Introduction

Improving cardiac outcomes was first defined as an organizational goal in the Strategic Quality Plan of Kaiser Permanente of Ohio (KP Ohio) in 1992. Table 1 lists the team members and contact person for this project.

The literature indicates that the use of aspirin in patients with known coronary artery disease (CAD) can decrease cardiac events by 25%.1 Lowering cholesterol to below 100 mg/dL in high-risk patients with CAD can reduce morbidity and mortality by as much as 35%.2,3 Beta blockers after a myocardial infarction have also been shown to decrease cardiac events.4

Physician compliance with guidelines pertaining to the use of aspirin and cholesterol-lowering drugs has been low.5,6

Background

This project was a joint effort between the Kaiser Foundation Health Plan and the Permanente Medical Group of Ohio (OPMG). The team was formed in 1993 to support the Strategic Quality Plan and was led by the Associate Medical Director for Medical Information and the Assistant Medical Director for Quality, Resource Management, and Continuity. The team included the Internal Medicine and Cardiology Departments; members of the Quality, Information Technology, and Clinical Innovation Departments. During the course of the project, individual team members changed, but the goals were maintained.

Process

In 1992, during a clinical strategic planning process which reviewed effective interventions for prevalent diagnoses, we determined that four interventions could have a measurable impact on our members and could improve cardiac outcomes for CAD patients. We estimated that cardiac events could be reduced by as much as 20% if compliance with established guidelines could be improved, with possible further decreases if beta blocker and smoking cessation programs were successful.

The project was implemented in 1994 after the deployment of the Medical Automated Record System (MARS).7 In 1995, an analysis of data from KP Ohio, indicated that one half of admissions for ischemic heart disease and one third of admissions for myocardial infarction were in patients with known CAD, the group at which the interventions described here were directed.

Objectives

The project goal was to improve cardiac outcomes by using four interventions in patients with CAD:

1. Increase aspirin use
2. Increase the use of cholesterol-lowering drugs
3. Encourage smoking cessation
4. Increase beta blocker use after a myocardial infarction.

Methodology

Scope

Cardiac disease is the most common cause of morbidity and mortality in the nation and in our Health Plan membership. The cost of cardiac-related admissions and procedures in KP Ohio is about $20 million per year, and approximately 4% of the membership have a diagnosis of CAD. This project was implemented within the normal duties of the Quality Chief of Internal Medicine, the Chief of Internal Medicine, the MARS team, the Quality, Resource Management, and Clinical Innovation Departments.

Intervention

The intervention consisted of computer-generated reminders from MARS at the time of a visit. Reminders suggested the use of aspirin for CAD patients, LDL cholesterol screening and control for patients with a CAD diagnosis, and use of beta blockers in patients who had a myocardial infarction in the past two years (Figure 1). All OPMG physicians use MARS to document treatment of patients. MARS prints a “paper intermediary” for all patients seen, which consists of a progress note.
that lists patients’ diagnoses, medications, allergies and immunizations, and a reminder page that suggests changes in clinical care when patients are not in compliance with guidelines.

Reminders were not generated for members with contraindications. For example, people with a history of aspirin allergy or side effects, gastritis, or esophagitis, warfarin use, or ticlopidine use were excluded from the aspirin intervention. Approximately 30% of the CAD patients were ineligible for the aspirin intervention due to these contraindications.

The intervention also included generation of comparative reports of physician performance in guideline areas. Literature validated the effectiveness of providing clinical guideline reminders to physicians at the moment of care. In addition, smoking status was collected at every adult visit and was prominently displayed on the progress note with the hope of triggering an education intervention in which clinical staff had been trained.

**Quality Measures**

Eight quality measures were used:

- Percentage of patients with CAD on aspirin
- Percentage of patients with CAD who have had LDL cholesterol screening in the past two years
- Percentage of patients with CAD whose cholesterol level is ≤100 mg/dL
- Percentage of patients receiving beta blockers after a myocardial infarction
- Patient-reported smoking prevalence
- Angina admission rate
- Myocardial infarction admission rate
- Death rate from CAD

Performance goals for these measures were adjusted over time. A performance goal of more than 80% of eligible CAD patients receiving aspirin was set in 1993. The literature indicated that between 13% and 58% of CAD patients take aspirin prophylactically and that only 10% to 15% of CAD patients are at target LDL levels. Baseline measurements in KP Ohio found that 56% of CAD patients were receiving aspirin and 10% were at target LDL levels.

A performance goal of 35% was set in 1996 for patients reaching their target cholesterol level of ≤100 mg/dL. The literature indicates that in a research setting, 60% of patients reached goal. A performance goal of 80% was set for cholesterol testing in the past two years. The KP Ohio baseline for this measure in 1997 was 70%.

No specific goals were set for beta blocker use or for patient-reported smoking prevalence.

The system prompted the collection of smoking status and made that information evident at the moment of care. The clinic smoking-cessation intervention is based on the TRAC program developed by the Center for Health Research. This program features brief tobacco cessation advice and counseling. Videos, written materials, and phone calls provide members with the support they need when they are ready to quit.

A hospital discharge cardiac assessment program was begun in 1995. The care path for this program includes the use of beta blockers for members with myocardial infarction.

In 1995, physician feedback reports were distributed quarterly which detailed the percentage of panel members with CAD who were prescribed aspirin. Similar reports detailing LDL cholesterol screening in the past two years, and LDL level controlled, were started in 1997.

Feedback reports also measured the percentage of panel members who smoked according to patient self-report.

The use of beta blockers after myocardial infarction, a HEDIS measure, was determined by chart review. Beginning in 1993, hospital admissions for myocardial infarction and angina pectoris as well as CAD death rates have been measured to determine if the interventions have led to improvements in the cardiac morbidity and mortality rates. The number of cardiac deaths is determined through use of State of Ohio Vital Statistics death tapes. The number of hospital admissions is obtained through the billing systems.

**Products**

Clinical practice guidelines for cardiac disease were developed, and provider education occurred at Internal Medicine Department meetings throughout the Permanente Medical Group of Ohio.

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**Reminder Notice**

- Your patient has been identified by the Encounter System as having Coronary Heart Disease (CHD). Consider the use of aspirin, because in patients with known CHD, aspirin has been shown to reduce the incidence of future cardiovascular events. (Reference: NEJM 1992; 327:175-181.)

Figure 1.
Quantitative Analysis
The data for 1993 (aspirin) and 1997 (cholesterol screening) were used as baselines prior to the interventions. Statistical Design Analysis Software (STAT-POWER) was used to analyze the data. Two-tailed tests were used to determine significance levels given a statistical power of .80.

Results
Significant improvements have been made in KP Ohio in compliance with the guideline for aspirin use in patients with CAD (Figure 2). Compliance increased from 56% to 84% (p < .0001) and has been maintained over the 80% goal for nearly three years.

The percentage of CAD patients with LDL levels < 101 mg/dL has increased from 10% to 36% (p < .0001), and the percentage of members with no LDL cholesterol screening within two years declined from 30% to 15% (p < .0001) in the 2.5 years of the intervention (Figure 3).

Physician compliance with beta blocker treatment within six weeks after myocardial infarction was reported as 98% in the 1998 HEDIS review using audited data and HEDIS criteria, an increase from 90% in 1995. The percentage of patients with myocardial infarction in the past two years taking beta blockers was not measured.

Patient-reported smoking prevalence declined from 17.2% in 1994 to 15.8% in 1998 (p < .01).

The CAD morbidity measures are shown in Table 2. The Medicare age ischemic heart disease admissions declined by 25% from the baseline year of 1993 through 1998. The non-Medicare age rate declined by 21%. Both declines were statistically significant (p < .001).

The myocardial infarction admission rate declined by 17% in the Medicare age group and 20% in the non-Medicare age group during the same period.

The cardiac mortality rate is shown in Table 3. The Medicare age mortality rate declined from 8.0 per 1000 members/year to 5.5 per 1000 members/year (p < .05). From 1993 to 1997, the cardiac mortality rate in the entire KP Ohio population declined by 20.1% (difference between proportions, p = .24 as compared with the entire population of the State of Ohio).

Comment
This project is unique because it uses computer-generated reminders which are printed at the time of a patient visit. The project has resulted both in increased compliance with guidelines and in decreased cardiac morbidity and mortality. This project was not conducted as a study with a control group, so it is not possible to attribute the results solely to the reminders. However, we observed improved guideline compliance and decreased morbidity and mortality after reminder activation.

The prevalence of CAD in KP Ohio is at Program average for each age band. However, since the KP
Ohio Region has an older population than the other Regions, total prevalence of CAD is the highest of all the KP Regions in the Program. The cardiac interventions implemented in the KP Ohio Region have led to a decline in both cardiac morbidity and mortality rates. Nationally, cardiac mortality rates have also declined.\textsuperscript{13} Many factors have contributed to the secular decline, including a decrease in cigarette smoking and in mean blood cholesterol levels.

From 1993 to 1997, the cardiac mortality rate for the State of Ohio declined by 7.2\% from 1993 to 1997. Had the mix of Medicare and non-Medicare members remained the same, the decrease in the KP Ohio cardiac mortality rate would have been around 30\%.

**Cost-Benefit Analysis**

The cost-benefit analysis for these interventions appears to be compelling. In 1998, there were approximately 365 fewer admissions for angina and 120 fewer for myocardial infarction than would have been predicted from 1993 rates. There were approximately 90 fewer cardiac deaths in 1997 than would have been predicted from 1993 rates. There were no incremental personnel costs. Nonpersonnel costs included the cost of increased medications and increased laboratory tests. Between 1997 and 1999, an additional 660 members were dispensed cholesterol-lowering drugs. The amount of antihyperlipidemic agents dispensed due to the encounter reminders also shifted. Cost of the increased medications was $228,000/year. The increased laboratory test costs were $50.00 per member per year, or approximately $33,000.

**Transferability**

The computer support in KP Ohio will become available to the rest of the organization as the Population Care Registry of the KP Clinical Information System is deployed. The same quality improvements that MARS has provided in Ohio may be seen nationally.

**Conclusions**

The use of computer-generated reminders and physician feedback reports has led to increased compliance with guidelines and to decreases in both cardiac morbidity and mortality. This program has met our goal of improving cardiac outcomes. The computer-generated reminders have assisted physicians in complying with the guidelines related to care of patients with coronary artery disease. In addition, physician-specific reports have

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**Table 2. Cardiac morbidity measures**

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<th>Year</th>
<th>Medicare</th>
<th>Non-Medicare</th>
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<td>3.8</td>
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<tr>
<td>1998\textsuperscript{c}</td>
<td>24.8\textsuperscript{d}</td>
<td>2.9\textsuperscript{d}</td>
</tr>
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\textsuperscript{a} Aspirin and beta blocker reminders, smoking program activated 3/94
\textsuperscript{b} Cholesterol/CAD reminders 3/97
\textsuperscript{c} Cholesterol/Diabetes reminders 9/98
\textsuperscript{d} Decrease from 1993 to 1998 is significant (p < 0.001)
\textsuperscript{e} Decrease from 1995 to 1996 is significant (p < 0.05)
\textsuperscript{f} Decrease from 1995 to 1997 is significant (p < 0.01)

**Table 3. Number of deaths from CAD per 1000 members/year in KP Ohio**

<table>
<thead>
<tr>
<th>Year</th>
<th>Medicare</th>
<th>Non-Medicare</th>
<th>KP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
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<td>0.28</td>
<td>0.97</td>
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</tbody>
</table>

\textsuperscript{a} Aspirin and beta blocker reminders, smoking program activated 3/94
\textsuperscript{b} p < 0.05 (1995 compared with mean in 1993 and 1994)
\textsuperscript{c} Cholesterol/CAD reminders 3/97
\textsuperscript{d} Decrease from 1993 to 1997 is significant (p < 0.05)
Figure 3. LDL cholesterol levels in CAD patients.
alerted individual physicians to their performance and have affected practice patterns. These reminders and reports appear to have decreased cardiac mortality more than the national trends. The success of the project is due to reminders and feedback reports in combination with the usual physician education efforts. Although a specific intervention may have had a greater impact than another, each component contributed to the overall success of the KP Ohio Improvement of Cardiac Outcomes project.

References


The Stained-Glass Past

Viewing the past is like peering through a stained-glass window from dawn to dusk. As the sun moves across the sky, the illumination of the many facets of glass changes. As I walk about the room, intricate patterns that were hidden in darkness reveal themselves only from certain angles.

Richard Stone, “The Healing Art of Storytelling”