

APM Perspectives

The Association of Professors of Medicine (APM) is the national organization of departments of internal medicine at the US medical schools and numerous affiliated teaching hospitals as represented by chairs and appointed leaders. As the official sponsor of The American Journal of Medicine, the association invites authors to publish commentaries on issues concerning academic internal medicine.

For the latest information about departments of internal medicine, please visit APM's website at www.im.org/APM.

A Systems Approach to Morbidity and Mortality Conference

Jason H. Szostek, MD,^a Mark L. Wieland, MD, MPH,^a Laura L. Loertscher, MD, MPH,^b Darlene R. Nelson, MD,^a Christopher M. Wittich, MD, PharmD,^c Furman S. McDonald, MD, MPH,^c Joseph C. Kolars, MD,^{c,d} Darcy A. Reed, MD, MPH^c

^aFrom the Department of Medicine, Mayo Clinic, Rochester, Minn; ^bDepartment of Medicine, Providence St Vincent Medical Center, Portland, Ore; ^cInternal Medicine Residency Program, Mayo Clinic, Rochester, Minn; ^dDepartment of Medicine, University of Michigan, Ann Arbor, Mich.

Pressure from within and outside the medical profession has pushed patient safety and recognition of medical errors to the forefront of health care priorities in the United States. The Institute of Medicine has recognized that it is essential for physicians at all levels of the educational continuum to participate in the examination of systems issues that contribute to medical error.^{1,2}

The morbidity and mortality conference within residency programs has been identified as an important platform to explore, disseminate, and address these systems issues that contribute to error in real-time.³⁻⁵ However, there is little literature examining a formal assessment of error at morbidity and mortality conferences with a systems focus.^{3,4}

The morbidity and mortality conference is nearly ubiquitous among internal medicine residency programs, but most lack explicit methods or formats.^{6,7}

Funding: This work was supported by the Mayo Clinic Internal Medicine Residency Office of Educational Innovations as part of the Accreditation Council for Graduate Medical Education Educational Innovations Project.

Conflict of Interest: None of the authors have any conflicts of interest associated with the work presented in this manuscript.

Authorship: All authors had full access to the data and take responsibility for data integrity. Statistical analyses were conducted by Dr Reed.

Reprint requests should be addressed to Jason H. Szostek, MD, Instructor in Medicine, Department of Internal Medicine, Mayo Clinic College of Medicine, 200 1st Street SW, Rochester, MN 55905.

E-mail address: szostek.jason@mayo.edu

Furthermore, although educators agree that morbidity and mortality conferences should examine medical error and adverse events, most conferences do not address either of these elements regularly.⁶⁻⁸

For resident physicians, the morbidity and mortality conference format has the potential to address all 6 of the core competencies mandated by the Accreditation Council for Graduate Medical Education.⁹ However, the conference's capacity to formally assess health care systems issues as they contribute to medical error positions is a potential hallmark for the systems-based practice competency. Therefore, we report our experience with a structured "systems audit" as a component of a weekly internal medicine residency morbidity and mortality conference. The objectives of this study were to determine whether implementation of the systems audit increased residents' awareness of systems issues in health care and to examine the educational value of the systems audit relative to other educational experiences. Institutional improvements in patient care resulting from systems audits also were identified.

MATERIALS AND METHODS

Design, Setting, and Participants

We conducted a cross-sectional study of all 144 first-, second-, and third-year categorical internal medicine residents at Mayo Clinic Rochester in 2007 to determine whether the systems audit increased residents'

awareness of systems issues in health care. We also measured improvements in systems and patient care outcomes resulting from systems audits between 2006 and 2008. This study was deemed exempt by the Mayo Clinic Institutional Review Board.

Morbidity and Mortality Conference

The morbidity and mortality conference is a weekly, 60-minute, large group educational session attended by internal medicine residents, chief medical residents, the program director, faculty, students, and non-physician professionals. The conference is organized and led by chief medical residents. Each week, a clinical case is reviewed and learning points are highlighted. Cases are selected for discussion on the basis of their educational value and exemplification of medical error, adverse patient events, or “near misses.” Residents involved in the case present the patient’s clinical course, and radiologists, pathologists, and other specialists discuss relevant aspects of the clinical case. Throughout the conference, chief medical residents facilitate group discussion and emphasize learning objectives. At the end of the morbidity and mortality conference, an experienced clinician provides clinical teaching relevant to the case.

Systems Audit Development and Implementation

Before implementation of the systems audit, the aim of the morbidity and mortality conference was to enhance residents’ medical knowledge. However, we recognized that the morbidity and mortality conference can be an ideal venue for enhancing residents’ competency in systems-based practice; therefore, we introduced a systems audit to morbidity and mortality conferences.

The systems audit is a curriculum developed, piloted, and modified on the basis of iterative feedback from chief residents, associate program directors, clinician-educator faculty, and the program director. This iterative process yielded a standardized set of learning objectives for residents conducting systems audits. On completion of the systems audit, residents will be able to critically review a clinical case involving an adverse event, identify a systems issue that led to the adverse outcome, conduct a root-cause analysis of the event, interview stakeholders and describe their perspective or role in the system, propose interventions to address the

problem, and calculate costs related to the adverse event.

Each week, a postgraduate year 2 resident (acting as the “systems auditor”) conducts a systems audit of the clinical case to be discussed at the upcoming morbidity and mortality conference. Notably, because the resident conducting the systems audit is not involved in the case being reviewed, he or she can serve as an independent auditor. The systems auditor performs 6 steps (Figure 1). These steps include reviewing all documentation related to the case (including the number of individuals involved in the case and their various roles); interviewing stakeholders (including individuals who directly provided care for the patient and others involved in the system analyzed); performing a root-cause analysis that incorporates use of an appropriate quality improvement tool (eg, a fish-

bone diagram, mind map, or systems walk) (Figure 2); determining the costs of care provided (by contacting the hospital business office who provided the cost of care related to the adverse outcome); identifying a systems-based problem that is believed to have contributed to the adverse outcome; and suggesting potential interventions for addressing the systems issue. One week (~35 hours) of curriculum time is dedicated to this activity.

The postgraduate year 2 systems auditor presents a summary of the systems audit during the weekly morbidity and mortality conference when the analyzed case is discussed. Opportunities for improved patient care are highlighted, and systems-based errors and solutions are openly discussed by conference participants.

PERSPECTIVES VIEWPOINTS

- Use of a structured Systems Audit in a morbidity and mortality conference enhances resident awareness of systems issues in healthcare.
- A Systems Audit facilitates discussion of improvement opportunities and dissuades negative overtones of shame or blame.
- Exploration of systems issues at morbidity and mortality conference can lead to meaningful improvements in the delivery of care.

Systems Audit: 6 Steps

1. Review all documentation relating to the case and identify all health care providers involved
2. Interview stakeholders, including those who directly provided care and those involved in the system
3. Use a quality improvement tool (e.g., fishbone diagram, mind map, systems walk) to conduct a root-cause analysis
4. Determine overall cost of care and cost of the adverse outcome
5. Identify a systems issue that contributed to the outcome
6. Propose systems-level interventions and prioritize based on effort-yield projections

Figure 1 Six steps of a systems audit.

Fishbone Diagram	Mind Map	Systems Walk
A cause-and-effect diagram where the "head" of the fish represents the adverse outcome or systems problem and the "bones" represent contributing factors.	A diagram representing relationships between a systems problem and its root causes. The adverse outcome or problem is typically depicted in the center with contributing factors branching outward to multiple levels.	A diagram depicting the stepwise sequence of elements in a system; similar to a flow chart. Often used to identify unnecessary or redundant steps in a process.

Figure 2 Systems audit tools.

Evaluation of the Systems Audit

The systems audit was evaluated according to 3 outcomes: residents' awareness of systems issues resulting from the systems audit, residents' views of the educational value of morbidity and mortality conference with systems audit compared with other educational conferences, and institutional improvements in patient care resulting from systems audits.

All 144 categorical internal medicine residents were surveyed electronically in May 2007, approximately 1 year after implementation of the systems audit. The anonymous survey assessed resident awareness of systems issues in morbidity and mortality conference cases, the variety of health care professionals involved in cases, and the costs of care. The survey also assessed resident perception of morbidity and mortality conference with the addition of the systems audit relative to the other core educational conferences (core curriculum conference and medical grand rounds). All 46 postgraduate year 2 residents who personally conducted systems audits during the 2007 academic year also were surveyed regarding their experience.

Data Analysis

We used descriptive statistics to summarize responses to all survey questions. The Fisher exact test was used to compare proportions. A *P* value less than .05 was considered statistically significant. Data were analyzed using STATA 8.0 (StataCorp LP, College Station, Tex). Improvements in health systems and patient care resulting from systems audits were described using case examples.

RESULTS

Since July 2006, 120 systems audits were performed by postgraduate year 2 internal medicine residents. In the 6 months before initiation of the systems audit, only 4 of 23 (17%) morbidity and mortality conferences addressed adverse events or medical errors, compared with 128 of 129 (99%) of subsequent conferences (*P* < .001). Furthermore, no morbidity and mortality conferences in the 6 months before implementation of the systems audit addressed systems issues, compared with 99% after implementation.

Resident Awareness of Systems Issues in Health Care

Surveys were completed by 119 of 144 residents (83%). The majority of residents (*n* = 71, 59%) agreed or strongly agreed that the systems audit increased their awareness of pertinent systems issues involved in morbidity and mortality conference clinical cases. More than three quarters of residents (91, 76%) reported that the systems audit made them more aware of the variety of health care professionals involved in patient care, and 92 residents (77%) reported increased awareness of costs of care.

Of the 46 postgraduate year 2 residents who had personally conducted systems audits during the 2007 academic year, 35 (76%) provided survey data. These residents reported that conducting the systems audit was a valuable learning experience (26, 74%) and that performing an audit on a case in which they were not involved was useful (25, 71%). Residents agreed or strongly agreed that the systems audit made them more aware of opportunities for improvement within the health care system (26, 74%). Many residents (20, 57%) agreed that after having completed a systems audit, they were more likely to notice systems issues affecting their patients. When asked about the learning environment at morbidity and mortality conferences, 27 residents (77%) agreed or strongly agreed that the learning climate facilitated an open and reflective discussion of improvement opportunities without negative overtones of shame or blame.

Resident Views of Morbidity and Mortality Conference with Systems Audit Compared with Other Educational Conferences

Residents rated the educational value of the morbidity and mortality conference with systems audit higher than other educational conferences (95% of residents agreed or strongly agreed that the morbidity and mortality conference was a valuable learning experience vs 61% for all other conferences combined, *P* < .001).

Improvements in Patient Care Resulting from Systems Audits

Several systems audits have resulted in important institutional improvements in systems and patient care. The

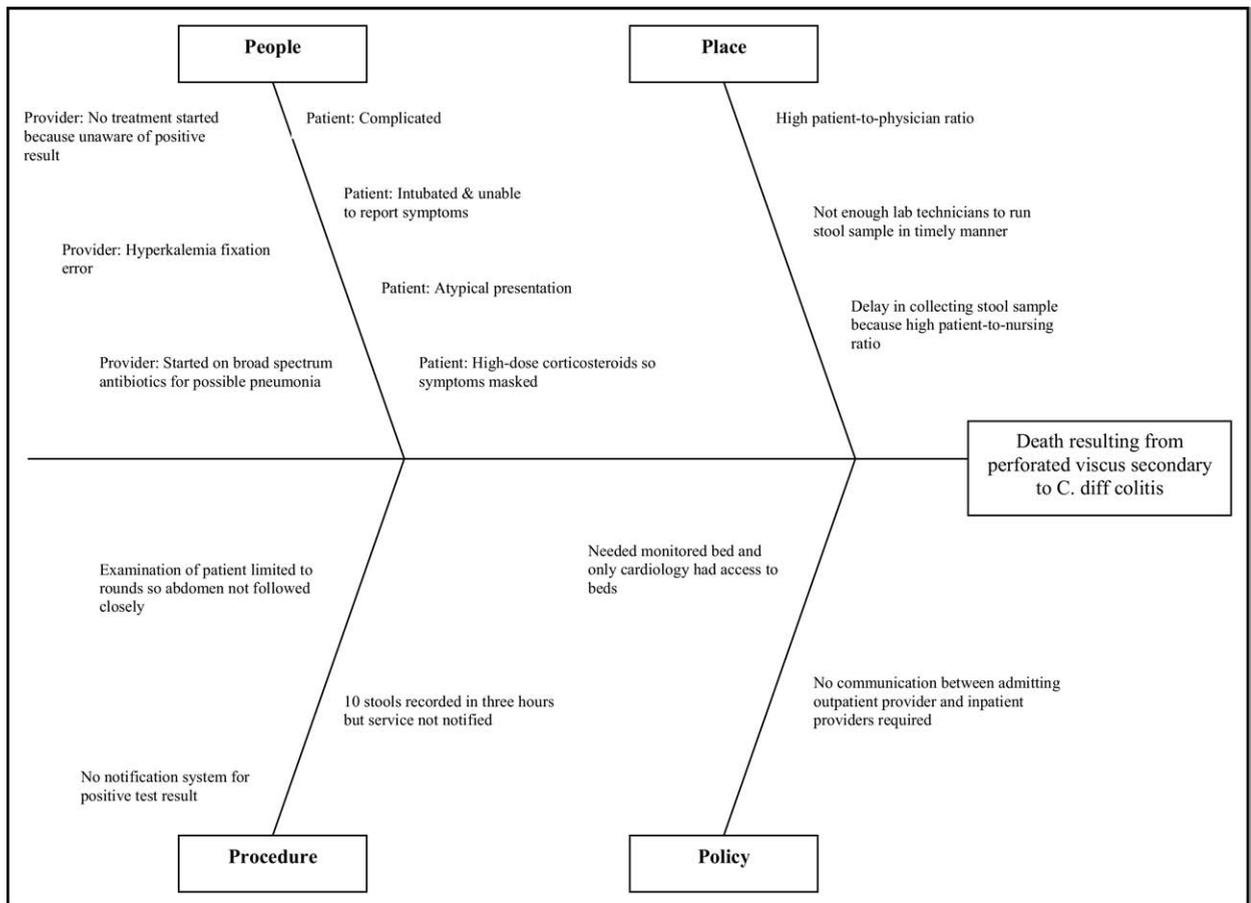


Figure 3 Example fishbone diagram for a systems audit examining *Clostridium difficile* colitis-related death.

2 examples of clinically important outcomes arose directly from morbidity and mortality conference systems audits.

Example 1

Clinical Case. An elderly man was admitted to the hospital for subacute, progressive diarrhea. The patient's condition destabilized, and he was empirically treated for sepsis with broad-spectrum antibiotics. Testing for *Clostridium difficile* showed positive results on hospital day 2, but the results were not noticed by the care team. The patient developed an acute abdomen and he died of cardiac arrest on hospital day 3. Autopsy revealed fulminate *C. difficile* colitis.

Systems Audit. By reviewing the clinical documents and interviewing the health care providers involved in the case, the systems auditor determined that the delay in treatment resulted from a delay in recognition of the positive test result. As shown in Figure 3, the systems auditor, using a fishbone diagram, performed a root-cause analysis to identify multiple contributing factors. The auditor then proposed several interventions, including resident education about recognition of *C. dif-*

ficile colitis, a telephone notification system of positive test results, a policy mandating verbal sign-out from the outpatient provider to the accepting inpatient provider, and nursing notification of service when stool output exceeds 3 bowel movements per day. The auditor proposed an adaptation to an existing telephone alert system as the intervention with the greatest yield and lowest effort. The existing system, whereby health care providers were notified of positive blood culture results, could easily be adapted for use in the case of positive *C. difficile* results.

Outcome. As a result of the systems audit, a telephone notification system for positive *C. difficile* results was instituted. Prospective evaluation of this intervention demonstrated a significant decrease in the time to antibiotic administration after institution of the telephone notification system.¹⁰

Example 2

Clinical Case. A middle-aged man was admitted for operative repair of a fracture. Postoperative chest pain prompted an electrocardiogram that demonstrated new ST-segment elevation in the inferior leads. Cardiac

biomarkers later returned elevated. There was confusion among care providers regarding the best approach to facilitate therapy. Although the institution has a system to expedite reperfusion therapy for patients presenting through the emergency department with an ST-segment elevation myocardial infarction, there was no system in place to expedite care for patients who develop a ST-segment elevation myocardial infarction during admission.¹¹ The resulting confusion led to an internal medicine consult, cardiology consult, and multiple phone calls to the emergency department and several cardiology staff, which ultimately culminated in an 18-hour delay between the time the electrocardiogram was obtained and the time of reperfusion therapy.

Systems Audit. The systems auditor identified other cases of inpatient ST-segment elevation myocardial infarctions and showed that there was a substantially longer “door-to-balloon time” for inpatients compared with patients brought to the emergency department. After reviewing the clinical records, interviewing the stakeholders and performing a root-cause analysis, the systems auditor determined that there was no standard process to access coronary angiography for inpatients on non-cardiology wards with acute ST-segment elevation myocardial infarction. The systems auditor proposed and subsequently developed an “in-house” ST-segment elevation myocardial infarction protocol to expedite coronary angiography for inpatients.

Outcome. The systems audit resulted in the design and implementation of an “in-house ST-segment elevation myocardial infarction protocol” that has streamlined the process of directing these patients to coronary angiography.

DISCUSSION

Nationally, the morbidity and mortality conference is too frequently a missed opportunity for exploration of the systems contributing to medical error and adverse outcomes in patient care.^{3,6,8} Our experience demonstrates that the integration of the structured systems audit into the weekly internal medicine residency morbidity and mortality conference increased resident awareness of systems-based practice, enhanced the perceived educational value, and led to meaningful improvements in patient care throughout the institution.

Our experience reflects proposed guidelines for morbidity and mortality conferences that should create a forum for the consistent examination of factors contributing to adverse outcomes while avoiding blame and criticism.^{3,7} It further expands on these suggestions by using the systems audit as a link to meaningful quality improvement endeavors, acting as a supplement rather than a substitute for ongoing institutional quality improvement activity and residency quality improvement curricula.¹²⁻¹⁴

This work adds to the limited literature describing an internal medicine morbidity and mortality conference with a systems focus on adverse outcomes. Bechtold et al¹⁵ recently described a monthly morbidity and mortality conference in which a resident collaborates with institutional quality improvement coordinators to facilitate a conference in which participants develop an intervention for issues identified. Likewise, Kravet et al¹⁶ reported a morbidity and mortality conference format that incorporates all 6 of the Accreditation Council for Graduate Medical Education core competencies with the systems-based practice component attempting to identify systems issues that may have contributed to adverse outcomes.

STUDY LIMITATIONS

The systems audit was implemented in a single residency program; thus, it is unknown whether similar results would be achieved with implementation of the audit in other programs. Because most internal medicine residency programs have morbidity and mortality conferences in place, addition of the systems audit to morbidity and mortality conferences at other institutions is a natural next step for future study. Second, residents' satisfaction with the systems audit and their awareness of systems issues were self-reported. Third, we report outcomes from the systems audit over 2 years, and further follow-up is required to determine whether outcomes are sustained long-term. Finally, there are challenges to implementing and sustaining the systems audit, including considerable time and “buy in” from those involved in maintaining a weekly format and dedicated curricular time for residents to conduct audits. However, the systems audit has now been in place for several years in our residency and has been assimilated into the learning and practice culture at our institution, with at least 3 other training programs within our institution adopting the format for their own conferences.

CONCLUSIONS

The systems audit is an effective way to increase residents' awareness of health care systems and meaningfully contribute to institutional quality improvement initiatives. The systems audit has transformed the morbidity and mortality conference from a conference focusing only on the clinical aspect of cases to one in which adverse outcomes are critically examined from a systems perspective. This has fostered a cultural change within the residency, whereby medical error and adverse events are openly discussed with less stigma or individual “shame and blame.” Future research should focus on evaluation of the systems audit across programs and mechanisms to ensure sustainability of educational and patient care outcomes.

References

1. Institute of Medicine. *To Err Is Human: Building a Safer Health System*. Washington DC: National Academy Press; 1999.
2. Longo DR, Hewett JE, Ge B, Schubert S. The long road to patient safety: a status report on patient safety systems. *JAMA*. 2005;294:2858-2865.
3. Orlander JD, Barber TW, Fincke BG. The morbidity and mortality conference: the delicate nature of learning from error. *Acad Med*. 2002;77:1001-1006.
4. Gore DC. National survey of surgical morbidity and mortality conferences. *Am J Surg*. 2006;191:708-714.
5. , Seigel TA, McGillicuddy DC, Barkin AZ, Rosen CL. Morbidity and mortality conference in emergency medicine. *J Emerg Med*. 2009 Feb 5. [Epub ahead of print]
6. Orlander JD, Fincke BG. Morbidity and mortality conference: a survey of academic internal medicine departments. *J Gen Intern Med*. 2003;18:656-658.
7. Aboumatar HJ, Blackledge CG Jr, Dickson C, et al. A descriptive study of morbidity and mortality conferences and their conformity to medical incident analysis models: results of the morbidity and mortality conference improvement study, phase 1. *Am J Med Qual*. 2007;22:232-238.
8. Pierluissi E, Fischer MA, Campbell AR, Landefeld CS. Discussion of medical errors in morbidity and mortality conferences. *JAMA*. 2003;290:2838-2842.
9. Accreditation Council for Graduate Medical Education. *Common Program Requirements: General Competencies*. 2007. Available at <http://www.acgme.org/outcome/>.
10. Verdoon BP, Orenstein R, Wilson JW, et al. Effect of telephone notification of positive *Clostridium difficile* test results on the time to the ordering of antimicrobial therapy. *Infect Control Hosp Epidemiol*. 2008;29:658-660.
11. Ting HH, Sharkey SW, Burke MN, et al. Regional systems of care to optimize timeliness of reperfusion therapy for ST-elevation myocardial infarction: The Mayo Clinic STEMI protocol. *Circulation*. 2007;116:729-736.
12. Leenstra JL, Beckman TJ, Reed DA, et al. Validation of a method for assessing resident physicians' quality improvement proposals. *J Gen Intern Med*. 2007;22:1330-1334.
13. Djuricich A. A continuous quality improvement (CQI) curriculum for residents. MedEdPORTAL; 2007. Available at <http://www.aamc.org/mededportal, ID=468>.
14. Ogrinc G, Headrick LA, Morrison LJ, Foster T. Teaching and assessing resident competence in practice-based learning and improvement. *J Gen Intern Med*. 2004;19(5 Pt 2):496-500.
15. Bechtold ML, Scott S, Dellsperger KC, et al. Educational quality improvement report: Outcomes from a revised morbidity and mortality format that emphasized patient safety. *Postgrad Med J*. 2008;84:211-216.
16. Kravet SJ, Howell E, Wright SM. Morbidity and mortality conference, grand rounds, and the ACGME's core competencies. *J Gen Intern Med*. 2006;21:1192-1194.