Changing and Sustaining Medical Students' Knowledge, Skills, and Attitudes about Patient Safety and Medical Fallibility

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Abstract

Purpose
To study the effects of a patient safety and medical fallibility curriculum on second-year medical students at the University of Missouri-Columbia School of Medicine in 2003–2004.

Method
Students completed a knowledge, skills, and attitudes questionnaire before the curriculum, after the final learning experience, and one year later. A 95% confidence interval (CI) for paired differences assessed change over time. At one year, students also responded to items about their use of the curriculum, error reporting, and disclosure experiences.

Results
Fifty three of 92 students (55%) completed the questionnaire at all three assessment points. Students' eight items and the calculated knowledge score improved after the curriculum but only seven of these improvements were sustained one year. Responses to seven items did not change and five changed in an undesired direction after the curriculum and/or after one year. Seventy two students completed the self-reported behavior questions at one year. More than half reported using what they learned in the curriculum. Although 76% of students reported observing an error, 71% of these disclosed an error to their peers, 56% to a resident, and 46% to faculty. Only 7% reported an error using our electronic error reporting system.

Conclusions
The curriculum led to changes in second-year medical students' knowledge, skills, and attitudes, but not all of the changes were sustained at one year, were in the desired direction, or were supported by their self-reported behaviors. The extent to which other informal or hidden curriculum experiences reversed the gains and affected the changes at one year is unknown.

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During her early morning prerounds, Julia—a third-year medical student on her first inpatient rotation at the university hospital—discovers that Mrs. Hernandez, a 68-year-old woman with pneumonia, is more short of breath than when Julia previously saw her on admission. Recalling that Mrs. Hernandez has a history of congestive heart failure and that the plan on admission was to limit her intravenous (IV) fluids, Julia is surprised when she notices several empty IV fluid bags in the room. Just as Julia is leaving the room, Mrs. Hernandez asks Julia why her breathing has gotten worse overnight. Julia suspects that Mrs. Hernandez received too much IV fluid. How did that happen? Julia's attending and resident spent a lot of time discussing appropriate fluid management. Julia does not know how to answer Mrs. Hernandez's question. She is uncomfortable with the thought of mentioning this to her team. Would they see it as a criticism of their work?

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Once medical students set foot into the clinical setting—short white coat or not—they join the front line of care. Medical students witness and sometimes are directly involved in unsafe situations, errors, adverse events, and incomplete, excessive, or inconsistent care. Like other members of the health care team, they have an opportunity (and an obligation) to contribute to the quality and safety of patient care.[1–4] This includes speaking up and reporting what they know. In the hierarchical world of many training settings, this may not be easy to do.

These realities of medicine are worthy of focused education. With preparation, guidance, and support, medical learners can contribute to the safety and quality of patient care. But what do we teach? When do we teach it? And how?

Several review articles and panel reports offer guidance.[5–9] Most of the literature on teaching patient safety and medical fallibility issues are case reports[10–12] or questionnaires of educational practices.[13] Medical schools have begun to incorporate patient safety/medical errors content into their curricula, but to our knowledge, little has been published so far about these efforts. One exception is the New York Medical College's Department of Family Medicine. Since 2000, this department has required third-year clerkship students to participate in a "Communicating about Medical Errors" curriculum. Through its website, the curriculum and supporting faculty materials are available to the public.[14] Recently, faculty there published a report detailing medical students' evaluation of the curriculum and self-reported awareness of their strengths and weaknesses in communicating medical errors to patients.[15]

To contribute to what is known about curricular content, methodologies, and timing in this domain, we developed an innovative patient safety and medical fallibility curriculum for second-year medical students at the University of Missouri-Columbia (MU) School of Medicine. In addition to collecting students' feedback about the curriculum, we assessed change in their knowledge, comfort with skills, and attitudes immediately following the patient safety/medical fallibility curriculum. One year later, we reassessed change in students'

knowledge, skills, and attitudes and asked them to report their safety behaviors.

Method

Curriculum design

The first two years of the MU School of Medicine curriculum are built around problem-based learning cases, but also include basic science lectures and an Introduction to Patient Care (IPC) course.[16] The IPC portion of the curriculum focuses on developing students' clinical skills, increasing their understanding of health care, and introducing psychosocial issues. IPC is divided into eight blocks of time over two years and covers interviewing and history taking, physical examination, behavioral medicine, clinical epidemiology and prevention, diagnostic testing and decision making, psychopathology, clinical skills, and ethics and humanism. Students also participate in an Ambulatory Clinical Experience course, where they spend four hours every other week with working clinicians.

We identified opportunities for introducing a patient safety and medical fallibility curriculum in the last two blocks of the second-year IPC course. The sections of the curriculum that we supplemented, called Clinical Practicum and Physician as Person, were chosen because a patient safety and medical fallibility curriculum could be readily linked with the existing content of these blocks and the faculty directors welcomed the new content. The curricular goals and learning objectives we added focused on developing second-year students' knowledge, skills, and attitudes relevant to patient safety and medical fallibility. Several references guided our development of the Improving Patient Safety portion of the curriculum. A separate body of literature informed the Challenges of Medical Fallibility segment. (Curricular references are available from the authors upon request.) We first implemented and taught the curriculum, which was approximately 10.5 contact hours, in the winter/spring of 2003. The curriculum was primarily taught by the authors, with the assistance of volunteer faculty for the panel discussions and small groups.

The course content addressed five main themes—patient safety overview, error reporting, system versus human approach, safety tools, and ethics/disclosure—and was presented using a variety of educational modalities. A description of the themes, content, and educational modalities follows (see Table 1).

The patient safety overview theme introduced students to the epidemiology of medical errors, the Institute of Medicine report *To Err is Human* and its recommendations, and definitions of error, adverse event, close call/near miss, and sentinel event. We presented this material in a lecture format. In addition, a panel of physicians with expertise in ethics, medical education, and public policy discussed the ethical, educational, and policy aspects of patient safety.

The second theme focused on how error reporting can lead to improved patient safety and how medical students can report errors within the practice setting. This part of the curriculum introduced the characteristics of successful reporting systems and demonstrated how to enter a patient safety report into our organization's electronic adverse event and near-miss reporting system (patient safety net [PSN]).[17] A lecture was followed by hands-on orientation to the electronic medical record in a computer training lab. During the computer training, students were asked to work through the patient-safety reporting tutorial.

Table 1

Patient Safety/Medical Fallibility Curricular Content and Educational Modality by Theme, University of Missouri-Columbia School of Medicine (MU), 2003–2004

Theme	Content	Educational modality
Patient safety overview	Epidemiology of medical errors	Lecture
	Institution of Medicine report *To Err is Human*, and its recommendations	Lecture
	Definitions of error, adverse event, close call/near miss, and sentinel event	Lecture
	Ethical, educational, and policy aspects of patient safety	Panel discussion
Error reporting	How reporting can lead to improvement	Lecture
	Characteristics of successful error reporting systems	Lecture
	How second-year medical students would report errors at MU	Demonstration
System vs. human approach	"Blame and shame" culture	Lecture
	Socialization of perfection in medicine	Lecture
	Safety culture in other high-risk industries	Lecture
	Human factors engineering	Lecture
Safety tools	Interdisciplinary root cause analysis	Lecture, Interactive forum
	System solutions that minimize reliance on human cognition and memory	Modified root cause analysis, Interactive forum
Ethics/disclosure	Ethical obligations surrounding medical fallibility and patient safety	Lecture
	Constructive responses to errors	Panel discussion
	Disclosure techniques	Role playing

The systems versus human approach component examined systems thinking (characterized by a focus on systems rather than on individuals to avert errors) and human fallibility. This theme taught concepts such as the historical "blame-and-shame" practice within medicine, the socialization of medical professionals to believe they should be perfect, cultural changes and improved safety in other high-risk industries such as aviation and nuclear power, and the use of human factors engineering principles to improve safety within high-risk industries. This section drew heavily from the patient safety curriculum developed by the Veteran's Administration National Center for Patient Safety (NCPS) and was taught in part by visiting scholar John Gosbee, MD, MS, Director of Patient Safety Information Systems, NCPS.[18]

The fourth theme focused on the use of tools to improve safety. This included system-based investigation as part of an interdisciplinary root-cause analysis (RCA) team. The emphasis was on identifying robust systems that protect patients from avoidable harm without relying on human cognition, memory, and ability. We based cases for the RCA exercise on actual errors from internal and external sources. In small groups, students evaluated the factors contributing to an adverse event and designed preventive strategies under the guidance of a faculty facilitator. Facilitators were drawn from an interprofessional group of school of medicine faculty, practicing hospital clinicians, and patient-safety experts.

The final theme explored the ethical obligations surrounding medical fallibility and patient safety, including constructive responses to medical errors. Students role-played disclosing an error to an attending, supporting a peer who experiences an error, and assuming the role of an attending to disclose an error to a patient. (We emphasized that students should disclose errors to patients only at the direction of the attending.) In addition, a panel of clinicians, residents, and students shared stories of medical errors they had been involved with, the emotional impact of those errors, and their professional responses to the experiences.

Assessment of students' knowledge, skills, and attitudes

We developed a 28-item questionnaire to evaluate the impact and sustainability of the curriculum on medical students' knowledge, skills, and attitudes. Item development was informed by our literature review. The questionnaire included items modified from existing questionnaires assessing institutional safety culture and medical error reporting[17,19] and physician's attitudes toward medical errors, tolerance of uncertainty, and reactions to uncertainty,[20] as well as new items based on our curricular learning objectives. We selected items for the questionnaire based on the likelihood that they would demonstrate change after students participated in our curriculum. Five multiple-choice items assessed students' knowledge, five items measured their comfort with skills (using a five-point ordinal scale where 1 = very uncomfortable and 5 = very comfortable), and 18 items measured attitudes (using a five-point ordinal scale of agreement with statements where 1 = strongly disagree and 5 = strongly agree.) We pilot-tested the questionnaire for comprehensibility with first-year medical students and for applicability with one second-year medical student with prior involvement in MU patient safety activities. We asked students to complete the questionnaire before the curriculum (pretest), after the final learning experience (posttest), and one year later (one-year posttest). Participants provided the last four digits of their student numbers to allow for paired comparisons. The University of Missouri Health Sciences Institutional Review Board approved the study; we received no external funding.

We deleted two attitude items from the analysis because the item wording was inconsistent across questionnaire administrations. For each student, we calculated a composite knowledge score as the number of correct knowledge items out of five. For the composite knowledge score and the remaining 21 items, we calculated a 95% confidence interval (CI) for paired differences to assess changes between students' pretest and posttest as well as their pretest and one-year posttest. We also analyzed the paired differences between the posttest and one-year posttest; however, because these data did not change our conclusions, the results are not included here.

Assessment of students' self-reported behaviors

On the one-year posttest, we also asked students to report their behaviors since completing the curriculum. Students responded "yes" or "no" to items about whether they used what they learned in the curriculum, error observation, and disclosure and reporting experiences. We calculated the percentage of students responding "yes" to each item.

Curriculum evaluation

We developed course evaluations to measure students' reactions to the curriculum. Students used a five-point ordinal scale to rate how well the curriculum met learning objectives, its usefulness in their medical education, its future benefit to their medical career, and if it should be continued. We also invited students to describe the most important thing they gained from the curriculum and to offer suggestions for improvement.

Results

Assessment of students' knowledge, skills, and attitudes

Eighty of 92 students (87%) returned the questionnaire before the first learning session (pretest), 89 of 92 (97%) returned the questionnaire after the final learning session (posttest), and 73 of 92 (79%) returned the questionnaire one year after the curriculum (one-year posttest). Twenty two students indicated that they had had prior experiences with patient safety or quality improvement in health care on the pretest. Prior experiences included training, compliance or accreditation requirements for previous hospital employment, allied health (RN, MA, EMT, and surgical technician) job responsibilities, hospital committee work, and research.

Fifty three students (55%) completed the questionnaire at all three assessment points. Our analysis of paired comparisons (posttest to pretest and one-year posttest to pretest) was based on these responses. These results can be divided into three categories: students' responses with improvement, those without change, and those with change in an undesired direction.

Responses with improvement

Table 2 presents the pretest means, mean paired differences, and confidence intervals for items with improvement both immediately after students participated in the curriculum (pretest to posttest) and/or at one year (pretest to one-year posttest). Students' responses to one attitude item addressing the inevitability of medical errors, another about the effectiveness of human versus system responses to errors, and a third reflecting perceptions about competence and harmful errors improved immediately after the curriculum; these improvements were sustained at one year. Four skill items also improved immediately after students took the curriculum and at one year: supporting a peer involved in an error, analyzing root causes of an error, accurately entering a safety report, and disclosing an error to a patient. Although not improving immediately, students' responses to one attitude item about physicians routinely sharing information about errors and their causes improved at one year. Students' responses to an additional attitude item on the effectiveness of error reporting systems, as well as the composite knowledge score, improved immediately following the curriculum, but these changes were not sustained at one year.

Responses without change

Table 3 presents the pretest means, mean paired differences, and confidence intervals for students' responses that did not change in either of the two comparison intervals. These items—six attitudinal and one skill—reflect that medical students already believed that a gap exists between best and actual patient care practice, that physicians can affect the sources of errors, and that it takes more than just physicians to determine causes of a medical error. However, students do not believe physicians routinely report medical errors, and they did not feel strongly that patient safety is a high priority at our institution. The mean student responses were neutral with regard to whether or not physicians should tolerate uncertainty in patient care and in their comfort with error disclosure to faculty.

Table 2

Questionnaire Items with Improvement, from a Study of the Effects of a Patient Safety/Medical Fallibility Curriculum on Second-Year Medical Students' Knowledge, Skills, and Attitudes, University of Missouri-Columbia School of Medicine, 2003–2004

Item	Pre-test mean response	Mean change (95% CI)	
		Pre-test to post-test	Pre-test to one-year post-test
Attitude items*			
Making errors in medicine is inevitable.	4.38	0.30 (0.10, 0.50)	0.21 (0.03, 0.39)
After an error occurs, an effective strategy is to work harder to be more careful.	3.47	−0.58 (−0.86, −0.31)	−0.51 (−0.84, −0.18)
Competent physicians do not make medical errors that lead to patient harm.	2.06	−0.55 (−0.89, −0.20)	−0.30 (−0.53, −0.08)
Physicians routinely share information about medical errors and what caused them.	2.25	0.15 (−0.17, 0.47)	0.32 (0.05, 0.59)
Reporting systems do little to reduce future errors.	2.57	−0.58 (−0.86, −0.31)	0.06 (−0.23, 0.34)
Skill items†			
Supporting and advising a peer who must decide how to respond to an error.	2.72	0.79 (0.44, 1.14)	0.66 (0.31, 1.01)
Analyzing a case to find the cause of an error.	2.58	1.00 (0.66, 1.34)	0.68 (0.39, 0.96)
Accurately entering a Patient Safety Net report.	2.11	0.75 (0.47, 1.04)	0.62 (0.26, 0.98)
Disclosing an error to a patient.	2.08	0.79 (0.48, 1.10)	0.45 (0.14, 0.77)
Knowledge items‡			
Composite knowledge score	3.29	0.50 (0.09, 0.91)	0.37 (−0.01, 0.74)

* Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.
† Scale: 1 = very uncomfortable, 2 = uncomfortable, 3 = neutral, 4 = comfortable, 5 = very comfortable.
‡ Number of correct multiple-choice questions out of the following five knowledge items:
1. Estimate of the volume of preventable adverse events each year as reported in the IOM Report *To Err is Human* (answer: 100,000)
2. Estimate of the percentage of hospitalizations with adverse events (answer: 2%–4%)
3. Characteristics of a successful error reporting system (answer: confidential and nonpunitive)
4. Definition of latent factors (answer: factors that have delayed effects)
5. Type of person who can use MU's Patient Safety Net (answer: MDs, staff, patients, visitors)

Table 3

Questionnaire Items without Change, from a Study of the Effects of a Patient Safety/Medical Fallibility Curriculum on Second-Year Medical Students' Knowledge, Skills, and Attitudes, University of Missouri-Columbia School of Medicine, 2003–2004

Item	Pre-test mean response	Mean change (95% CI)	
		Pre-test to post-test	Pre-test to one-year post-test
Attitude items*			
There is a gap between what we know as "best care" and what we provide on a day to day basis.	3.85	−0.13 (−0.36, 0.09)	−0.08 (−0.34, 0.19)
Most errors are due to things that physicians can't do anything about.	2.32	−0.08 (−0.33, 0.18)	−0.08 (−0.34, 0.19)
Only physicians can determine the causes of a medical error.	1.68	0.11 (−0.14, 0.36)	0.09 (−0.17, 0.36)
Physicians routinely report medical errors.	2.45	−0.11 (−0.33, 0.11)	0.11 (−0.20, 0.42)
In my clinical experiences so far, faculty and staff communicate to me that patient safety is a high priority.	3.32	0.02 (−0.30, 0.34)	0.23 (−0.09, 0.54)
Physicians should not tolerate uncertainty in patient care.	2.74	−0.02 (−0.36, 0.33)	−0.23 (−0.53, 0.07)
Skill item†			
Disclosing an error to a faculty member.	2.68	0.32 (−0.02, 0.67)	0.23 (−0.10, 0.55)

* Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.
† Scale: 1 = very uncomfortable, 2 = uncomfortable, 3 = neutral, 4 = comfortable, 5 = very comfortable.

Responses with change in an undesired direction

Table 4 presents the pretest means, mean paired differences, and confidence intervals for items where students' responses changed, but in an undesired direction. Immediately after the curriculum and at one year, students agreed less that there was value in spending professional time improving care and disagreed less that the culture of medicine makes it easy to deal constructively with medical errors. At one year, students agreed less that spending time in medical school learning how to improve safety was an appropriate use of time, were less likely to be open about errors they witnessed, and were more likely to believe that no-harm errors did not require disclosure.

Assessment of self-reported behaviors

A substantial proportion of students completing the questionnaire at one year answered "Yes" to whether they had certain behaviors in the year following curriculum completion. Forty of 72 (56%) students reported having used what they learned in the curriculum and 55 (76%) reported observing a medical error. Of these 55 students, 39 (71%) had disclosed an error to a fellow student, 31 (56%) had done so to a resident, 25 (46%) had disclosed an error to a faculty member, and four (7%) had used the PSN to report an error.

Curriculum evaluation

At the completion of the curriculum, 88 of 92 students (96%) completed course evaluations. By design, 46 students evaluated the content in the Clinical Practicum block and 42 evaluated the content in the Physician as Person block. On average, 72% of these students agreed that the course content improved their ability to meet the learning objectives either well or very well. Seventy-three percent, on average, agreed or strongly agreed that the curriculum and learning modalities were useful in their medical education. Eighty-two percent, on average, agreed or strongly agreed that the curriculum would be of benefit to their future career, and on average 72% recommended that the curriculum be continued for future medical school classes. Topics mentioned as the most important thing students gained from the curriculum were an understanding that everyone makes mistakes, how to address errors at the root cause, and that error reporting and disclosure are important. Suggested improvements included changes in the timing of the curriculum (one student suggested during the first year "before we get our God complexes," others during the third or fourth year), shorter sessions, less lecture and more small group sessions, more guidance on communication issues for third-year students, and more time for practice using the PSN.

Discussion

All members of the health care team, including medical students, should be able to recognize unsafe conditions, systematically report errors and near misses, investigate and improve such systems with a thorough understanding of human fallibility, and disclose errors to patients. Our results demonstrate that our patient safety/medical fallibility curriculum was well received and led to some changes in second-year medical students' knowledge, skills, and attitudes. However, not all of these changes were for the better, nor were all of the positive changes sustained at one year or supported by students' self-reported behaviors.

Table 4

Questionnaire Items with Change in an Undesired Direction, from a Study of the Effects of a Patient Safety/Medical Fallibility Curriculum on Second-Year Medical Students' Knowledge, Skills, and Attitudes, University of Missouri-Columbia School of Medicine, 2003–2004

Item	Pre-test mean response	Mean change (95% CI)	
		Pre-test to post-test	Pre-test to one-year Post-Test
Attitude items*			
Physicians should routinely spend part of their professional time working to improve patient care.	4.57	−0.23 (−0.43,−0.02)	−0.28 (−0.51, −0.06)
The culture of medicine makes it easy for providers to deal constructively with errors.	1.81	0.30 (0.03, 0.57)	0.38 (0.11, 0.65)
Learning how to improve patient safety is an appropriate use of time in medical school.	4.30	−0.17 (−0.40, 0.06)	−0.26 (−0.46, −0.07)
If I saw a medical error, I would keep it to myself.	2.11	0.09 (−0.12, 0.31)	0.26 (0.03, 0.49)
If there is no harm to a patient, there is no need to address an error.	1.58	0.15 (−0.07, 0.37)	0.34 (0.08, 0.60)

* Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

We believe there are several sets of factors that contributed to these results. The first is the curriculum itself, including the course content, instructor effectiveness, educational modalities, timing and integration of topics within the overall curriculum, planned redundancy, and evaluation methods. The second comes from other formal or informal learning experiences within the preclinical and clinical years, including the hidden curriculum. The third set of factors includes the study design, questionnaires, and evaluation tools used. We discuss each of these three areas below.

Curriculum characteristics

Our analysis identified aspects of the curriculum that worked well for our second-year medical students. We believe that presenting the course content at Bloom's application level[21] and the interactive nature of the learning modalities contributed to the improved responses after students participated in the curriculum and at one year. For example, the most improvement was seen in items addressed by interactive sessions, such as the modified RCA and the error disclosure role-playing, where students applied knowledge and practiced skills. Conversely, students' improved mastering of content delivered solely by lecture, such as facts reported in the Institute of Medicine's *To Err is Human* about percentage of hospitalizations with adverse events and estimated annual deaths due to preventable errors, were not sustained at one year. These results and the curriculum evaluation suggest that application-focused learning and case-based interactive or narrative sessions may achieve more lasting impact on students' knowledge, skills, and attitudes, as well as improved student satisfaction with the curriculum. In addition, when we covered topics multiple times using several educational modalities during the curriculum, as in the inevitability of medical errors, students' learning was sustained.

On the other hand, several topics led to no change in students' knowledge, skills, and attitudes. For many of these topics, students were already familiar with the concepts that were taught, such as the quality gap between ideal patient care and actual care and that it takes more than physicians to determine the causes of a medical error. Students' prior experiences and baseline knowledge may eliminate the need to cover this material in a curriculum. Alternatively, this lack of change in students' responses might indicate that curricular timing and integration should be improved for these topics. For example, the curriculum did not convince students that patient safety is a high priority at MU. This may be due to a lack of clear messages and planned redundancy within the curriculum about our institutional focus on patient safety.

Based on these results, when we presented the curriculum to the next class of second-year medical students in 2004, we decreased the amount of time spent on introductory material, substituted a required reading for a background lecture, and focused more on the interactive, application-based aspects of the curriculum, including the time allotted for students to enter a PSN report based on their modified RCA exercise. We also developed the modified RCA exercise into an interprofessional experience by including nursing, health management and informatics students, and pharmacy residents and emphasized MU's quality improvement efforts and patient-safety success stories. The results of these modifications, including the one-year posttest, are pending.

Other learning experiences

Calling to mind the effects of the informal and hidden curricula, our study shows that students' responses to the two items describing secrecy about medical errors weakened after one year of clinical experience. Additionally, responses to two items on the value of learning about improving care during medical school and working to improve care as part of their professional life, both ACGME competencies, worsened after one year of clinical experience. It is not surprising that the preclinical curriculum alone could not sustain all improvements. During the development and implementation of this curriculum, we discussed the importance of having trained staff and faculty serve as role models to help sustain medical students'

knowledge, skills, and attitudes. Specifically, if students saw their faculty mentors role modeling the behaviors of identifying an error, acknowledging the error within the care team, reporting the error, conducting a system-based investigation, and disclosing the error to the patient, then the lessons they learned through classroom-based curricular activities would be reinforced during real-time clinical experiences. Although the students' self-reported behaviors reflected their use of the curriculum content and clear identification of medical errors, students were much more likely to disclose an error to a peer than to a resident or a faculty member. In addition, despite a high error-observation rate, few students used the PSN to report an error. These behaviors provide further insight into our clinical environment at MU and suggest that patient safety principles are not optimally reinforced.

Not unlike other academic health centers, MU faces challenges to an institutional culture that supports patient safety. Although department-specific lectures, discussions, and other patient safety activities are periodically scheduled at MU, there remains no consensus in our organization about comprehensive patient safety content for staff and faculty, or how and when it should be taught. Even when comprehensive safety training is developed and offered, faculty attendance may be incomplete. There is no mandate for licensed health care professionals to complete any patient safety courses as part of their continuing-education requirements for license renewal.[22] Fear of tort action and reporting to licensing boards is another barrier to role modeling behaviors of reporting, investigating system failures, and disclosing errors to patients. These disincentives will continue to slow progress toward patient safety. However, evidence exists that health care systems that adopt full disclosure policies and practices can reduce liability.[23]

Given these challenges to supporting and encouraging sustained student learning about patient safety and medical fallibility, MU began the process of integrating this content into the clinical clerkships during the 2004–05 academic year. Within the internal medicine clerkship, third-year medical students now participate in two learning experiences to reinforce their skills. One is a mini-RCA using a teaching case, and the other is small group work where students report on observed adverse events or near misses and identify system issues and propose system-based solutions. A fourth-year elective in patient safety and quality of care will be offered in the spring of 2006.

At the residency level, the Department of Internal Medicine at MU has implemented a new systems-based format of Morbidity and Mortality conferences that includes follow-up reports on previously identified and pursued system interventions. Since February 2005, as part of a Partners in Quality Education initiative called "Achieving Competence Today" supported by the Robert Wood Johnson Foundation, family medicine and internal medicine residents, as well as nurse practitioner students, have worked closely with residency faculty and health care system improvement experts to learn how to identify safety problems and use systems-based approaches to improve patient care.

Various faculty development activities have also been introduced. For example, structured courses on systems-based practice have been offered twice to residency faculty. As of June 2005, over 550 nurses, respiratory therapists, unit attendants/clerks, pharmacists, and patient care managers, as well as over 200 attending physicians and residents, have attended Crew Resource Management training. This interdisciplinary teamwork training was developed and has been used successfully in the aviation industry to reduce accidents by teaching about human error, human performance limits, and countermeasures to error.

Study design, questionnaire, and evaluation tools

Limitations in our study design, questionnaire, and evaluation methods also may have blunted the effects of our curriculum on students' learning. A stronger study design would have included a control group of MU students or students from a similar institution. However, we felt strongly that all MU students should be exposed to this content and thus integrated it into the core curriculum. As this was a novel curriculum and likely to be adapted further, we did not seek to implement it at another institution during this phase of the study. Although the response rate was adequate at each time period, our core analysis focused only on those students who completed the questionnaire at all three administrations, excluding those who did not. The survey instrument was new and therefore limited by its lack of formal validation and reliability testing. Some attitude items were confusing in that they required the students to respond in a way that reflected both what we taught (i.e., in general physicians do not report errors routinely) and what we demonstrated to the contrary (i.e., physicians at MU use the PSN to report errors). Ultimately, our study is limited by reliance on students' self-reporting their comfort with skills and behaviors, rather than our using observational methods to determine their actual performance or measuring patient-related outcomes with respect to safety and medical fallibility. In addition, students completed the curricular evaluation after the last session, thereby requiring them to recall sessions presented several weeks earlier.

Conclusions

We designed an innovative patient safety and medical fallibility curriculum for second-year medical students at the University of Missouri-Columbia and studied the effects of the curriculum on medical students' knowledge, skills, and attitudes after their participation in the curriculum and at one year, gathered data on student-reported behaviors regarding use of the curriculum and exposure to and disclosure of errors, and measured students' evaluations of the curriculum.

Our results show that a patient safety and medical fallibility curriculum can affect the knowledge, comfort with skills, and attitudes of second-year medical students. Within several different domains, students demonstrated improvement that was sustained one year later. However, some improvements were not sustained and some changes were not consistent with the learning objectives. Student-reported behaviors at the one-year time frame demonstrated that although students recognize medical errors, the number of students who disclose errors to faculty members is far less than those disclosing errors to residents and/or their peers. In addition, the patient safety and medical fallibility curriculum was well received by second-

year medical students. More specifically, students perceived it to be useful, beneficial for their careers, and recommended it for future medical students.

Our study thus suggests that there is value in spending curricular time and faculty effort in teaching medical students about patient safety and medical fallibility early in their medical school experience. It also suggests that it will be essential to address the clinical educational environment and the hidden curriculum of our academic institutions in order to achieve lasting results.

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Did You Know?

With support from the National Institutes of Health, researchers at the University of Colorado Health Sciences Center School of Medicine discovered a new progressive neurological disorder in 2004. The disorder, predominantly affecting men over age 50 years, is linked to a small mutation in the same gene that causes fragile X syndrome, a common cause of inherited mental retardation.

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