation adherence to key evidence-based therapies. The baseline sample was identified using claims with the International Classification of Diseases-Ninth Revision-Clinical Modification principal discharge diagnosis code for AMI (410.xx) between January 1, 2001 and June 30, 2001. Patients with codes that designated subsequent episodes of care (410.x2) were excluded from the study. Data were abstracted from two groups: cases with Medicare as their primary insurance (Medicare group) and patients not having Medicare as their primary insurance (non-Medicare group). Medicare baseline cases were identified from filed CMS beneficiary claims data, whereas non-Medicare baseline patients were identified from individual hospitals. A 50% random sample and a 20-case minimum of baseline Medicare cases were selected from each hospital. The non-Medicare sample consisted of a 33% random sample and a minimum of 20 cases per hospital. From a universe of 728 Medicare and 626 non-Medicare cases, 359 and 207 cases were abstracted at baseline, respectively. Patients without a confirmed AMI were excluded from the study sample, leaving a total of 523 patients to constitute the baseline sample. Cases discharged between December 15, 2001 and March 31, 2002 with the same inclusion and exclusion criteria were eligible for "re-measurement." Cases for both Medicare and non-Medicare groups were identified from individual hospitals. To achieve a similar sample size for re-measurement, a 95% sample of Medicare cases discharged from the hospital with a valid beneficiary claim during the re-measurement period were sampled. For non-Medicare cases, a 50% sample was selected with 20 minimum cases per hospital. For re-measurement, 349 Medicare and 200 non-Medicare charts were abstracted, and after

Table 1. Hospital Characteristics

Hospital Characteristics	n
Total	5
Teaching hospital/non-teaching	5
Large/moderate/small volume*	3/2/0
Facility for CABG/No CABG surgery	4/1
Hospitals with >10% minority patients with acute myocardial infarction discharge per year	4/5

*Based on peer grouping criteria.
CABG = coronary artery bypass graft.

Table 2. Patients' Demographics, Past Medical History, and Clinical Features

Characteristics	Baseline (1/1/2001 to 6/30/2001) n = 523	Re-Measurement (12/1/2001 to 3/31/2002) n = 499
Demographics (%)		
Females	43.8	42.7
Non-white	10.3	12.0
Mean age, yrs	66.8	67.5
Medical history, n (%)		
Hypertension	354 (67.7)	360 (72.1)
Diabetic	175 (33.5)	163 (32.7)
Current smokers	156 (29.8)	151 (30.3)
Previous myocardial infarction	206 (39.4)	194 (38.9)
Previous congestive heart failure	141 (30.0)	130 (26.1)
Previous coronary bypass surgery	98 (18.7)	102 (20.4)
Previous percutaneous coronary intervention	84 (16.1)	94 (18.8)
Previous stroke	83 (15.9)	68 (13.6)
Clinical, n (%)		
Chest pain	438 (83.8)	410 (82.2)
Systolic BP >160 mm Hg or diastolic BP >100 mm Hg	128 (24.5)	146 (29.3)
Heart rate >100 beats/min	128 (24.5)	105 (21.0)
Discharge home	392 (75.0)	374 (75.1)
Hospital mortality	48 (9.2)	54 (10.8)

BP = blood pressure.

Table 3. Quality Indicator Rates at Baseline and at Re-Measurement (Overall) and With Tool Use

Quality Indicator	Baseline, n (% [SD]) n = 523	Re-Measurement n (% [SD]) n = 499	p Value*	Re-Measurement With Tool n (% [SD])	p Value†
Early aspirin	215/241 (88.9 [2.2])	170/191 (89.6 [2.5])	0.834	147/161 (92.0 [2.3])	0.330
Early beta-blockers	106/144 (71.8 [4.3])	88/122 (71.6 [5.5])	0.977	75/106 (72.0 [5.1])	0.976
Cholesterol measured within 24 h	176/209 (82.3 [3.2])	158/187 (83.6 [3.8])	0.794	142/162 (86.8 [3.5])	0.343
Discharge aspirin	191/235 (78.8 [3.0])	190/211 (90.9 [1.9])	0.001	95/103 (93.0 [2.6])	< 0.001
Discharge beta-blockers	66/84 (78.4 [5.5])	80/87 (90.4 [3.9])	0.075	33/37 (89.2 [4.5])	0.129
Discharge ACE inhibitors	63/90 (69.2 [5.6])	52/63 (88.8 [3.2])	0.002	31/36 (89.2 [4.6])	0.006
Discharge treatment of elevated cholesterol	95/130 (76.8 [3.8])	115/139 (84.1 [3.1])	0.137	48/55 (87.2 [4.6])	0.081
Smoking cessation counseling	85/135 (57.5 [4.3])	93/128 (72.8 [4.2])	0.011	49/56 (87.2 [4.6])	< 0.001
Dietary counseling (%)	309/393 (78.1 [2.2])	329/367 (88.8 [1.7])	< 0.0001	167/174 (95.6 [1.7])	< 0.001

*For comparison of baseline and remeasurement sample; †for comparison of baseline and remeasurement with tool use.
ACE = angiotensin-converting enzyme.

exclusions as previously noted, 499 confirmed cases remained in the post-intervention sample. As in the baseline, additional inclusion and exclusion criteria were applied at the indicator level (1,2,6,7). Medical records for each sampled hospitalization were copied and forwarded to the national CMS clinical data abstraction center. Data were collected for each hospitalization, including patient medical history, symptoms on arrival, electrocardiographic examination, in-hospital treatment and events, and discharge treatment and disposition. For quality assurance purposes, data were re-abstracted for a random sample of both baseline and re-measurement records (40 records) by the clinical data abstraction center. There was an overall reliability of 93.6% (original abstracted data vs. re-abstracted data) and an accuracy rate of 96.7% (both original abstracted data and re-abstracted data compared with "gold standard" data) for the variables in the abstraction module. Quality of care was assessed by measuring the use of key indicators in "ideal patients" as reported in previous studies (1,2,6,7). Four test indicators (indicators that are under development and review) were also evaluated (1,2,6,7).

Table 4. Guidelines Applied in Practice Tool Utilization at Baseline and Re-Measurement

GAP Tool Utilization	Baseline (n)	Rate (%)	Re-Measurement (n)	Rate (%)
Emergency room preset orders	0/523	0.0	1/499	0.2
AMI standing orders	67/523	12.8	142/499	28.5
ACS standing orders	289/523	55.3	305/499	61.1
AMI or ACS standing orders	341/523	65.2	408/499	81.8
Clinical pathway	313/523	59.8	394/499	79.0
AMI specific discharge form*	5/405	1.2	179/380	47.1
Any tool used	403/523	77.1	465/499	93.2

*Excluding transfers to another acute care facility, expired cases, cases with unknown discharge status, terminal illness, or limitation of resuscitation.
ACS = acute coronary syndromes; AMI = acute myocardial infarction; GAP = Guidelines Applied in Practice.

Statistical analysis. Data analysis was performed using the same algorithm as the one used for CMS's current national AMI quality indicators (1,2,6,7). Abstracted data were analyzed to confirm the presence of an AMI based upon elevated cardiac biomarkers and/or electrocardiographic analyses, and/or the presence of chest pain within 48 h of arrival as reported by earlier studies (1,2,6,7). Additional indicator-specific inclusion and exclusion criteria were applied so that only "ideal" patients remained in the denominators (1,2,6,7). Each quality indicator baseline rate was compared with the re-measurement rate for "ideal cases" at the aggregate and individual hospital level. To measure the effect of tool use, baseline rates were also compared with re-measurement rates for those cases where GAP tools were measured or referenced in the chart. Because a stratified sample method was used, aggregate indicator rates were calculated by weighting hospital-specific rates to reflect each hospital's proportion of Medicare and non-Medicare cases in the combined AMI patient universe.

The statistical tests of comparison at the aggregate level were made using two-tailed binomial z test for proportions ($p = 0.05$). Additional analyses were performed to examine the effect of the quality improvement effort in patients with and without percutaneous coronary intervention (PCI) and patients with and without coronary artery bypass graft (CABG) surgery during their current hospitalization. The SAS version 8.0 (SAS Institute Inc., Cary, North Carolina) was used for all statistical analysis.

RESULTS

Hospital characteristics and patients' demographic data, past medical history, and clinical presentations. We studied 1,022 patients, 523 from the baseline period (pre-intervention) and 499 from the re-measurement (post-intervention) period. The hospital characteristics are shown in Table 1. The proportion of Medicare patients in baseline and re-measurement samples were 62.9% and 62.5%, respectively (p = NS). Most clinical characteristics of the two patient populations were similar (Table 2). The proportion

Table 5. Quality of Care in Patients Undergoing PCI

Quality Indicators	Re-Measurement PCI Numerator/ Denominator (%) [SD]	Re-Measurement No PCI Numerator/ Denominator (%) [SD]	p Value
Discharge aspirin	102/110 (92%) [2.4]	58/65 (89.1%) [4.0]	0.415
Discharge beta-blockers	44/45 (98.7%) [1.3]	23/25 (93.3%) [4.8]	0.278
Discharge ACE inhibitors	20/22 (92.9%) [5.1]	28/31 (91.6%) [4.9]	0.854
Discharge treatment of elevated cholesterol	58/62 (94.5%) [2.6]	43/53 (81.2%) [5.6]	0.031
Smoking cessation counseling	57/65 (87.8%) [4.2]	17/38 (44.7%) [8.5]	< 0.001
Dietary counseling (%)	172/178 (96.5%) [1.4]	112/139 (81.0%) [3.6]	< 0.001

ACE = angiotensin-converting enzyme; PCI = percutaneous coronary intervention.

of patients discharged to home and the in-hospital mortality did not differ between the two groups.

Impact of quality improvement initiative on the overall quality of care. Significant increases in adherence to key treatments were seen in the discharge treatment indicators of administration of aspirin at 93.0% ($p < 0.001$), angiotensin-converting enzyme (ACE) inhibitors at 89.2% ($p = 0.006$), smoking cessation counseling at 87.2% ($p < 0.001$), and dietary counseling at 95.6% ($p < 0.001$) with trends for improvement in the other discharge indicators (Table 3). The admission indicator rates were high at baseline and remained high at re-measurement (Table 3). No substantive effect on time to reperfusion in ST-segment elevation AMI was observed. However, small sample size precluded meaningful analyses of this indicator.

Tool use and its impact on the quality of care. Evidence of utilization of at least one tool was present in 93.2% of the records at re-measurement (Table 4). All five hospitals were using standard admission orders for most patients with acute coronary syndromes at baseline. The presence of preset admission orders was identified in the records of 65.2% of patients at baseline and 81.8% at re-measurement. Clinical pathways were used in 59.8% and 79.0% of the cases at baseline and re-measurement, respectively. The AMI specific discharge tool, developed for this project, was evident in 47.1% of patients at re-measurement.

When standard orders were used, a high rate of adherence to the use of admission aspirin, beta-blockers, and measurement of cholesterol panel within 24 h was observed. Because admission orders were widely used before this initiative, the admission indicator rates, although higher than baseline for all indicators, were not statistically higher in the re-measurement sample (Table 3). In contrast, the use of a standard discharge tool was associated with increases (or a trend towards increase) in all discharge indicators including aspirin ($p < 0.001$), beta-blockers ($p = 0.129$), ACE inhibitors ($p = 0.006$), treatment of elevated cholesterol ($p = 0.081$), and smoking cessation ($p < 0.001$) and dietary counseling ($p < 0.001$) (Table 3).

Quality indicator rates in patients undergoing percutaneous interventions or CABG. Percutaneous coronary intervention or CABG was performed in 200 (40.1%) and 57 (11.4%) of patients during hospitalization, respectively. Rates of discharge indicators in PCI patients were higher than in those not undergoing PCI (Table 5). In contrast, the use of discharge aspirin, beta-blockers, ACE inhibitors, and treatment for elevated cholesterol was lower in patients undergoing CABG. Smoking cessation and dietary counseling were offered to similar proportions of patients in the CABG and no-CABG group (Table 6).

DISCUSSION

This study demonstrates that the implementation of tools of AMI care was increased across five hospitals when a major emphasis was placed on monitoring and increasing their utilization. Use of care tools was associated with increases in adherence to the key quality of care indicators for AMI care. Together with previous reports (2,4), our results suggest

Table 6. Quality of Care in Patients Undergoing CABG Surgery

Quality Indicators	Re-Measurement CABG (n)	Re-Measurement CABG (% [SD])	Re-Measurement No CABG (n)	Re-Measurement No CABG (% [SD])	p Value
Discharge aspirin	24/29	83.2 (6.3)	160/175	91.3 (2.2)	0.225
Discharge beta-blockers	9/11	84.8 (10.9)	67/70	96.3 (2.2)	0.301
Discharge ACE inhibitors	4/8	44.2 (5.9)	49/53	92.0 (3.8)	< 0.001
Discharge treatment of elevated cholesterol	8/14	53.1 (17.5)	101/115	87.9 (3.1)	0.050
Smoking cessation counseling	14/18	77.1 (10.9)	74/103	71.5 (4.5)	0.635
Dietary counseling (%)	45/50	90.1 (4.1)	265/294	90.1 (1.7)	1.000

ACE = angiotensin-converting enzyme; CABG = coronary artery bypass graft.

Table 7. Barriers to the Use of Tools/Strategies to Overcome Barriers

Barrier	Strategies
Planning	
Lengthy approval processes for new forms, threatening start date and time line.	Used a revised approach to customize forms. Physician champions to accelerate the process. Labeled the project a "pilot" until results were available, accelerating acceptance.
Education	
Difficulty reaching all medical staff (cardiologists, emergency department, internist, family practice, and so forth) for project recruitment, education, and feedback after implementation.	Scheduled CME presentations to coincide with existing medical staff meetings, and invited other disciplines/house officers to the meeting. Supplied samples of new forms and information fliers at all locations.
Difficulty reaching all nursing and ancillary staff (critical care units, emergency department, general units, off shifts, and the like) for project recruitment, education, and feedback after implementation.	Included GAP as an agenda item at medical staff meetings with short, concise updates. Created one-page informational sheets to capture attention. Communicated via mass phone mail messages, e-mails, and articles in staff newsletters. Provided continuing educational presentations at regular staff meetings for nursing and ancillary staff. Identified/trained key nursing support staff (case managers, advance nurse practitioners, unit charge nurses, discharge coordinators, CNS group, and others) to promote GAP, educate staff, and conduct follow-up discussions for all shifts. Used volunteers to assist with promotional materials and roll out activities.
Implementation	
Physicians resistant to use standing orders. Nurses resistant to use new discharge form.	Provided one-on-one follow-up by physician champion and nurse managers stressing the importance of tools for improving quality.
Monitoring Tool Use	
Difficulty identifying concurrent AMI sample to review charts for tool use.	Created sample from list of patients with elevated troponins generated by hospitals' laboratory.
Re-Measurement	
Medical records process of coding and closing charts was lengthy, with delays when physicians still needed to dictate or sign records.	Involved medical records staff and coders in designing rapid process to meet remeasurement time line. Gave special feedback to physicians at meetings.

AMI = acute myocardial infarction; CME = continuing medical education; CNS = central nervous system; GAP = Guidelines Applied in Practice.

that the routine use of care tools is an effective method of reminding caregivers and patients regarding key priorities in AMI care.

Knowledge of or even implementation of national guidelines (3) meant to alter physician behavior often yields disappointing results (6–16). The clinical care tools for AMI described in this study attempted to encourage a standardized clinical approach to the management of AMI victims and served as an important reminder as to the goals of care. This "simple," multifaceted approach to improving quality of AMI care, focused on caregivers and patients, supported by the national guidelines, and endorsed by local physicians and opinion leaders, resulted in improved adherence to key quality indicators. By directing the focus on processes of care and tool use rather than focusing solely on the key indicators, we achieved higher utilization of tools than observed in the previous study (2) with resultant improvement in quality of AMI care.

Both approaches (tracking adherence to key indicators vs. an emphasis on tool use) are relevant to effective improvement in adherence to key quality indicators. However, monitoring of tool use acknowledges that the development of a sustained process of care (or system) that is triggered by the admission of a patient may be more effective than relying on a consistent memory of caregivers in rendering evidence-based care. We believe that focusing on improved

tool use translates directly to improved indicator rates if there has been broad institutional buy-in and support. Also, it is possible for a clerk or other staff member to track tool use, whereas monitoring of the key indicators themselves requires a clinician with broad knowledge of the indications and contraindications for each measure.

Our study provides several insights that may be useful in future initiatives aimed at quality improvement. First, despite the collaborators' best efforts, some of the tools (particularly the discharge document) were not utilized in all patients. To be able to gain better insights into factors related to resistance for tool use for AMI care, we prospectively tracked perceived barriers to their utilization. We identified multiple barriers during the project and some of our strategies to overcome them (Table 7). Second, our study identified a clinical subgroup that may have greater potential for improvement in care after AMI. Patients undergoing CABG were less likely to receive aspirin, beta-blockers, ACE inhibitors, and cholesterol-lowering agents at discharge (Table 6). Physicians' ambivalence about using beta-blockers, ACE inhibitors, and statins in patients after CABG may stem from the lack of specific randomized trials supporting their use in post-CABG patients. However, because patients with AMI in general benefit from the use of evidence-based medicines, and because data from observational studies support use in post-CABG patients (17,18), their use among ideal patients is generally endorsed by the national guidelines.

In contrast to patients undergoing CABG, those undergoing PCI were more likely to receive most key indicators known to improve survival in these patients (Table 5). Several factors may account for this, including younger age of the patients, more frequent use of standardized protocols for their care, and physicians and staff who were more aware of the guideline initiative and its importance.

In the era of growing national focus on quality in health care together with the recognition that important gaps exist (6–16), strategies such as the ACC GAP initiatives may provide a roadmap to improving quality of care across the nation (19). Medicine by memory is not reliable. Focusing as much on the use of a care system, rather than simply on indicators themselves, represents an additional step that will improve performance. Institutions and caregivers should embrace these strategies in caring for patients with AMI as we attempt to realize the target of "Healthy People 2010" (20).

Study limitations. This study was an observational cohort study which used each hospital's previous performance as the control against which improvement was measured. Because there has been a general improvement in quality indicators in recent years, it is not possible for us to determine how much improvement stemmed from GAP versus secular trends. However, in the ACC GAP pilot, we showed that improvement in quality indicators was more substantial in the 10 hospitals that participated in the GAP Project than in "control" hospitals that volunteered to participate but were not chosen (2). Second, we analyzed quality indicator rates in "ideal" patients only. There are many patients with relative contraindications to key therapies who may also benefit from them. Third, because we studied care in just five hospitals in two Michigan communities, the generalizability of our results to other regions or care environments is not possible. Finally, although we believe that this study, as well as the GAP Pilot Project, demonstrates the potential to improve hospital AMI care by embedding key therapeutic targets into the care itself, the sustainability of this improvement after discharge is unproven and needs to be studied.

Reprint requests and correspondence: Dr. Kim A. Eagle, Albion Walter Hewlett Professor of Medicine, Chief of Clinical Cardiology, University of Michigan, 1500 East Medical Center Drive, 3910 TC, Ann Arbor, Michigan 48109. E-mail: Keagle@umich.edu.

REFERENCES

1. Eagle KA, Gallogly M, Montoye CK, et al. Taking the national guideline for care of acute myocardial infarction to the bedside: developing the Guideline Applied in Practice (GAP) initiative in Southeast Michigan. Jt Comm J Qual Improv 2002;28:5–19.
2. Mehta RH, Montoye CK, Eagle KA, et al. Improving quality of care for acute myocardial infarction: the Guidelines Applied in Practice (GAP) initiative. JAMA 2002;287:1269–76.
3. Ryan TJ, Antman EM, Brooks MH, et al. ACC/AHA guidelines for management of patients with acute myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction). J Am Coll Cardiol 1999;34:890–911.
4. Mehta RH, Das S, Tsai T, et al. Quality improvement initiative and its impact on the management of patients with acute myocardial infarction. Arch Intern Med 2000;160:3057–62.
5. Montoye CK, Mehta RH, Baker PL, et al. A rapid-cycle collaborative model to promote guidelines for acute myocardial infarction. Jt Comm J Qual Saf 2003;29:468–78.
6. Ellerbeck EF, Jencks SF, Radford MJ, et al. Quality of care for Medicare patients with acute myocardial infarction: a four state pilot study. The Cooperative Cardiovascular Project. JAMA 1995;273:1509–14.
7. Marciniak TA, Ellerbeck EF, Radford MJ, et al. Improving the quality of care for Medicare patients with acute myocardial infarction: results from the Cooperative Cardiovascular Project. JAMA 1998;279:1351–7.
8. Gurwitz JH, Goldberg RJ, Chen Z, Gore JM. Beta-blocker therapy in acute myocardial infarction: evidence for underutilization in the elderly. Am J Med 1992;93:605–10.
9. McLaughlin TJ, Samurai SB, Wilson DJ, et al. Adherence to national guidelines for drug treatment of suspected acute myocardial infarction. Arch Intern Med 1996;156:799–805.
10. Mehta RH, Ruane TJ, McCargar PA, Eagle KA, Stalhandske EJ. The treatment of elderly diabetic patients with acute myocardial infarction. Arch Intern Med 2000;160:1301–6.
11. Yarzebski J, Col N, Pagley P, Savangeau J, Gore J, Goldberg R. Gender differences and factors associated with receipt of thrombolytic therapy in patients with acute myocardial infarction: a community-wide perspective. Am Heart J 1996;131:43–50.
12. Vaccarino V, Horwitz RI, Meehan TP, Petrillo MK, Radford MJ, Krumholz HM. Sex differences in mortality after myocardial infarction: evidence for a sex-age interaction. Arch Intern Med 1998;158:2054–62.
13. Allison JJ, Kiefe CI, Centor RM, Box JB, Farmer RM. Racial differences in the medical treatment of elderly Medicare patients with acute myocardial infarction. J Gen Intern Med 1996;11:736–43.

14. O'Connor GT, Quinton HB, Traven ND, et al. Geographic variation in the treatment of acute myocardial infarction: the Cooperative Cardiovascular Project. JAMA 1999;281:627–33.
15. Krumholz HM, Radford MJ, Wang Y, Chen J, Heait A, Marciniak TA. National use and effectiveness of beta-blockers for the treatment of elderly patients after acute myocardial infarction: National Cooperative Cardiovascular Project. JAMA 1998;339:551–3.
16. Jencks SF, Huff ED, Cuerdon T. Change in quality of care delivered to Medicare beneficiaries, 1998–1999 to 2000–2001. JAMA 2003; 289:305–12.
17. Chen J, Radford MJ, Wang Y, Marciniak TA, Krumholz HM. Are beta-blockers effective in elderly patients who undergo coronary revascularization after acute myocardial infarction? Arch Intern Med 2000;160:947–52.
18. Christenson JT. Preoperative lipid control with simvastatin reduces risk for graft failure already 1 year after myocardial revascularization. Cardiovasc Surgery 2001;9:33–43.
19. Bossone E, Kline-Rogers E, Montoye CK, et al. Implications of the results of ACC sponsored Guidelines Applied in Practice (GAP) project: opportunity to save >35,000 lives per year in U.S. Circulation 2001;104:II837.
20. U.S. Department of Health and Human Services. Healthy People 2010, Understanding and Improving Health. Washington, DC: U.S. Government Printing Office, 2000.

APPENDIX

The American College of Cardiology Guidelines Applied in Practice Steering Committee Members: Raymond J. Gibbons, MD, FACC (Chair), Christopher P. Cannon, MD, FACC, Richard A. Chazal, MD, FACC, James T. Dove, MD, FACC, Kim A. Eagle, MD, FACC, Arthur Garson, Jr., MD, MPH, MACC, Rick A. Nishimura, MD, FACC, Cary Sennett, MD, PHD (ACC Staff).