Medication Error Instruction in Schools of Pharmacy Curricula: A Descriptive Study

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The present descriptive investigation had the primary objective of assessing the manner and extent to which the topic of medication error is included in the curricula of schools of pharmacy in the United States. A cover letter and survey were sent to 82 schools of pharmacy in April 2001. Thirty-six surveys were returned (48 percent response). Five returned surveys were incomplete. The quality and quantity of medication error instruction in pharmacy curricula varied significantly. A lack of standardization and inclusion of key domains was observed. Given the well-documented magnitude and costs of medication errors, it seems imperative that schools of pharmacy incorporate into curricula a meaningful and consistent amount of instruction pertaining to medication errors. This study illustrates the need for schools of pharmacy to articulate and standardize a minimal level of medication error instruction for pharmacy curricula and provides a sample curriculum that could be used.

INTRODUCTION

In November 1999, a report by the Institute of Medicine’s Committee on Quality of Health Care in America, entitled To Err Is Human: Building a Safer Health System, put into perspective the magnitude of medical errors in the United States (U.S.). In this report, it was estimated that there were between 44,000 and 98,000 deaths each year as the result of medical errors, which ranks as the eighth leading cause of death in the U.S. Additionally, 7000 deaths could be directly attributed to medication errors. These statistics were extrapolated from acute-care data and do not represent the much larger component of drug utilization and exposure by patients at home, or those in long-term care, rehabilitation, psychiatric or hospice facilities. The report stated that medical errors are more likely to be the result of problems inherent in poorly designed health care systems than the result of reckless behavior on the part of health care practitioners. The report pointed to the need for health care and governmental agencies to make this problem a priority and to implement systems to decrease medical errors(1).

A follow-up report from the Institute of Medicine entitled, Crossing the Quality Chasm: A New Health System for the 21st Century, more globally identified and examined the problems that exist within the American health care delivery system. The report described the overall delivery of health care as disjointed and inefficient and noted that “quality problems are everywhere, affecting many patients.” The report called for fundamental changes over the next ten years to the American health care delivery system and gave a comprehensive strategy to accomplish this. Among other recommendations, patient safety
The magnitude of this problem has been well documented in the literature. Originally, Barker and McConnell reported that one of every six doses of medication was given in error(3). Bates, et al. estimated that there were 1.4 medication errors for every hospital admission(4). Barker, et al estimated that one error occurs daily per patient in the U.S.(5). Bond, et al reported that medication errors occur in 5.22 percent of hospitalized patients yearly(6). In terms of costs, Johnson and Bootman reported that $76 billion was spent annually on adverse drug events in the ambulatory care setting largely due to hospital admissions. It is estimated that the total cost of drug-related morbidity and mortality in the U.S. may be over $100 billion annually(7). Factors generally thought to contribute to this problem include the increasing number of new products on the market, the increasing complexity of health care processes, and decreasing resources(8). Studies have demonstrated that pharmacists play a vital role in significantly reducing the incidence, severity, and cost of adverse drug events. Indeed, one study reported a reduction of 66 percent adverse drug events with a pharmacist rounding in the intensive care unit(9).

The pharmacy profession is being asked to provide leadership in patient safety initiatives as part of a multidisciplinary approach within health care(10,11). In fact, the American Society of Health-System Pharmacists (ASHP, formerly the American Society of Hospital Pharmacists) through its Committee on Safety Practices and Procedures realized the importance of patient safety in the 1950s and 1960s. This committee, chaired by R. David Anderson, published guidelines for the safe use of medications in hospitals and urged hospital pharmacists “to extend their responsibilities to include participation in programs dealing with the safe handling of drugs throughout the hospital.” This committee’s report set the standard for the practice of pharmacy at that time in ensuring patient safety and even defined medication errors with procedures to address them(12,13).

More recently, many pharmacists in health-systems and in community pharmacy settings have implemented programs both within the pharmacy department and interdepartmentally to better identify and prevent medication errors(1,9,14-21). A significant initial and ongoing component of these programs is the training and education of pharmacy personnel with regards to medical error, medication error, human error and human factors, and quality/process improvement techniques(22). The Institute of Medicine of the National Academy of Science has recommended that changes are necessary within the curricula of health care provider programs to address medication errors(1). Davis has suggested that quality clinical education and practice skills are essential elements along with bar coding and prescriber computer order entry for reducing medication errors(23). Davis has also suggested that quality education in schools of pharmacy can help overcome knowledge deficits that lead to medication errors(24). Therefore, it is quite clear that the introduction of medication error coursework in the curricula of schools of pharmacy is an important and necessary component of the training of pharmacy students. To this end, it is necessary to characterize what education is being provided within the curricula of schools of pharmacy. The present descriptive investigation had one primary objective: to assess the manner and extent to which the topic of medication error is included in the pharmacy curricula of schools of pharmacy in the U.S.

LITERATURE REVIEW
A review of the pharmacy literature revealed no published studies examining the global curricular status of medication error teaching in schools of pharmacy. Two abstracts of posters presented at national pharmacy meetings addressed this topic(25). The first was a poster presented by Wolfe, et al. at the 1997 American Association of Colleges of Pharmacy Annual Meeting in which colleges of pharmacy within the U.S. and Canada were surveyed to examine the curricular status of medication error teaching(25). However, at the time of the presentation, data collected had not been analyzed. The second poster was presented more recently at the 2001 ASHP Midyear Clinical Meeting in which Daftary, et al. conducted a survey to determine medication error training received by pharmacists (32 percent), pharmacy students (40.9 percent), pharmacy residents (9.3 percent), and others not specified (17.8 percent). The survey was conducted at a national pharmaceutical association meeting in 2000. The results showed that the majority of respondents received didactic medication error training during pharmacy school (65 percent). Likewise, 54.9 percent of the respondents stated that their current place of employment provided formal medication error training. Also of note was that 59.5 percent of respondents stated that they had provided medication error training to other health care providers1. No literature was identified with regards to medication error training during pharmacy residency programs. In addition, two posters have been presented over the last several years at national pharmacy association meetings which describe medication error coursework that two schools of pharmacy have developed(26).

In the first, Temple University partnered with the Institute for Safe Medication Practices (ISMP) and the U.S. Food and Drug Administration (FDA) to offer a certificate program in medication safety, which is awarded concomitantly with the Doctor of Pharmacy Degree. The 12-credit course included instruction in pharmacoepidemiology, risk management, medication error prevention, safe medical product design, and adverse drug reaction training. Experiential learning was accomplished by on-site rotations at the FDA, hospitals and health-systems, pharmaceutical industry, and Institute for Safe Medication Practices2. Another poster described The University of South Carolina approach, in which medication error training was included in a recitation portion of the Integrated Pharmacy Laboratory and Recitation course early in the pharmacy school educational process(26). Posters on the use of a medication incident form in a professional practice laboratory and effective communication strategies of pharmacy-based errors have also been presented(27,28).

By contrast, more literature was identified concerning medication error and adverse drug reactions training in the curricula of schools of medicine and within medical residency programs. However, the results generally show that more formal education and training programs on this topic are needed(29-33). A recent survey of medical students and internal medicine residents showed that the majority of respondents had little or insufficient exposure to adverse drug reactions and in measures to prevent medication errors. In fact, 17 percent of medical residency directors had little or no awareness of the

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IOM report. The study called for increased clinical pharmacology training in medical education(30).

METHODOLOGY
A survey was developed to assess the quantity, quality, and method of medication error instruction in the curricula of schools of pharmacy in the U.S. It was felt that a survey would provide a means of providing a comprehensive and accurate picture of curricular inclusion of medication error at schools of pharmacy. Interested readers are directed to obtain a copy of the survey from the authors.

Toward the end of April of 2001, a cover letter and survey were sent to the 82 deans of the schools of pharmacy. The names and addresses of the deans were taken from the American Association of Colleges of Pharmacy 2000-01 Roster. The project was approved by the Institutional Review Board of the authors’ university. The cover letter asked each school’s dean for assistance in completing the survey by distributing it to pertinent faculty members responsible for teaching topics pertaining to medication error in the school’s curriculum. The survey used for this investigation was developed by the authors based on their own personal experiences in medication errors both curricularly and experimentally and also on their knowledge of survey methodology. The pharmacy literature was likewise searched to determine if previous studies had examined medication error inclusion in pharmacy curricula.

To maximize the response rate, the survey design employed a modified method developed by Salant and Dillman, whereby an initial cover letter and instrument are sent to the sample(34). This initial mailing was followed by three reminders to nonresponders spaced two weeks apart.

RESULTS
Of the 82 initial letters and instruments sent, 36 were returned to the authors and three responses were sent by e-mail (48 percent response). Upon analysis, it was determined that the three e-mailed responses and two of the 36 returned surveys were incomplete and therefore were discarded from further analysis.

Table I. Year the topic is taught in pharmacy school

<table>
<thead>
<tr>
<th>Topic</th>
<th>N (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P1</td>
</tr>
<tr>
<td>Human error</td>
<td>2</td>
</tr>
<tr>
<td>Medical errors</td>
<td>1</td>
</tr>
<tr>
<td>Medication errors</td>
<td>3</td>
</tr>
<tr>
<td>Quality improvement</td>
<td>2</td>
</tr>
<tr>
<td>Root cause analysis</td>
<td>0</td>
</tr>
<tr>
<td>Failure mode and effects analysis</td>
<td>0</td>
</tr>
</tbody>
</table>

*Respondents chose response P1 to P4 if the topic was taught throughout all pharmacy school years.

Table II. Course within which the topic is taught

<table>
<thead>
<tr>
<th>Topic</th>
<th>Pharmacy Administration</th>
<th>Pharmacy Therapeutics</th>
<th>Pharmacy Law</th>
<th>Other</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human error</td>
<td>16 (47)</td>
<td>0 (0)</td>
<td>2 (6)</td>
<td>2 (6)</td>
<td>14 (41)</td>
</tr>
<tr>
<td>Medical errors</td>
<td>15 (44)</td>
<td>2 (6)</td>
<td>2 (6)</td>
<td>3 (9)</td>
<td>12 (35)</td>
</tr>
<tr>
<td>Medication errors</td>
<td>26 (76)</td>
<td>1 (3)</td>
<td>2 (6)</td>
<td>1 (3)</td>
<td>4 (12)</td>
</tr>
<tr>
<td>Quality improvement</td>
<td>23 (68)</td>
<td>1 (3)</td>
<td>1 (3)</td>
<td>1 (3)</td>
<td>8 (23)</td>
</tr>
<tr>
<td>Root cause analysis</td>
<td>11 (32)</td>
<td>1 (3)</td>
<td>0 (0)</td>
<td>1 (3)</td>
<td>21 (62)</td>
</tr>
<tr>
<td>Failure mode and effects analysis</td>
<td>6 (18)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>28 (82)</td>
</tr>
</tbody>
</table>

IV. Most respondents taught the domains within a didactic setting, while some also taught them within a skills laboratory;
Table III. Topic inclusion as a separate course vs. included within another course

<table>
<thead>
<tr>
<th>Topic</th>
<th>Separate course</th>
<th>Within another course</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Error</td>
<td>1 (3)</td>
<td>17 (50)</td>
<td>16 (47)</td>
</tr>
<tr>
<td>Medical Errors</td>
<td>1 (3)</td>
<td>20 (59)</td>
<td>13 (38)</td>
</tr>
<tr>
<td>Medication Errors</td>
<td>3 (9)</td>
<td>25 (73)</td>
<td>6 (18)</td>
</tr>
<tr>
<td>Quality Improvement</td>
<td>2 (6)</td>
<td>24 (71)</td>
<td>8 (23)</td>
</tr>
<tr>
<td>Root Cause Analysis</td>
<td>1 (3)</td>
<td>10 (29)</td>
<td>23 (68)</td>
</tr>
<tr>
<td>Failure Mode and Effects Analysis</td>
<td>1 (3)</td>
<td>5 (15)</td>
<td>28 (82)</td>
</tr>
</tbody>
</table>

Table IV. How the topic is taught: Didactic setting vs. skills lab

<table>
<thead>
<tr>
<th>Topic</th>
<th>Didactic</th>
<th>Skills Lab</th>
<th>Both</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Error</td>
<td>8 (23)</td>
<td>2 (6)</td>
<td>10 (29)</td>
<td>14 (41)</td>
</tr>
<tr>
<td>Medical Errors</td>
<td>13 (38)</td>
<td>1 (3)</td>
<td>10 (29)</td>
<td>10 (29)</td>
</tr>
<tr>
<td>Medication Errors</td>
<td>16 (47)</td>
<td>3 (9)</td>
<td>12 (35)</td>
<td>3 (9)</td>
</tr>
<tr>
<td>Quality Improvement</td>
<td>16 (47)</td>
<td>3 (9)</td>
<td>9 (26)</td>
<td>6 (18)</td>
</tr>
<tr>
<td>Root Cause Analysis</td>
<td>9 (26)</td>
<td>1 (3)</td>
<td>3 (9)</td>
<td>21 (62)</td>
</tr>
<tr>
<td>Failure Mode and Effects Analysis</td>
<td>5 (15)</td>
<td>0 (0)</td>
<td>2 (6)</td>
<td>27 (79)</td>
</tr>
</tbody>
</table>

Table V. Status of topic inclusion into coursework: Mandatory vs. voluntary

<table>
<thead>
<tr>
<th>Topic</th>
<th>Mandatory</th>
<th>Voluntary</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Error</td>
<td>20 (59)</td>
<td>0 (0)</td>
<td>14 (41)</td>
</tr>
<tr>
<td>Medical Errors</td>
<td>23 (68)</td>
<td>1 (3)</td>
<td>10 (29)</td>
</tr>
<tr>
<td>Medication Errors</td>
<td>30 (88)</td>
<td>1 (3)</td>
<td>3 (9)</td>
</tr>
<tr>
<td>Quality Improvement</td>
<td>28 (82)</td>
<td>0 (0)</td>
<td>6 (18)</td>
</tr>
<tr>
<td>Root Cause Analysis</td>
<td>12 (35)</td>
<td>2 (6)</td>
<td>20 (59)</td>
</tr>
<tr>
<td>Failure Mode and Effects Analysis</td>
<td>6 (18)</td>
<td>1 (3)</td>
<td>27 (79)</td>
</tr>
</tbody>
</table>

Table VI. Practice settings in medication error coursework

<table>
<thead>
<tr>
<th>Practice setting</th>
<th>Covered</th>
<th>Not covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Care</td>
<td>29 (85)</td>
<td>5 (15)</td>
</tr>
<tr>
<td>Long-Term Care</td>
<td>21 (62)</td>
<td>13 (38)</td>
</tr>
<tr>
<td>Community</td>
<td>28 (82)</td>
<td>6 (18)</td>
</tr>
<tr>
<td>Outpatient</td>
<td>27 (79)</td>
<td>7 (21)</td>
</tr>
<tr>
<td>Industry</td>
<td>4 (12)</td>
<td>30 (88)</td>
</tr>
<tr>
<td>Regulatory</td>
<td>7 (21)</td>
<td>27 (79)</td>
</tr>
<tr>
<td>Other</td>
<td>3 (9)</td>
<td>31 (91)</td>
</tr>
</tbody>
</table>

The majority of the domains were considered mandatory curricular elements as noted in Table V as opposed to being taught to students on a voluntary basis. It is assumed that most of the domains were taught in required coursework as opposed to a voluntary (elective) course to select students.

Table VI reveals the extent to which various practice settings were covered in medication error coursework. Most schools of pharmacy included the practice settings of acute care, long-term care, community practice, and outpatient pharmacy practice within their curricula of medication errors. Practice settings not taught as frequently included industry and regulatory.

Table VII. Subject matter in the medication error coursework

<table>
<thead>
<tr>
<th>Subject</th>
<th>Covered</th>
<th>Not covered</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Errors</td>
<td>28 (82)</td>
<td>5 (15)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Impact of Errors</td>
<td>28 (82)</td>
<td>5 (15)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Frequency of Errors</td>
<td>27 (79)</td>
<td>6 (18)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Nomenclature</td>
<td>22 (65)</td>
<td>11 (32)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Morbidity/Mortality</td>
<td>21 (62)</td>
<td>12 (35)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Process Mapping</td>
<td>7 (21)</td>
<td>26 (76)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Local/Societal</td>
<td>16 (47)</td>
<td>17 (50)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Legislative</td>
<td>19 (56)</td>
<td>14 (41)</td>
<td>1 (3)</td>
</tr>
</tbody>
</table>

Of the 34 completed responses to this study, four (12 percent) stated that medication error information was taught during clerkships or apprenticeships. In addition, four schools revealed that medication error instruction involved the public. No other disciplines were listed as participating within the curricula of the schools of pharmacy. Also, of the 34 completed responses, 27 (79 percent) stated that a single faculty member was not responsible for medication error education at member schools.

The final component of this investigation asked respondents to state specific topics covered in each school’s medication error education program. The major topic headings included
subject matter, impact of technology, references, and error reporting.

In terms of subject matter, it was found that most schools of pharmacy included costs of errors (82 percent), impact of errors (82 percent), and frequency/incidence of errors (79 percent), nomenclature (65 percent), morbidity and mortality (62 percent), and legislation and education (56 percent). These results are shown in Table VII.

Inclusion of the “impact of technology” is addressed by Table VIII. The data indicates that a majority of respondents included the subject matter “impact of technology.”

The inclusion of reference organizations and societies within the curricula is shown in Table IX. Overall, the results of this were split between those schools of pharmacy that did and those that did not include these elements in their curricula. Of note, the majority of respondents (56 percent) did not include other reference organizations such as ISMP within the framework of the curricula.

Elements of error reporting are examined in Table X. A majority of respondents included the topics of non-punitive systems for error reporting (65 percent), error nomenclature (59 percent), and quality/process improvement (65 percent) within their curricula. However, the majority of respondents noted that they did not include comparative database analysis and benchmarking (65 percent) or the available systems and products for error reporting (65 percent).

**DISCUSSION**

This study was a descriptive study with the primary objective to assess the manner and extent to which the topic of medication error is included in the pharmacy curricula of schools of pharmacy. Through the use of a survey instrument sent to schools of pharmacy, it was felt that a comprehensive and accurate assessment of curricular inclusion of medication error and relevant topics was obtained.

The results of the present study indicate the need for a more standardized approach to medication error curricula within schools of pharmacy. The results of the survey indicate that there is much inconsistency and diversity in what, how, and when the topic of medication error is being taught within the curricula. Surprisingly, some schools of pharmacy did not include many of the core domains of medication error training within their curricula, such as human error and medical errors. This parallels observations of health care practitioner knowledge base(22). An even greater number of schools did not include the core domains of root cause analysis and failure mode and effects analysis within their curricula. In fact, the Joint Commission on the Accreditation of Health-Care Organizations is now requiring health-systems to perform a failure mode and effects analysis on new processes that are implemented within a health-system. Thus, this further underscores the importance to include this domain within a school of pharmacy curriculum.

Pharmacists have demonstrated their value in identification and prevention of adverse drug events. Leape, et al., evaluated the impact of pharmacist participation on rounds in an intensive care unit. The study demonstrated that preventable prescribing errors decreased by 66 percent from baseline. This resulted in a projected annualized savings of $270,000 in the group in which the pharmacist participated with the medical team on rounds vs. a control group of patients in which the pharmacist did not round but was available for questions(9). Likewise, Kaushal, et al. demonstrated that unit-based pharmacists working in an inpatient pediatric setting could have prevented 94 percent of potential adverse drug events (defined as errors that were identified and corrected before administration to the patient or those that did not cause harm)(35). In another study, Bond, et al. demonstrated that as staffing of clinical pharmacists increased from the 10th to 90th percentile, medication errors decreased by 286 percent(6). With an increased emphasis on clinical education within the Doctor of Pharmacy program, future pharmacists should be more prepared to accept these clinical responsibilities(23).

The impact of technology as related to medication error was included in the curricula of the majority of schools of pharmacy surveyed, although about one-third of respondents did not include the pertinent topics within their curricula. Based upon evolving literature as related to prevention of
adverse drug events, technology and its impact on medication error (both prevention and cause) should be universally taught at all schools of pharmacy(36-44).

Error reporting systems and organizational references concerning medication error were likewise not included in all curricula of the schools of pharmacy surveyed. Again, it is felt that that instruction in these areas is vital to pharmacists’ understanding of medication error. Further education of pharmacy students is needed in these areas.

Although more literature was found concerning medication error in medical school and medical residency programs, this study demonstrated that a multi-disciplinary approach is not currently being utilized in the curricular status of medication errors training within schools of pharmacy. This emphasizes the need to incorporate our medical and nursing colleagues based on the interplay and reliance on other disciplines within the framework of medication error.

Designing a medication error curriculum for a school of pharmacy must be undertaken ideally through a coordinated, structured, and planned approach. This may be best accomplished by one faculty member that takes a lead role in coordinating the medication error curriculum at the school of pharmacy, much as a medication safety coordinator would perform in the acute care health-system(45). Where and when these elements are taught within the curricula may not be as important, although a continual inclusion throughout the four professional years of pharmacy school may help to build and solidify what has been previously taught. The authors feel that the inclusion of medication error curricula in both a didactic setting and a more applied approach within the confines of a skills lab and experiential rotation would be the preferred method for curricular inclusion. Some schools of pharmacy are currently developing or have developed structured curricula on medication errors(46). An example curriculum for medication error education based upon the authors experiences and available literature is given in Appendix B(47).

LIMITATIONS
This study may be limited by a lack of understanding of certain terms used in the survey by the respondents. Definitions of the key domains were not provided with the survey. Whether this would have affected the results of the present study is unknown. However, it was assumed that a faculty member(s) responsible for teaching medication error curricula would be familiar with such terms. Likewise, key abbreviations (Institute for Safe Medication Practices-ISMP) were not given. Whether this would have affected the results of the present study is unknown. Again, it was assumed that a faculty member(s) responsible for teaching the medication error curricula would be familiar with such abbreviations. The response “not applicable” likewise was not consistent throughout the survey, which again may demonstrate problems in understanding the survey by the respondents. In addition, the survey may not have been completed by the most knowledgeable person at the school of pharmacy. The response rate of 48 percent is certainly acceptable for most studies, but it was hoped that a greater response rate would have been attained for this topic based on its immediacy and implications. Whether other methods of follow-up would have resulted in a greater response rate, such as a follow-up letter to the chair of Pharmacy Administration or Pharmacy Practice division, is unknown.

CONCLUSIONS
In conclusion, this descriptive study of the quality and quantity of medication error instruction in curricula of schools of pharmacy in the United States demonstrates lack of standardization and lack of inclusion of key domains within medication error instruction. The results of the present study call for a more standardized approach to medication error curricula within schools of pharmacy in United States. If pharmacists are to take a leadership role in the identification and prevention of medication errors, then schools of pharmacy need to offer a structured, formalized process of teaching medication errors and related topics. This study further identifies the need for future studies in this area to further characterize and document the curricular status on medication error training in schools of pharmacy and pharmacy residency programs. Outcomes data demonstrating that students are more prepared upon entering their experiential rotations and upon graduation are also needed.

Acknowledgement. The authors would like to acknowledge the significant contributions of Blenda Ann Chao, PharmD and Shiva V. Kumar, PharmD, who at the time of this study were Doctor of Pharmacy candidates at the Bernard J. Dunn School of Pharmacy, Shenandoah University.

References
(1) Institute of Medicine Division of Health Care Services Committee on Quality of Health Care in America, To Err Is Human: Building A Safer Health System, National Academy Press, Washington DC (1999).
(2) Institute of Medicine Division of Health Care Services Committee on Quality of Health Care in America, Crossing The Quality Chasm: A New Health System For The 21st Century, National Academy Press, Washington DC (2001).
(20) Schneider, P.J., “Pharmacists building a safer health system,” ibid., 58,


Carmenates, J. and Keith, M.R., “Impact of automation on pharmacist and pharmacy-based error—the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim—the accumulation of errors results in accidents 1.

Human Error—body of research that examines why people make errors and how to prevent them. Human Factors Research—The study of the interrelationships between humans, the tools they use, and the environment in which they live and act. Errors are a normal human occurrence. Errors may occur in the “automatic mode” (“slips” resulting from distractions or failure to pay attention at critical moments) or “problem-solving mode” (“mistakes” that are rule-based or knowledge-based). In human factors research, human error may be the nearest cause before an untoward event occurs, but causes are usually beyond the individual’s control (systems errors) 2,3.

Medical Error—broad term used to describe errors that occur in caring for a patient regardless of the setting—includes the subset of medication errors 4.

Medication Error—any preventable event that may cause or lead to inappropriate medication use or patient harm, while the medication is in the control of the health-care professional, patient, or consumer. Such events may be related to professional practice, health-care products, procedures, and systems including: prescribing; order communication; product labeling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use 5.

Quality Improvement or Process Improvement—monitoring of a process and incorporation of improvements based on the findings noted.

Root Cause Analysis—an analysis to determine the underlying reason(s) for an untoward event, focusing on systems and processes—involves asking “why” questions repeatedly until no additional relevant questions or answers are apparent 6.

Failure Mode and Effects Analysis—process of examining and identifying the potential risks in a product or system that would cause it to fail and the consequences thereof—can be applied to the design stage or as part of a post-hoc analysis 7.

1 Institute of Medicine Division of Health Care Services Committee on Quality of Health Care in America, To Err Is Human: Building A Safer Health System, National Academy Press, Washington DC (1999).


APPENDIX B. PROPOSED CURRICULUM FOR MEDICATION ERROR EDUCATION

Didactic Outline - Errors in Health Care
1. Human Factors (1st or 2nd year)
2. How does industry approach error? - aviation, nuclear (1st or 2nd year)
3. Errors in Health Care (1st or 2nd year)
   • current literature
   • types of error
   • obstacles to improvement
   • strategies for improvement

4. Terms and Definitions (2nd or 3rd year)
   • literature references
   • resources – American Society of Health-System Pharmacists (ASHP), Institute for Safe Medication Practices (ISMP), National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP), National Patient Safety Foundation (NPSF), etc.
   • terms and definitions – human factors vs. system error, adverse drug event, adverse drug reaction, medication error, side effect, sentinel event, root cause analysis, failure mode effects analysis, fault tree analysis, “high-alert” medication, non-punitive culture
   • categorization of medication errors by severity, type, etc.

5. Technology (2nd or 3rd year) - role as a cause and prevention of medication errors
   • information technology
   • robotics
   • bar-coding/scanning
   • automated dispensing

6. Risk Management & Quality Improvement Techniques (2nd or 3rd year)
   • Juran, Demming, 6-Sigma
   • Tools:
     • error reporting, data management skills
     • root cause analysis, fault tree, & failure mode and effects analysis
     • process flow mapping

7. Legislation, Regulatory, Education, and Professional Organization issues (3rd or 4th year)
   • legislation
   • regulatory: JCAHO, professional boards
   • professional organizations: ASHP, ISMP, NCCMERP, NPSF, United States Pharmacopeia (USP), etc.
   • education

8. Regulatory and Accreditation Requirements (3rd or 4th year)
   • Board of Pharmacy
   • Joint Commission on the Accreditation of Health Care Organizations (JCAHO)
   • Food and Drug Administration (FDA)

9. Use of above to: (3rd or 4th year)
   • identify and address error-related issues in a current patient’s therapy
   • identify and address error-related issues within complex medication systems.
   • formulary processes and impact on medication errors; drug recall or shortage policy and procedure
   • identify and address high risk areas (medications, patients, processes) and potential safety strategies

10. Error Reporting Mechanisms (3rd and 4th years)
    • culture and environment (non-punitive process)
    • nomenclature
    • quality/process improvement
    • comparative database analysis and benchmarking
    • available systems and products (USP-ISMP Medication Errors Reporting Program, MedMARx, JCAHO Sentinel Event Reporting)
    • systems in health-systems: patient safety team, risk management, pharmacy and therapeutics committee, quality improvement committee

Applied/Experiential Component (3rd and 4th years)
    • standardized patient assessment lab exercises
    • dispensing lab exercises
    • identification and write-up of medications errors from experiential rotations
    • communication strategies in informing a patient of a medication error
    • collaborative efforts with other health care professionals