Critical Pathways for Acute Myocardial Infarction

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Critical pathways are standardized protocols for optimizing and streamlining patient care. They are important in the management of patients with acute myocardial infarction, many of whom do not receive evidence-based therapies. Several studies have demonstrated that the development and implementation of critical pathways that follow published guidelines and are tailored to the needs and resources of each institution result in increased use of evidence-based therapies, such as aspirin and ß-blockers, and is associated with decreased mortality. Use of these protocols has also been shown to reduce unnecessary therapy and under- or overutilization of certain procedures, thereby resulting in more cost-effective treatment.

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Critical pathways are standardized protocols for disease management that aim to optimize and streamline patient care.[1,2] Some of the best examples of critical pathways are the acute myocardial infarction (MI) protocols used in the emergency department (ED) to reduce time to treatment with fibrinolysis.[3]

Table 1
Rate of Use of National Registry of Myocardial Infarction Guideline-Recommended Therapies in Patients with Acute Myocardial Infarction

Recommended Therapy	Patients undergoing recommended therapy (with thrombolysis), % (n = 84,477)	Percent undergoing recommended therapy (no thrombolysis), % (n = 156,512)
ASA	84	63
Heparin	97	56
IV nitroglycerin	76	50
IV ß-blockers	17	6
Oral ß-blockers	36	29
Calcium channel blockers	29	42

IV, intravenous. Data from Rogers et al.[4]

For patients with acute MI, critical pathways are needed because many patients do not receive evidence-based therapies. For example, the National Registry of Myocardial Infarction (NRMI) showed that among 240,989 MI patients receiving fibrinolytic therapy, only 87% received aspirin, and only 63% of patients with non–ST-segment elevation MI received aspirin (Table 1).[4] ß-Blockers and angiotensin-converting enzyme (ACE) inhibitors were also very underused, and early intravenous (IV) ß-blockade was used in fewer than 20% of patients. Even more astoundingly, only 30% of patients had been treated with oral ß-blockers at the time of hospital discharge. Better but still suboptimal findings were seen in the Thrombolysis in Myocardial Infarction (TIMI) 9 Registry of ST segment elevation MI, in which ß-blockers were given to 61% of patients.[5] However, in the TIMI 9 Registry of patients who developed congestive heart failure or had documented left ventricular dysfunction post-MI, only 39% were treated with ACE inhibitors at hospital discharge.[5] Another, more recent survey in 2000—European Action on Secondary Prevention by Intervention to Reduce Events (EUROASPIRE)—found wide variability in the use of recommended therapies across approximately 20 countries in Europe. For example, ß-blockers were used in an overall average of just over 60% of patients.[6] Thus, with such poor compliance with guidelines, the central role of critical pathways is to try to improve the use of recommended and evidence-based therapies.

A second target of critical pathways is to improve the timeliness of reperfusion therapy with thrombolysis and primary percutaneous coronary intervention (PCI). This is indeed where the first widely used critical pathway began. The National Heart Attack Alert Program pathway focused on "the door-to-drug time"—the time from hospital arrival to the start of thrombolysis.[7,8] Analyses have shown that delays in door-to-drug time for patients treated with thrombolysis, or door-to-balloon times for those treated with primary PCI, are associated with increased mortality.

A final link has been made: Patients who are treated according to guideline recommendations have better outcomes. One analysis looked at the U.S. News & World Report "best hospitals" and their use of various therapies.[9] As shown in Figure 1, the top-ranked hospitals gave guideline-recommended therapies, such as ß-blockers, more frequently than did the other hospitals. The survey also showed that invasive hospitals with catheterization laboratories tended to do a little better than the noninvasive, community hospitals. Similarly, aspirin use was significantly higher in the U.S. News & World Report top-ranked hospitals. Most importantly, the investigators found a correlation between the use of these therapies and mortality. It was observed that the U.S. News & World Report best hospitals had a significantly lower mortality compared with the invasive hospitals or the noninvasive hospitals. The lower mortality observed in America's best hospitals was very much related to the use of evidence-based therapies, such as aspirin and ß-blockers. The encouraging part of this analysis is that it applies to any hospital: If a hospital implements critical pathways to improve the use of guideline-recommended therapies, it would be expected to translate that into improved outcomes.

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This same circle of quality improvement has been shown to exist in unstable angina and non-ST eleva-

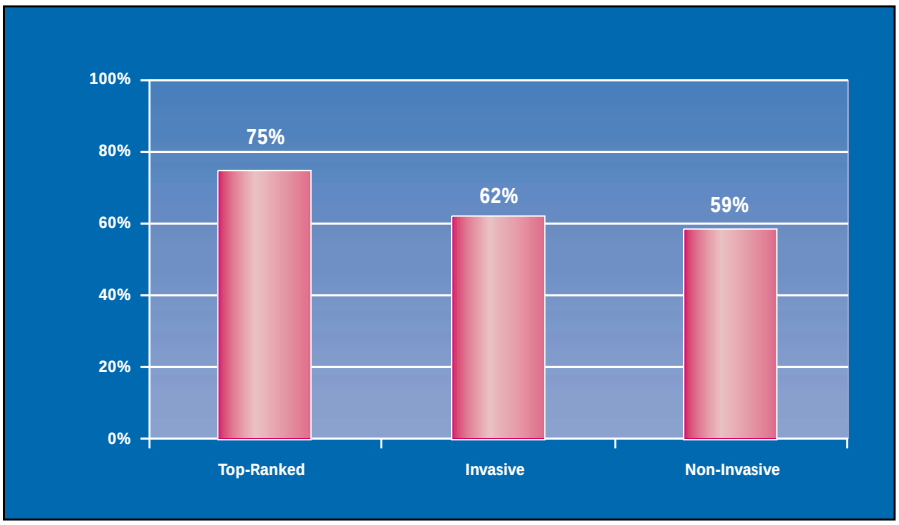

Figure 1. *Data on the use of ß-blockade in patients determined to have no contraindications, stratified by type of hospital (as ranked by* U.S. News & World Report*). Data from Chen et al.*[9]

tion MI (the latter group accounting for more than half of all acute MI patients). Underutilization has been seen in several registries. For improvement, we examined the effect of publication of guidelines on the quality of care. In this analysis, we looked at two registries: TIMI 3, which was done before publication of the 1994 Unstable Angina guidelines, and the Global Unstable Angina Registry and Treatment Evaluation (GUARANTEE), done a year after publication of the guidelines. There was a slight improvement in the use of aspirin, heparin, and ß-blockers after the guidelines were published (Table 2). However, even after publication, use of these therapies was still suboptimal, with 80% of patients receiving aspirin on admission and 50% receiving ß-blockers: hardly an ideal treatment algorithm. For the second part of quality improvement, Giugliano and colleagues[10] found in a single-center study that patients who were treated according to the guidelines had an adjusted survival that was significantly lowered compared with those who had lower compliance with guideline recommendations. These data indicate that quality really matters. Thus, monitoring the rates of use of aspirin, ß-blockers, heparin, and all the other therapies, using pathways and other strategies to improve this use, should translate into improved outcomes for patients with acute coronary syndromes.

Critical Pathways

The overriding goal of critical pathways is to optimize care (Table 3).[11,12] Initially, their use focused on reducing length of hospital stay. However, several other components may be added to critical pathways, with the overall goal of improving patient care. These other goals focus on improving the use of appropriate treatments and on facilitating patient triage to the appropriate level of care. Another goal is to ensure appropriate use of procedures, avoiding both under- and overutilization. In this fashion, decreasing the use of inappropriate procedures can improve the overall cost of therapy. Pathways are a useful tool to improve the quality of care while making that care more cost-efficient.

There are two broad categories of pathways: diagnostic pathways, such as those used in chest pain centers where the goal is to determine whether a patient has unstable angina or noncardiac chest pain; and therapeutic pathways, such as the acute MI thrombolysis pathways noted earlier. Each type can be useful in improving the quality and cost-efficiency of medical care.

Setting Up a Critical Pathway

The process of setting up a critical pathway is an involved one, with

Table 2
Use of Guideline-Recommended Therapies for Unstable Angina and Non-ST Elevation Myocardial Infarction Before and After Guideline Publication

Therapeutic options administered on admission	Pre-Guideline Men (n=1678)	Pre-Guideline Women (n=1640)	Post-Guideline Men (n=1788)	Post-Guideline Women (n=1160)	*P* values Men	*P* values Women
ASA	82	77	84	80	0.30	0.05
Heparin	63	50	66	60	0.13	0.001
ß-blockers	41	35	53	49	0.001	0.001

Data taken from the Thrombolysis in Myocardial Infarction (TIMI) 3 registry and the Global Unstable Angina Registry and Treatment Evaluation (GUARANTEE).
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Table 3
Goals of Critical Pathways

- Increase use of recommended medications (eg, aspirin, ß-blockers)
- Reduce time to treatment with reperfusion therapy
- Provide guidance on timing of cardiac procedures
- Decrease use of unnecessary tests and procedures
- Reduce emergency department and intensive care unit visits as well as overall length of stay in the hospital
- Increase participation in clinical trials
- Provide a framework for collecting data for continuous quality improvement
- Improve patient care and decrease costs

several steps (Table 4).[13] The first step is to identify problems in care; thus, one must evaluate what the common diagnoses are in his or her own hospital. It is not likely to be worthwhile to develop a pathway for a rare disease, rather one should focus on the common ones, such as acute MI. The next step is to assemble a complete group of all the important participants in the care of the patients involved (eg, MI patients). Thus, for an acute MI pathway, one should include representatives from cardiology, internal medicine, nursing, the emergency department, the clinical laboratory, and cardiac surgery, as well as flow managers and administrators. The group of people involved in the development of care for acute MI patients is a broad one.

The group is then assembled at a meeting to begin the process. In a setting such as acute MI, one may adapt a pathway from another institution or develop a new one. There should be input from all the various groups to make sure that this pathway will fit into clinical practice at the institution. Some hospitals have computerized order entry systems, others have paper order sets. Thus, the type of pathway needs to be adapted for each institution for it to actually become implemented.

Once a pathway has been agreed on, the "roll out" should include presentations to the relevant caretakers at grand rounds, in-services, and other educational meetings throughout the institution. The change in practice occurs with distribution of the various tools to the physicians and nurses who will be using them. One has to work with the resources available at his or her hospital to figure out what fits. For example, one may use standardized order sets or computerized forms, or simple pocket cards, reminders, or checklists. These tools are all useful to remind the busy clinician of the various therapies that must be given to the acute MI patient. Some institutions have established pathways, such as congestive heart failure pathways, that are run by dedicated case managers. However, this type of dedicated staff cannot be developed for each pathway, so tools must be developed for use by the regular hospital staff so that they become part of routine clinical care.

The final part of the quality circle is to monitor various performance measures of quality, such as use of aspirin and ß-blockers. This is usually accomplished by having a data registry to monitor the rates of use of the recommended therapies before and after implementation of a critical pathway. That way, if some problems are observed with persistent underutilization, the pathway may be adapted if necessary. Thus, the critical pathway is a continuous effort that involves many steps and an ongoing commitment to improve quality.

Using Pathways to Improve Quality of Care

There are now a growing number of studies showing that pathways can improve the quality of care. The first example was the widely discussed pathway by the National Heart Attack Alert Program called "the four Ds": door, data, decision, and drug

Table 4
The Steps in Critical Pathway Development

1. Define problems in patient care (eg, practice variation, excess resource use, failure to provide known evidence-based therapies.
2. Form a working committee or task force to develop optimal guidelines for medical care.
3. Create a pathway (or adapt an existing one).
4. Distribute a draft critical pathway to all personnel and departments involved. Revise the pathway to reach a best-consensus approach.
5. Implement the pathway, preferably via a pilot test involving a prominent local clinical champion(s).

time.[3] This simple pathway focused on the effort to administer thrombolytic therapy within 30 minutes of a patient's arrival at the emergency department by listing the four key steps of treatment. Although this pathway had only one parameter, it was a successful one. Data from the NRMI have shown a significant reduction in door-to-drug time, from more than 60 minutes in the early 1990s to approximately 30–35 minutes on average.[14] Indeed, this pathway provides a good example of how to start implementation: Begin with a focus on one problem area, then broaden the perspective to other areas and issues in care. Similar improvements in door-to-drug times have been seen at individual hospitals, including our own.

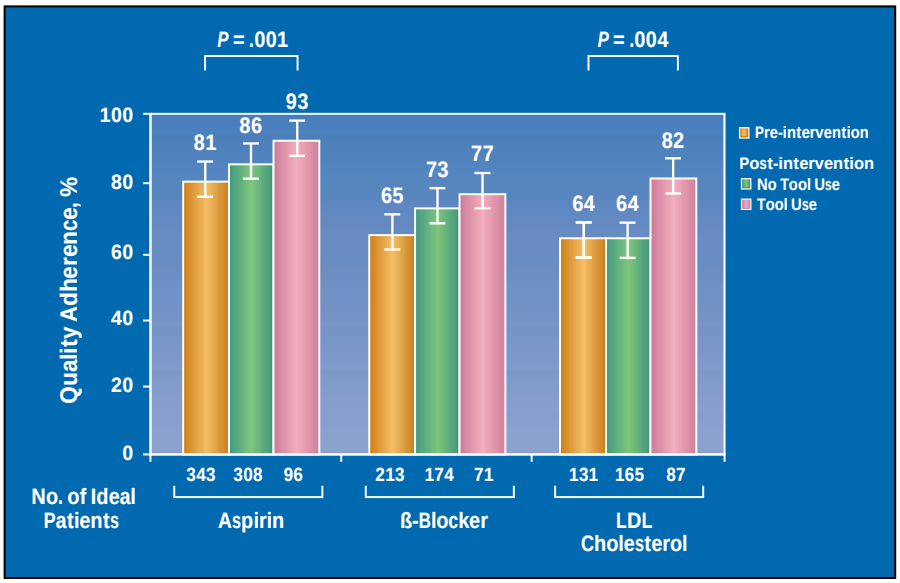

Figure 2. *Data showing improved utilization of guideline-recommended therapies with GAP program participation, particularly in conjunction with tools such as critical pathway standardized order sets. Adapted with permission from Mehta et al.*[16]

The focus is now on a similar process, one to improve door-to-balloon times for patients treated with primary PCI. One of the first published experiences of a quality improvement effort was done at Beth Israel Hospital. Beginning in 1992, this institution switched to performing only primary PCI for patients with ST-segment elevation MI.[15] However, when they looked at their experience after the first year, the observation was sobering. They found that their door-to-balloon time was more than 3 hours and mortality was 26%. The study did include some shock patients, but the results were shocking to the researchers, who resolved to "clean up their act." They implemented a critical pathway in an effort to reduce the time needed to perform all the various steps from the time a patient arrives in the emergency department to the time he or she receives PCI. The researchers successfully cut the time almost in half, to approximately 90 minutes, and saw parallel improvement in mortality. This was yet another demonstration of a single center that developed a pathway that had a significant impact on the quality and outcome of a treatment strategy.

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Two of the most recent studies on critical pathways were published by the American College of Cardiology (ACC) and the Veterans Affairs (VA) hospital system.[16,17] The ACC sponsored the Guideline Applied in Practice (GAP) Program, which was led by Kim Eagle in Michigan. In this program, ten hospitals were identified to participate in the quality improvement effort. They each worked to implement pathways using methods that included education of hospital staff through grand rounds programs, development and implementation of standardized order sets, and distribution to the physicians of pocket cards with treatment guidelines. As shown in Figure 4, they found improvement in the use of guideline-recommended therapies and procedures: Early use of aspirin and ß-blockers and measurement of low-density lipoprotein cholesterol were all improved after implementation of the GAP effort.[16] The improvement in ß-blocker use early on was especially significant. Perhaps the most interesting thing about the study is that it looked at whether the tools had actually been used. Thus, improvement was seen across the board but was greatest in patients in whom there was evidence documented in their charts that the standardized pathway, the pocket tool, or one of the other tools rolled out at the individual hospital had actually been used. These results demon-

strated that having tools for clinicians to use as reminders really does work and improves the use of various therapies. This study also provided evidence that it is critical for an individual institution to make sure that whatever tools are selected are adapted to fit that hospital's standard clinical practice.

The American Heart Association (AHA) has developed "Get with the Guidelines℠," a web-based program that focuses on the time of discharge to help assess, in real time, whether all of the various guideline-recommended therapies have been used. In this simple program, the targeted clinical information about the patient is entered and reminders built into the system prompt compliance with the guidelines. For example, if a patient has high serum cholesterol and no lipid-lowering agent is listed in the discharge medications, the program will prompt the physician with the suggestion that the patient is a candidate for statin therapy. The tool is also linked to the ACC/AHA guidelines, so the specific recommendation is immediate.

A second component of the Get with the Guidelines program is the data registry. All the patient data are stored and can be summarized, so that a hospital can track its overall compliance with the guidelines. As noted above, this is the step in the overall quality circle where one has to collect data to monitor performance. There are now many different registries, including NRMI and the ACC's National Cardiovascular Data Registry (NCDR) database of patients undergoing cardiac catheterization and PCI. Finally, several unstable angina/non–ST-segment elevation MI registries exist, including CRUSADE (Can Rapid Risk Stratification of Unstable Angina Patients Suppress Adverse Outcomes with Early Implementation of the ACC/AHA Guidelines) and GRACE (Global Registry of Adverse Coronary Events).

Giving equal attention to decreasing unnecessary therapies can improve efficiency overall, thereby improving cost-effectiveness and quality at the same time.

The most recent publication in this field comes from the VA system, which initiated a "reengineering" of cardiology approximately 5 years

Main Points

- Critical pathways are needed for acute myocardial infarction patients because many of them do not receive guideline-recommended evidence-based therapies.
- The U.S. News & World Report "best hospitals in America" gave guideline-recommended therapies, such as aspirin and ß-blockers, more frequently than did other hospitals, resulting in better outcomes, including lower mortality.
- Giugliano and colleagues found that patients who were treated according to Unstable Angina guidelines had an adjusted survival that was significantly lower compared with those who had lower compliance with guideline recommendations.
- Another goal of critical pathways is to ensure the appropriate use of procedures, avoiding both under- and overutilization, and to reduce unnecessary therapy. This results in more cost-effective treatment.
- There are several steps in setting up a critical pathway: identifying the problem in care, assembling all of the participants who are involved in the patients' care, developing a protocol or adapting an existing one, distributing the various tools needed by the physicians and nurses to implement the protocol, and keeping a data registry to monitor rates of recommended therapies.
- The Guideline Applied in Practice Program, sponsored by the American College of Cardiology, assessed whether the tools used by ten hospitals in implementing their critical pathways were actually used. Improvement in quality of care and mortality were greatest in the patients who had documented evidence in their charts of having been treated by clinicians using a standardized pathway, pocket chart, or one of the other tools used by a particular institution.
- The Veterans Affairs system initiated a "reengineering" of cardiology, focusing on the use of standardized approaches and pathways, information technology, and computer order sets to build a system to help clinicians administer appropriate care. They observed significant improvement of 90%–95% over a 4-year period in the use of key therapies, such as aspirin and ß-blockers, with rates of 90-95% use in appropriate patients: the best data reported to date.

ago. The researchers focused on using standardized approaches and pathways, using information technology and computer order sets to build a system to help clinicians administer appropriate care.[17] These efforts were applied broadly to congestive heart failure, pneumonia, and acute MI. A key part of the study consisted of monitoring data and publicly disclosing the results from each of the hospitals. Thus, each hospital was accountable for its successes or failures in terms of administering these therapies. The hospitals observed an improvement over 4 years in the use of key therapies, such as aspirin and ß-blockers, at admission and discharge. The improvement was significant at all institutions, reaching levels greater than 90%–95% for use of aspirin and ß-blockers: the best results that have been reported to date. These results are encouraging because they show that we can implement a pathway program, monitor data, and have significantly meaningful improvement in outcome.

Conclusion

This is an exciting time for implementing the evidence-based therapies. Critical pathways now have been shown in numerous studies to improve quality of care and outcomes. These are important tools for us to use in treating our patients, not only improving the quality of the care they get but also increasing the cost-effectiveness of this care. Giving equal attention to decreasing unnecessary therapies can improve efficiency overall, thereby improving cost-effectiveness and quality at the same time. It is hoped that with these published successes, more institutions will implement critical pathways and quality improvement efforts, thereby improving the care of their patients. ■

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