

---



---

 INNOVATIONS IN EDUCATION AND CLINICAL PRACTICE
 

---

## Creating a Quality Improvement Elective for Medical House Officers

Saul N. Weingart, MD, PhD, Anjala Tess, MD, Jeffrey Driver, JD, Mark D. Aronson, MD, Kenneth Sands, MD, MPH

**The Accreditation Council on Graduate Medical Education (ACGME) requires that house officers demonstrate competencies in “practice-based learning and improvement” and in “the ability to effectively call on system resources to provide care that is of optimum value.” Anticipating this requirement, faculty at a Boston teaching hospital developed a 3-week elective for medical house officers in quality improvement (QI).**

**The objectives of the elective were to enhance residents’ understanding of QI concepts, their familiarity with the hospital’s QI infrastructure, and to gain practical experience with root-cause analysis and QI initiatives. Learners participated in three didactic seminars, joined hospital-based QI activities, conducted a root-cause analysis, and completed a QI project under the guidance of a faculty mentor.**

**The elective enrolled 26 residents in 3 years. Sixty-three percent of resident respondents said that the elective increased their understanding of QI in health care; 88% better understood QI in their own institution.**

**KEY WORDS:** quality improvement; patient safety; interns and residents; medical education.

**J GEN INTERN MED 2004;19:861-867.**

Although American health care is heralded for excellence in research, clinical care, and education, several high-profile reports have identified serious deficiencies. The 1998 President’s Advisory Commission on Consumer Protection and Quality in the Health Care Industry stated that the American health care system offered “the best of care, the worst of care.”<sup>1</sup> The Institute of Medicine issued a report in 1999 on medical error and in 2001 on the “chasm” that stands between the promise of health care in America and its current state.<sup>2,3</sup>

---

*Received from the Department of Medicine (SNW, AT, MDA, KS), Stoneman Center for Quality Improvement in General Medicine and Primary Care, and Department of Healthcare Quality (JD, KS), Beth Israel Deaconess Medical Center; and Harvard Medical School (SNW, AT, MDA, KS), Boston, Mass.*

*An abstract of this project was presented at the 6th annual meeting of the Society of Hospital Medicine, San Diego, Calif, April 1-2, 2003.*

*Address correspondence and requests for reprints to Dr. Weingart: Division of General Medicine and Primary Care, Beth Israel Deaconess Medical Center, RO-112, 330 Brookline Avenue, Boston, MA 02215 (e-mail sweingar@bidmc.harvard.edu).*

Citing the need for fundamental change in the health care system, thought leaders in medical education called for the introduction of training in quality improvement (QI) and patient safety in the education of health care professionals.<sup>1-5</sup> The Accreditation Council on Graduate Medical Education (ACGME) required in 2002 that house officers demonstrate competencies in “practice-based learning and improvement” and in “the ability to effectively call on system resources to provide care that is of optimum value.”<sup>6</sup>

Anticipating the implementation of the ACGME requirements, faculty at our academic medical center developed a QI elective in 2000 for medical house officers. We report here on the format and content of the elective and our experience to date.

### PROGRAM DESCRIPTION

#### Background

Beth Israel Deaconess Medical Center (BIDMC) is a 534-bed Boston teaching hospital. It offers residency training programs in medicine, surgery, neurology, pathology, anesthesiology, emergency medicine, pathology, radiology, and obstetrics-gynecology, and participates in Harvard-wide residency programs in orthopedic surgery, psychiatry, and radiation therapy. The medicine training program is the largest in the United States, with 62 postgraduate year 1 (PGY-1) interns and 98 PGY-2 and PGY-3 residents in 2002 to 2003.

In 2000, the hospital vice president of Healthcare Quality and faculty in the Division of General Medicine and Primary Care submitted a successful proposal to BIDMC’s Stoneman Center for Quality Improvement in General Medicine and Primary Care to establish a QI elective for medical house officers. Internal grant proposals were solicited for research, demonstration, and educational projects. Applicants were required to emphasize medication safety in order to align the initiative with an institutional strategic objective.<sup>7</sup>

#### Objectives

The elective was designed such that at completion, residents would be able to:

- define common quality improvement terminologies, outline general strategies for improving quality, and discuss substantive topics such as medication safety;
- apply knowledge of the hospital's systems for delivering and improving medical care while investigating an adverse event;
- investigate a medical error or complaint, find its root causes, and propose solutions; and
- participate in hospital QI activities by attending committee meetings and completing an independent study project.

## Structure

We offered a QI elective to PGY-2 and PGY-3 medical residents during their ambulatory block rotation. Residents have 5 to 7 ambulatory blocks annually. During the 3-week rotations, residents complete 15 half-day clinic sessions and participate in small group conferences on preventive health care, critical reading of the medical literature, and

a postpractice clinical conference. The remaining 20 hours per week is spent in one of 30 clinical electives of the resident's choice including geriatric medicine, orthopedics, endocrinology, dermatology, ophthalmology, rheumatology, neurology, and hematology-oncology. The QI elective was approved by the primary care program director and a one-paragraph description of the elective was prepared for prospective enrollees and included in the pamphlet of ambulatory block electives. There was no active recruitment other than word-of-mouth recommendations among residents.

Course organizers created a combination of didactic sessions and experiential learning opportunities, reasoning that hands-on activities would reinforce classroom learning (Table 1). Residents completed 3 one-on-one hour-long seminars with course faculty from the Division of General Medicine and Primary Care and the hospital's Department of Healthcare Quality (including the medical director of Clinical Effectiveness, the director of Risk Management, and the vice president of Healthcare Quality). Residents

**Table 1. Structure of Stoneman QI Elective**

Method	Objective	Format		Specific Content
Didactic sessions	To define common quality improvement terminologies, outline general strategies for improving quality, and discuss substantive topics such as medication safety.	Group discussion with faculty, guided by resident interest and selected readings.	1) Introduction to quality and safety. 2) Risk management and incident investigation. 3) Institutional design and leadership in quality improvement.	Introduction to medication and patient safety, change theory and measurement. Introduction to the role of risk management and how incident investigation can improve health care quality. The IOM dimensions of quality and how they are measured and controlled at our institution.
Hospital committee experience	To participate in hospital QI activities by attending committee meetings.	Residents observe, participate in discussions, and present cases.	1) Patient Safety Task Force 2) Provider Order-entry Task Force 3) Department of Medicine Quality Improvement Committee 4) Patient Care Assessment Committee For examples see text.	Monitor hospital safety initiatives. Prioritizing and streamlining requests for POE. Peer review process. Peer review and policy-making process. See text.
Incident investigation	To investigate a medical error or complaint, find its root causes, and propose solutions.	Case selected from incidents and patient complaints. Resident reviews chart and interviews participants to complete analysis and facilitate peer review.		
Individual project	To complete an independent study project that affects practice at our institution.	Working closely with a faculty mentor, resident designs and implements a project.	For examples see text.	See text.

also spent time with faculty mentors who helped guide them through the planning and implementation of a project. The teaching burden was manageable given that three of the core faculty members taught at most 1 hour-long session per month. Seminars have included up to three learners at a time. Residents received a set of current, relevant references.

## Content

Didactic seminars addressed three topics:

**Introduction to Quality and Safety.** Residents discussed the definition of error, adverse event, and quality of care. They considered methods for measuring quality and the concept of rapid-cycle improvement. They also examined how latent errors in complex systems permit injuries to occur.

**Risk Management and Incident Investigation.** In this seminar, residents discussed the legal and regulatory environment in which QI takes place. They examined the role of incident reporting in the hospital, and the use of root-cause analysis (RCA) and failure mode and effects analysis to identify opportunities for prevention and improvement.

**Institutional Design and Leadership in Quality Improvement.** Residents met with the vice president of Healthcare Quality to examine the structure of QI at the hospital, including governance and management structures, department-based committees, and short-term task forces. They considered obstacles and opportunities for affecting change in complex organizations.

In the experiential component of the elective, residents participated in hospital-based QI activities, conducted an RCA, and completed a QI project.

**Hospital-based QI Activities.** Depending on the resident's schedule and the meeting calendar, residents participated on hospital committees including the Patient Safety Task Force, Data Analysis Working Group, Provider Order-entry Task Force, Medicine Department Quality Improvement Committee, and Patient Care Assessment Committee.

**Root-cause Analysis.** Residents completed an RCA of a recently reported incident by interviewing hospital staff and using a template derived from the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) instrument. A faculty member supervised and coached the resident in conducting a nonpunitive investigation. If an RCA or failure mode and effects analysis was conducted by the Department of Healthcare Quality during the rotation, the resident participated in this process rather than completing an independent investigation.

**QI Project.** Each resident selected a QI project with the assistance of a faculty mentor. We asked residents to

consider potential projects before beginning the elective. In the first year, projects dealt almost exclusively with topics in medication safety. In subsequent years, with the endorsement of the Stoneman Center and hospital administration, a broader set of topics was permitted and encouraged. Projects included medical record reviews, surveys, and analyses of potentially problematic processes. Projects were often identified in response to a recent incident. The resident wrote a brief report and presented the results directly to the relevant committee or team. Faculty mentors met with residents regularly during the rotation to select and supervise projects. Core faculty members rotated mentorship responsibilities through the year, typically supervising 2 to 3 residents each.

## Examples of RCA and QI Projects

Residents completed a variety of RCAs and QI projects (Table 2). Here are several examples.

**RCA: Dye-induced Renal Failure.** A resident analyzed the case of a man who went into renal failure after a cardiac catheterization and CT scan of the abdomen. Although the CT scan had been ordered without contrast, contrast was provided. The investigation revealed differences in physicians' interpretation of a radiology requisition. Radiologists regarded the requisition as a consultation request that allowed them discretion to determine the optimal study. Nonradiologists regarded the requisition as a physicians' order that was to be executed as written. But appropriate choice of study was often limited by technical problems (e.g., truncated requisition information), by failure of the ordering clinician to provide adequate clinical detail, and by clinicians' infrequent use of email or the page system to insure direct clinician-to-clinician communication. In addition to building bridges between the medical service and radiology department, this project resulted in a change to the electronic radiology requisition. It now includes a mandatory field that asks about the presence of a contraindication to contrast dye.

**QI Project: Inpatient EKG Follow-up.** Prompted by the case of a patient who was discharged from the hospital with an abnormal but unread electrocardiogram (EKG), the resident flow-charted the process for ordering and obtaining an inpatient EKG (Fig. 1). He found that only 44% of routine EKGs were filed in patients' charts prior to discharge, and none were referenced in house officers' progress notes.

**QI Project: Overuse of Telemetry.** To evaluate the appropriate use of telemetry, another resident classified telemetry cases in the hospital based on American College of Cardiology guidelines. Of patients on telemetry, one third had a class III indication (i.e., telemetry *not* indicated). Most patients were placed on telemetry appropriately on admission, but physicians failed to discontinue telemetry when it was no longer indicated. He presented the findings to the medical

**Table 2. Stoneman QI Elective: Selected Projects**

Project	Finding
Identifying reasons for inadequate follow-up of outpatient laboratory tests.	No standardized methodology for lab follow-up among outpatient physicians exists.
Analyzing performance characteristics of IV dextrose orders as a marker of medication error.	Dextrose orders are a poor marker for adverse drug events.
Examining timeliness and completeness of follow-up on inpatient EKGs.	EKGs ordered for inpatients are retrieved by the medical team after several days, if at all. Few EKGs make it into the medical record prior to the patient's discharge from the hospital.
Identifying reasons for delayed medical discharge.	Multifactorial, with delays for testing, involvement of families, and attending input all significant factors.
Assessing accuracy of information on Physician Referral ("Page 1") forms used for discharge.	100% error rate; 18% with "critical" errors.
Improving communication during cardiac catheterization laboratory transfers.	Creation of dedicated Cardiology Liaison led to dramatic improvement in communication between interventional cardiology staff and medical house staff.
Improving telemetry utilization.	>50% of telemetry utilization was not within guidelines. An intervention to standardize criteria increased appropriate utilization to 75%. The majority of patients had only a relative indication for admission.
Evaluating indications for admission of patients with syncope.	The majority of residents were not aware of cost implications of laboratory send-outs.
Assessing the utilization of laboratory send-out tests among medical house staff.	Many studies ordered on the day of discharge are routine postprocedure assessments; failure to prioritize can lead to unnecessary delays in hospital discharge.
Examining utilization of radiology studies on the day of hospital discharge.	Data in electronic nurse records accurately reflect actual intubation and extubation times.
Analyzing the accuracy of electronic ICU records in identifying the time of intubation and extubation.	Study requisitions are highly variable and inconsistent with regard to need for contrast or noncontrast study; radiologists are often forced to make their own determinations.
Assessing the quality of radiology requests by internists.	

IV, intravenous; EKG, electrocardiogram; ICU, intensive care unit.

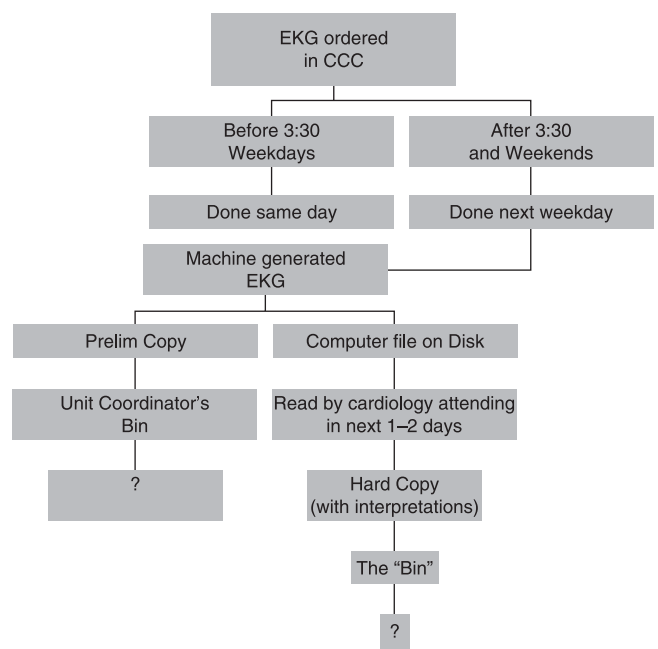
house staff, urging prompt discontinuation of telemetry after chest pain patients are ruled out for myocardial infarction. In follow-up, the percent of patients with a class III telemetry indication decreased by 62% on the medicine and cardiology services. There was no statistically significant change among telemetry patients on nonmedicine services (obstetrics-gynecology and surgery).

**PROGRAM EVALUATION**

Twenty-six residents enrolled in the Stoneman elective from 2000 to 2003. Faculty identified several problems including staff turnover and the need to streamline the syllabus. The greatest challenge was to identify meaningful projects that could be completed within 3 weeks. Several projects were not completed because the objective was too ambitious; one resident left the elective early (maternity leave). Nevertheless, participating faculty described the project as a qualified success, citing enthusiastic resident participation and the completion of many meaningful RCAs and QI projects. Residents presented several projects to other house officers during morning report and to the medicine department Quality Improvement Committee.

Informally, residents said that they liked working on problems that vexed them during their clinical rotations. Many found the elective to be an eye-opening window on hospital QI activities.

To further characterize residents' experience, we surveyed all 19 residents who completed the elective from January 2001 through October 2003 by email. The survey asked residents whether the elective was their first exposure



**FIGURE 1.** Inpatient EKG delivery process.

to QI. It also asked whether they had completed the components of the elective (QI committee meetings, didactic sessions, incident investigation, project) and to evaluate the usefulness of the experience. The survey offered binary (yes/no) responses for questions about completion and Likert scales (strongly disagree to strongly agree) for questions about the usefulness of each component. The survey also asked residents whether the elective changed their understanding of quality in health care broadly and at the hospital. It also queried whether the elective influenced their behavior as a physician, and whether they used the information to teach others about QI. The survey allowed respondents to elaborate free-text explanations for most questions.

Sixteen (84%) of 19 completed the survey. Eighty-eight percent of respondents described the elective as their first exposure to QI. Favorable ratings were reported by 75% of the 19 residents who attended QI committee meetings, 71% of 16 residents who completed didactic sessions, 82% of 13 who completed the incident investigation, and 87% of 15 who completed the project. Sixty-three percent reported an improved understanding of quality in health care; 88% better understood QI in their own institution; and 56% reported that they changed their behavior as a physician. Two thirds of respondents said that they subsequently taught other students, peers, and staff about quality in health care.

Resident respondents' open-ended comments corroborated the generally positive survey responses. Many identified lessons learned from their assignments. In response to the question about what the resident learned from the experience of investigating an adverse event, a resident wrote that "The step-by-step evaluation helps bring out other issues (i.e., institutional problems that one may not otherwise think of as an adverse event)." Another respondent stated that the experience permitted them "To see what goes on behind the scenes regarding decisions made in the hospital." Residents also described lessons learned from their independent projects. "[I learned] an appreciation of the myriad areas of the practice of inpatient medicine that could be improved by the systematic study and institution of well-reasoned changes, as well as a glimpse of the difficulty of conducting an appropriate study and developing the changes."

Others also identified changes in their behavior as a physician as a result of the elective. One wrote, "I am more likely to request/advise people to report adverse events and to try and correct/point out potentially dangerous practices." Another resident responded this way: "[The elective] gave me a sense of what could be done and who to talk to." and at least one resident found that they shared their learning with others. "I have recommended this elective [to others]. I have been able to teach other residents and interns to think about tests they order and decisions they make."

## DISCUSSION

Recognizing their important role as frontline clinicians, Ashton characterized house officers as "invisible" doctors

in the quality assessment and assurance process.<sup>8</sup> Furthermore, in their role as frontline physicians, they often are the first to recognize and identify systemic problems in the delivery of care that lead to inefficiencies and diminish quality. As future leaders in academic and community settings, they represent a group that should be educated and empowered with new skills and knowledge.

Although several important papers describe QI education for undergraduate health professional students, there are surprisingly few reports in the medical literature of initiatives that engage house officers in quality improvement activities.<sup>9-22</sup> For example, Parenti and colleagues described a project involving house officers at the Minneapolis Veterans Affairs Medical Center that resulted in a 13% decrease in unnecessary use of intravenous catheters.<sup>16</sup> Ellrodt described the participation of house officers in the re-design of the internal medicine residency training program at Cedars-Sinai Medical Center in Los Angeles, using total quality management principles.<sup>18</sup> Weingart reported on the emergence and subsequent collapse of a grassroots improvement initiative among house officers at BIDMC, due in large part to failure to create an institutional infrastructure to sustain the effort.<sup>19</sup> Curley and colleagues described a randomized, controlled trial of interdisciplinary rounds on an inpatient medical service that was developed by nurses, unit supervisors, and medical house officers at Cleveland's MetroHealth Medical Center.<sup>20</sup> The investigators demonstrated cost savings and decreased length of stay among patients assigned to the intervention group. Several reports also describe house officers as the target of QI projects that seek to improve preventive health screening, psychosocial evaluation, and compliance with inpatient guidelines for emergency care.<sup>23-26</sup>

An apparent limitation of several previously reported house officer QI initiatives is a failure to create a durable infrastructure for sustaining the initiative. One-time improvement efforts are rarely replicated with subsequent groups of house officers. Furthermore, initiatives with a strong didactic component are not always embedded in the clinical environment or guided by senior hospital QI leaders. The Stoneman QI elective, now in its fourth year, demonstrates the feasibility and durability of an approach that balances didactic and experiential learning in the context of an elective clinical rotation. The experiential component of the elective, in particular, provided residents with an immediate and relevant "in-the-trenches" opportunity that often resulted in a tangible contribution to the quality of care. It illustrates one promising approach to the ACGME required competencies in "practice-based learning and improvement" and "the ability to call on system resources to provide care." The ACGME was not prescriptive about how to satisfy these requirements, and various solutions may be appropriate.

Features of the elective contributed to its rapid introduction. First, we used an existing ambulatory elective rotation format rather than trying to create a new learning venue. Second, residents self-selected, resulting in a group

of motivated learners. Third, an internal grant process helped to focus and support faculty efforts. Fourth, participation of clinician-administrators in the Department of Healthcare Quality insured that projects were timely and relevant, and provided physician role models.

The model has several limitations. It is a time-limited rotation that does not allow an individual resident to participate in multiple improvement cycles. Although we had hoped to create an interdisciplinary experience, few nurses have enrolled in the rotation or participated as faculty. The effort depends on the participation of a small number of faculty members who are skilled in QI; expansion of the effort and integration into the inpatient medical service will require aggressive faculty development efforts. It is not a mandatory requirement, and therefore reaches a limited number of house officers. Finally, the ability to replicate this model beyond our teaching hospital remains to be demonstrated.

We hope that lessons learned from the implementation of our QI elective and the limitations of the approach will be useful to clinician-educators. As educators, we need to learn how better to evaluate whether residents have, in fact, acquired the clinical competencies that we aspire to teach, and whether they maintain and use these skills to solve practical problems in clinical care.

With the successful implementation of the QI elective, faculty members are developing and have pilot tested a curriculum that will be integrated into the inpatient ward rotation and provided to all residents. The inpatient curriculum will complement the existing elective rotation, which will continue in its current format. Creating the curriculum poses several challenges, including the selection and presentation of topics that are both descriptive (e.g., nature and epidemiology of medication error) and prescriptive (e.g., improvement techniques and best practices in medication safety). A critical component of this effort is a faculty development initiative that will enhance the ability of teacher-clinicians in general and hospital medicine to teach residents about quality and safety in health care. This promises to be a collaborative and exploratory effort, where faculty together identify and describe "teachable moments" that occur during work rounds, attending rounds, and informal interactions with students and house officers. In addition, we are working with chief residents and other house staff program leaders to enhance the content related to quality improvement and patient safety in the weekly morbidity and mortality case conference. We are optimistic about the prospect that all medical house staff at our institution will have the opportunity to learn and apply the principles of quality improvement during their training, and that they will develop a set of skills that will serve them well throughout their professional careers.

## REFERENCES

1. President's Advisory Commission on Consumer Protection and Quality in the Health Care Industry. *Quality First: Better Health Care for All Americans*. Washington, DC: USGPO, 1998.
2. Kohn LT, Corrigan JM, Donaldson MS, eds. *To Err Is Human: Building a Safer Health System*. Washington, DC: National Academy Press; 1999.
3. Committee on the Quality of Healthcare in America. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, DC: National Academy Press; 2001.
4. Council on Graduate Medical Education: *Managed Health Care: Implications for the Physician Workforce and Medical Education* (6th report). Washington, DC: U.S. Department of Health and Human Services; 1995.
5. Pew Health Professions Commission: *Health Professions Education and Managed Care: Challenges and Necessary Responses*. San Francisco, Calif: University of California, San Francisco; 1995.
6. ACGME Outcome Project. Available at: <http://www.acgme.org/outcome/comp/compFull.asp>. Accessed May 24, 2004.
7. Weingart SN. Making medication safety a strategic organizational priority. *Jt Comm J Qual Improv*. 2000;26:341-8.
8. Ashton CM. "Invisible" doctors: making a case for involving medical residents in hospital quality improvement programs. *Acad Med*. 1993;68:823-4.
9. Headrick LA, Kathcher W, Neuhauser D, McEachern E. Continuous quality improvement and knowledge for improvement applied to asthma care. *Jt Com J Qual Improv*. 1994;20:562-8.
10. Headrick LA, Neuhauser D, Melnikow J, Vanek E. Teaching medical students about quality and cost of care at Case Western Reserve University. *Acad Med*. 1992;67:157-9.
11. Headrick L, Neuhauser D, Melnikow J. Asthma health status: ongoing measurement in the context of continuous quality improvement. *Med Care*. 1993;31(3 suppl):MS97-MS105.
12. Gordon PR, Carlson L, Chessman A, Kundrat ML, Morahan PS, Headrick LA. A multisite collaborative for the development of interdisciplinary education in continuous improvement for health professions students. *Acad Med*. 1996;71:973-8.
13. Headrick LA, Knapp M, Neuhauser D, et al. Working from upstream to improve healthcare: the IHI interdisciplinary professional education collaborative. *Jt Com J Qual Improv*. 1996;22:149-64.
14. Alexander GC, Fera B, Ellis R. From the students: learning continuous improvement by doing it. *Jt Com J Qual Improv*. 1996;22:198-205.
15. Headrick LA, Richardson A, Priebe GP. Continuous improvement learning for residents. *Pediatrics*. 1998;101:768-74.
16. Parenti CM, Lederle FA, Impola CL, Peterson LR. Reduction of unnecessary intravenous catheter use: internal medicine house officers participate in a successful quality improvement project. *Arch Intern Med*. 1994;154:1829-32.
17. Welsh CH, Pedot R, Anderson RJ. Use of morning report to enhance adverse event detection. *J Gen Intern Med*. 1996;11:454-60.
18. Ellrod AG. Introduction of total quality management (TQM) into an internal medicine residency. *Acad Med*. 1993;68:817-23.
19. Weingart SN. A medical house officer-sponsored quality improvement initiative: leadership lessons and liabilities. *Jt Comm J Qual Improv*. 1998;24:371-8.
20. Curley C, McEachern JE, Speroff T. A firm trial of interdisciplinary rounds on the inpatient medical wards: an intervention designed using continuous quality improvement. *Med Care*. 1998;26:AS4-12.
21. Rosebraugh CJ, Honig PK, Yasuda SU, Pezzullo JC, Woosley RL. Centers for Education and Research on Therapeutics report: survey of medication error education during undergraduate and graduate medical education in the United States. *Clin Pharmacol Ther* 2002;71:4-10.
22. Gosbee JW. Human factors engineering is the basis for a practical error-in-medicine curriculum. In: Johnson C, ed. *Glasgow Accident Analysis Group Technical Report G99-1*. Glasgow, Scotland: University of Glasgow; 1999.

23. Holmboe E, Scranton R, Sumption K, Hawkins R. Effect of medical record audit and feedback on resident's compliance, with preventive health care guidelines. *Acad Med.* 1998;73:901-3.
24. Gunther GS, Bingham RL. A continuous quality improvement cycle for teaching the identification of psychosocial problems to general internal medicine residents. *Acad Med.* 1993;67:308-10.
25. Sox CM, Burstin HR, Orav J, et al. The effect of supervision of residents on quality of care in five university-affiliated emergency departments. *Acad Med.* 1998;73:776-82.
26. Leshan LA, Fitzsimmons M, Marbella A, Gottlieb M. Increasing clinical prevention efforts in family practice residency program through CQI methods. *Jt Comm J Qual Improv.* 1997;23:391-400.