

FINAL PROGRESS REPORT

Title of Project: Addressing Preventable Medication Use Variance in Mississippi

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Structured Abstract

Purpose: The University of Mississippi Medical Center proposed to establish a large-scale demonstration project to assess the effectiveness of Mississippi's methods of collecting and using information to reduce medical errors and their impact. Nine sites throughout Mississippi, all of which share the same system for reporting of medication errors and, for several academic and administrative functions, report to UMMC's Vice Chancellor for Health Affairs, participated in the project.

Scope: The goals of this project were threefold: (1) to identify the causes of preventable healthcare errors and patient injury in healthcare delivery; (2) to develop, demonstrate, and evaluate strategies for reducing errors and improving patient safety throughout Mississippi; and (3) to disseminate the results of our research and the strategies we have developed throughout the healthcare industry.

Methods: We improved the existing mechanism for data collection on incidents of medication use variance for nine ambulatory sites within Mississippi and broadened the types of data collected. A voluntary reporting component was added. Several modes for gathering data were used, including hard-copy incidence reports; web-based incidence reports; an existing patient hotline; interviews with patients and, if applicable, their caregivers; physicians and other healthcare providers; pharmacists; and independently sponsored surveys. The data collected were analyzed using traditional and data mining/machine learning technologies.

Results: Results of our research were disseminated to different audiences via seven refereed publications and 19 presentations at the state and national level. Specific projects were completed, including 1) website development; 2) a patient safety hotline; 3) Focus One focus groups; 4) a medication error reporting system; 5) a pharmacy survey; 6) an ambulatory clinic patient survey; and 7) the establishment of private industry partnerships (SoftMed and DecisionQ).

Key Words: medical errors; patient safety; medication use variance

Purpose

The goals of this project were threefold: (1) to identify the causes of preventable healthcare errors and patient injury in healthcare delivery; (2) to develop, demonstrate, and evaluate strategies for reducing errors and improving patient safety throughout Mississippi; and (3) to disseminate the results of our research and the strategies we have developed throughout the healthcare industry.

Four specific aims were identified in order to facilitate achievement of these goals:

- (1) fostering a confidential, nonpunitive environment for reporting the information to be collected in our proposed project;
- (2) identifying the root causes of medication use variance;
- (3) developing strategies to improve levels of patient safety, including improvements in administration systems, reporting mechanisms, and education programs for both healthcare providers and the consumers of healthcare services; and
- (4) disseminating the results of our research, increasing the awareness of healthcare providers and consumers of healthcare about their roles in improving patient safety, and implementing systematic changes to effect positive outcomes.

Scope

The University of Mississippi Medical Center (UMMC) proposed to establish a large-scale demonstration project to assess the effectiveness of Mississippi's methods of collecting and using information to reduce medical errors and their impact. In keeping with the mission of AHRQ to sponsor research that improves the safety of patients being cared for in a wide variety of medical settings, the purpose of the proposal was to effect changes in healthcare delivery procedures in order to reduce the risk of harm to patients in Mississippi.

Setting: We undertook a comprehensive evaluation of the existing reporting system in nine sites throughout Mississippi, all of which shared the same system for reporting of medication errors and, for several academic and administrative functions, reported to UMMC's Vice Chancellor for Health Affairs. These sites were (1) UMMC's University Hospital, (2) G.V. (Sonny) Montgomery Veteran Affairs Medical Center, (3) Wiser Hospital for Women and Infants, (4) Blair E. Batson Children's Hospital, (5) Jackson Medical Mall, (6) UMMC's University Internal Medicine Associates, LLP, (7) UMMC's Durant Clinic, (8) Durant Extended Care Facility; and, (9) UMMC's Hypertension Clinic.

In addition to evaluating our reporting system for medication errors in an ambulatory setting, we also collected information on adverse events, adverse outcomes, clinical responses to errors, dangerous situations, hazards, "near misses," no-harm events, preventable adverse events, positive sentinel events, sentinel events, and patient response.

Participants: The demographics of Mississippi's population, and specifically of those individuals who use the services of the nine sites included in our proposal, focused heavily on the priority areas and populations of AHRQ. Specifically, these included inner-city areas, rural areas, low-income groups, minority groups, women, children, and the elderly. Of the sites participating in this study, together with their satellite clinics, we included participants from throughout the state, including the inner-city setting of Jackson and the rural, poverty-stricken areas of the Mississippi Delta and Holmes County.

Methods

In keeping with AHRQ's goals, our study design included the following:

- (1) Data collection on incidents of medication use variance for several ambulatory sites within Mississippi. Already in place was an existing mechanism for collecting data on incident reports; with this project, we proposed to improve the existing mechanism and broaden the types of data collected.
- (2) An existing mechanism was based on mandatory reporting of medical errors. We proposed to collect data for this project through a voluntary reporting component; data gathered from voluntary sources were maintained on a confidential basis.
- (3) Information received that is required to be reported to the Food and Drug Administration was reported, using the legal framework now in place at the University of Mississippi Medical Center.
- (4) We proposed to use several measures for gathering data, including hard-copy incidence reports; web-based incidence reports; an existing patient hotline; interviews with patients and, if applicable, their caregivers; physicians and other healthcare providers; pharmacists; and independently sponsored surveys.
- (5) The data collected were analyzed using traditional and data mining/machine learning technologies.
- (6) Once data were collected, including the outcomes of education programs and seminars we developed to improve levels of patient safety, we proposed to disseminate the results of our research to several different audiences.

The goals of our project were threefold: (1) to identify the causes of preventable medication use variances and patient injury; (2) to develop, demonstrate, and evaluate strategies for reducing errors and improving patient safety throughout Mississippi; and (3) to disseminate the results of our research and the strategies we have developed throughout the healthcare industry.

Working closely with the AHRQ Steering Committee, composed of the principal investigator for each of these projects, the director of the Coordinating Center, and AHRQ program officials, we proposed a general 3-year timeline for completion of the project tasks:

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| Months 1 – 3: | Initial survey instrument development and testing; initial web page design and development, redesign, and standardization of incident and other reports; and hiring of certain personnel |
| Months 4 – 9: | Initial data collection effort to quantify and define magnitude of medication use variance problem; pilot and validate |

survey instruments; begin development of educational and CQI materials; and hire certain personnel

Months 10 – 36: Intervention activities, web page refinement, ongoing data collection and refinement of CQI efforts, CQI-blackboard development, delivery of education and training programs; dissemination of results through articles in refereed journals and presentations at professional conferences

Specific projects completed in keeping with the study methods:

1. Website development
2. Patient safety hotline
3. Focus One focus groups
4. Medication error reporting system
5. Pharmacy survey
6. Ambulatory clinic patient survey
7. Symposium
8. Partnerships with private industry (SoftMed and Decision Q)

Results

Results are presented through general discussion of each of the four specific aims, with additional narrative highlighting projects completed through the grant.

Within our first specific aim, fostering a confidential, nonpunitive environment for reporting the information to be collected in our project, activities included an aggressive education and marketing program that helped alleviate the stigma attached to reporting medication use variance. In addition, we encouraged ease with which to report medication use variance. Several formats were introduced, and the effectiveness of each format was assessed. These formats included web-based reporting systems, hard-copy reporting systems, and our project's hotline. Two additional activities helped us achieve our first aim: 1) modifying our existing incident report to be more conducive to the environment we are trying to promote and 2) sponsoring survey research initiatives conducted by professionals independent of our nine sites.

Our aim was to create an open, blame-free environment for addressing medication use variance. We used pre-existing mechanisms in order to establish a baseline, and then we expanded and enhanced these mechanisms based on our research, which was designed to preserve personnel confidentiality in a nonpunitive environment, to be universally applied in all clinical settings. We established a centralized data warehouse using SMS software for the participating systems within the study to provide baseline comparisons of CQI efforts.

Within our second specific aim, identifying the root causes of medication use variance, activities can be categorized into two general areas: gathering the data, and interpreting the data. Data-gathering techniques involved several sources and several constituencies. One of our activities was to implement use of an additional procedure for incident reporting. During the 3 years of our proposed project, the existing procedure and our modified procedure worked in tandem.

We redesigned a medication variance form for easy completion and standardized it across all sites. In designing the new forms, we incorporated recommendations as outlined by the National Coordination Council for Medication Error Reporting and Prevention. The new form redirected focus to the cause and potential solution(s) rather than focusing on blame for the reported variance. Instead of asking who is at fault, we asked where the variance happened, how it happened, and what we can do to prevent it from happening again. It also included a uniform severity scale to be used across all sites for medication use variance.

Data were collected from each of the sites using the historic reporting mechanism to allow for comparison between the two. After month 10 and for the duration of the study, the standardized form was used. For a period of 12 months (months 10 to 22), we used a paper form. Then, for months 23 to 36, we introduced an electronic version of the standardized incident report. By doing so, we were able to test the efficacy of the historical reporting method along with paper and electronic standardized medication use variance forms.

Throughout all sites, workstations contain computer terminals. Each of these workstation computers could be accessed by universal access and log-in codes that could be used by any hospital employee without specific identification of the user. During part of the study period, the standardized forms were electronic on the Intranet with mechanisms, such as universal access and log-in codes, built into the process to ensure confidentiality. The information provided was routed to a centralized data warehouse for analysis to identify procedures that led to a medication error and potential solutions.

Our third specific aim, developing strategies to improve levels of patient safety, including improvements in administration systems, reporting mechanisms, and education programs for both healthcare providers and the consumers of healthcare services, was met through a number of mechanisms, including website development and enhancement of the patient safety hotline, focus groups, and surveys. These items are addressed separately in the ensuing paragraphs.

Our fourth specific aim, disseminating the results of our research, increasing the awareness of healthcare providers and consumers of healthcare about their roles in improving patient safety, and implementing systematic changes to effect positive outcomes, was completed via publications in refereed journals and presentations at state- and national-level patient safety conferences. Again, the website, patient safety hotline, focus groups, and surveys offered participants additional portals for accessing information and updates pertaining to the project.

Another mechanism for dissemination of project information and educational activities was Blackboard 5™, a comprehensive e-learning system that allows educators to enhance their learning product using the internet. Specifically, Blackboard 5™ software gives users access to academic, personal, and social information through an institutional portal. Web pages are easily constructed with hyperlinks to databases, reports, presentations, calendars, and announcements. Interactive features, such as discussion boards and chat rooms, can be used to build information change within the system. Employees of the participating sites could access information from this system.

The following paragraphs provide additional details for activities and projects completed through the grant.

1) Website. In 2002, a webpage, medicinematters.org, was constructed to be used by the grant staff and by patients. Its content contained information on the primary care physicians along with medication information and links to other healthcare sites. Almost a full year was used to develop this webpage, with most of the delays resulting from administrative issues. Regrettably, the webpage was not utilized to its full potential.

2) Patient and Staff Reporting Hotlines. Toll-free phone lines were available for patients to call and report any suspected medication use variance. These phone lines were manned during two daily shifts (7AM-3PM/3PM-11PM), 7 days a week. UMMC personnel had access to informatics systems to provide education for patients on drug/drug interactions and drug/food interactions. Protocols detailed mechanisms of remedying the problem or event. Standardized incident reports were used in the other clinical sites to collect information from the medication use variance hotline. Patients were informed of the availability of the hotline as part of the educational process received as they exit the healthcare clinic. Also, the patient received an embossed, pocket-sized card with pertinent information, such as the toll-free number and hours and days of operation.

3) Focus groups. Two local agencies, Focus One and The Godwin Group, were employed to orchestrate the focus groups. Specifically, the grant sought to understand a) how patients use medications prescribed to them; b) what is a medication error; c) perceptions of a prescription; d) where one receives information about their prescription; and e) what should one do if an error occurs.

Participants were randomly selected and screened to ensure that they had personally seen a healthcare provider in the past 6 months (or have been with a family member). They must have received a prescription during that encounter. There were eight groups, with approximately 10 people per group; participants represented a mix of genders, ages, races/ethnicities, and income levels. Recruiting resulted in more women than men (70/40 mix). Groups were video and audio recorded.

Each focus group discussion had five main objectives: a) to understand people's impression of what qualifies a medication as a prescription, b) to understand people's knowledge of prescription medications, c) to understand people's perceptions about errors in prescriptions; d) to understand people's actions and expectations after a medication error; and e) to understand how people would react to future experiences with medication errors.

4) Medication error reporting system.

The medication reporting system was changed from a paper to a web-based system. Each computer in the UMMC system had an icon (Figure 1) that led to a web form with drop-down boxes (Figure 2).

Figure 1.

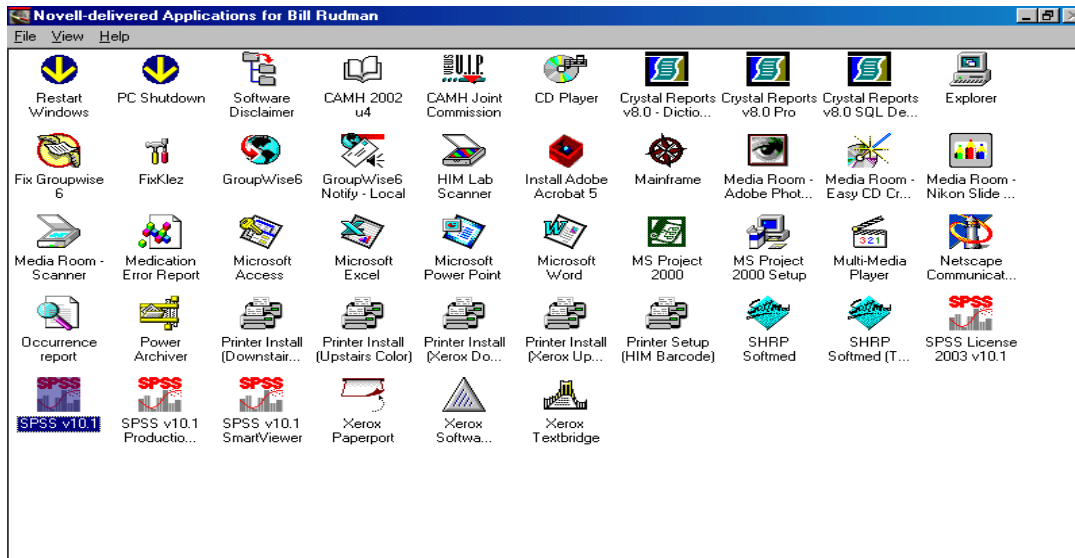


Figure 2.

A screenshot of a Microsoft Internet Explorer browser window displaying a "Medication Error Information Report" web form. The browser's address bar shows "http://riskmanagement.umc.edu/meds/". The form contains several fields and dropdown menus:

- 1. Billing number: [text input]
- Medical record number: [text input]
- 2. What is the patient's name?: [text input]
- Patient's Date of Birth (mm/dd/yyyy): [text input]
- Patient's gender: [text input]
- Patient's race: [text input]
- 3. Date and Time of error: [text input] at [Hour] : [Min] [AM/PM]
- 4. Location: Unit: [dropdown menu]
- Department: [dropdown menu]
- 5. Where in the process did the initial error: [dropdown menu]

Over the course of the grant we have had approximately a 600% increase in the number of medication errors reported (Table 1). Our goal was to introduce the reporting mechanism directly into the workflow and decrease the amount of time it took to report the medication error. Several physicians noted that it used to take more finding the paper report, than filling out the new report.

Table 1. Increase in Medication Errors Reported

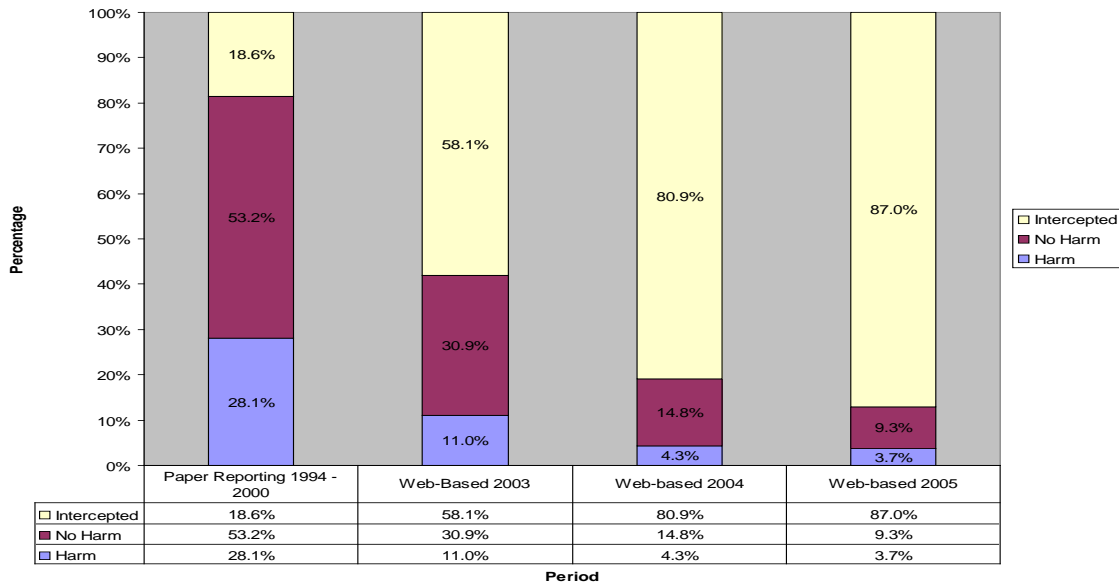
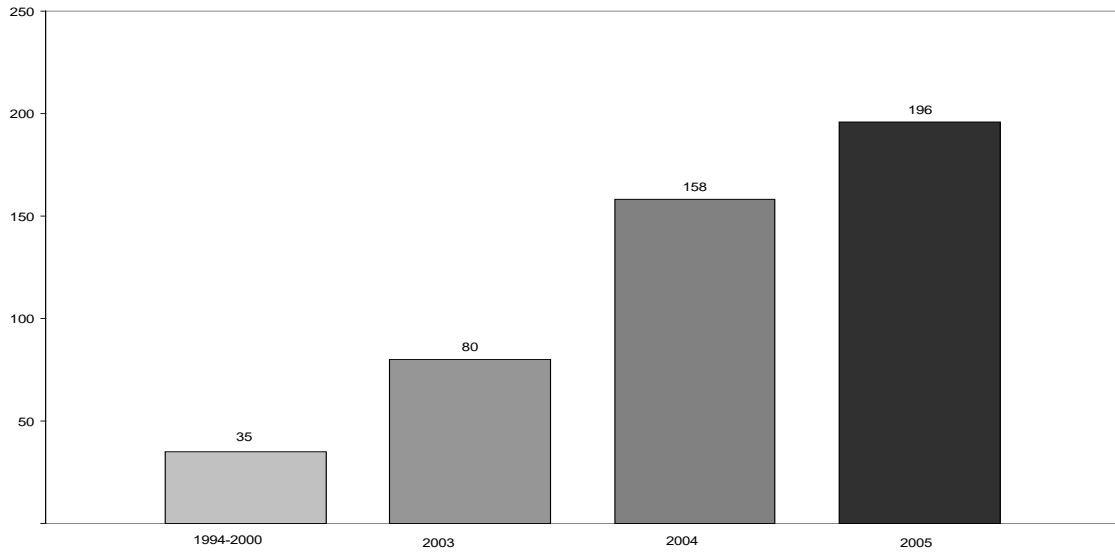


Table 2. Decrease in the Number and Percent of ADEs

In addition to increasing the number of medication errors reported, we significantly increased the number of intercepted errors and decreased the number and percent of ADEs (Table 2). The percent of intercepted errors increased from 18.6% to 87%; the percent of ADEs decreased from 28.1% to 3.7%. Furthermore, we decreased the number of ADEs from 13 per month to five per month. Given that the average ADE costs UMMC approximately \$4,000-\$4,400 per month, this worked out to a cost savings of over \$32,000.00 per month.

5) Pharmacy survey. Our objective was to identify procedure errors, such as illegible handwriting or wrong abbreviations; inappropriate strength, dosing, or number to be dispensed; concomitant prescribing of medications likely to interact; incomplete written prescriptions, such as failing to include directions; and leading and trailing zeros. In total, 594 pharmacists were selected from the state pharmacy registry. Of this number, 303 responded (51% response rate). A final analysis is still being conducted.

6) Ambulatory clinic patient survey. A random sample of patients stratified by age, sex, race/ethnicity, and site of care was surveyed by telephone within 72 hours of a clinical encounter. The questionnaire included questions regarding the individuals' medications, such as dosage, timing, and route of administration; individual understanding of ADEs; and understanding of mechanisms to report ADEs.

As part of the survey process, we queried patients regarding issues of noncompliance. A significant component of the follow-up questionnaire focused on filling of prescriptions, causes for nonfilling of prescriptions, and continued understanding of medication directions. In total, 710 surveys were completed, which represents a 48% response rate. Final analysis of this data is still being conducted.

7) Exit interviews. At the point of contact, a random sample of patients stratified by age, sex, race/ethnicity, and site of care received exit interviews. Patients were questioned on the medication/education process received at their point of contact with the healthcare delivery system with regard to medications, dosing, and the potential for adverse events. The exit interview questionnaire included questions relating to noncompliance, such as socioeconomic factors, understanding of medications, complexity of medication regimen, and financial considerations (e.g., cost, third-party payor, and income). In total, 710 surveys were completed, which represents a 48% response rate. Final analysis of this data is still being completed.

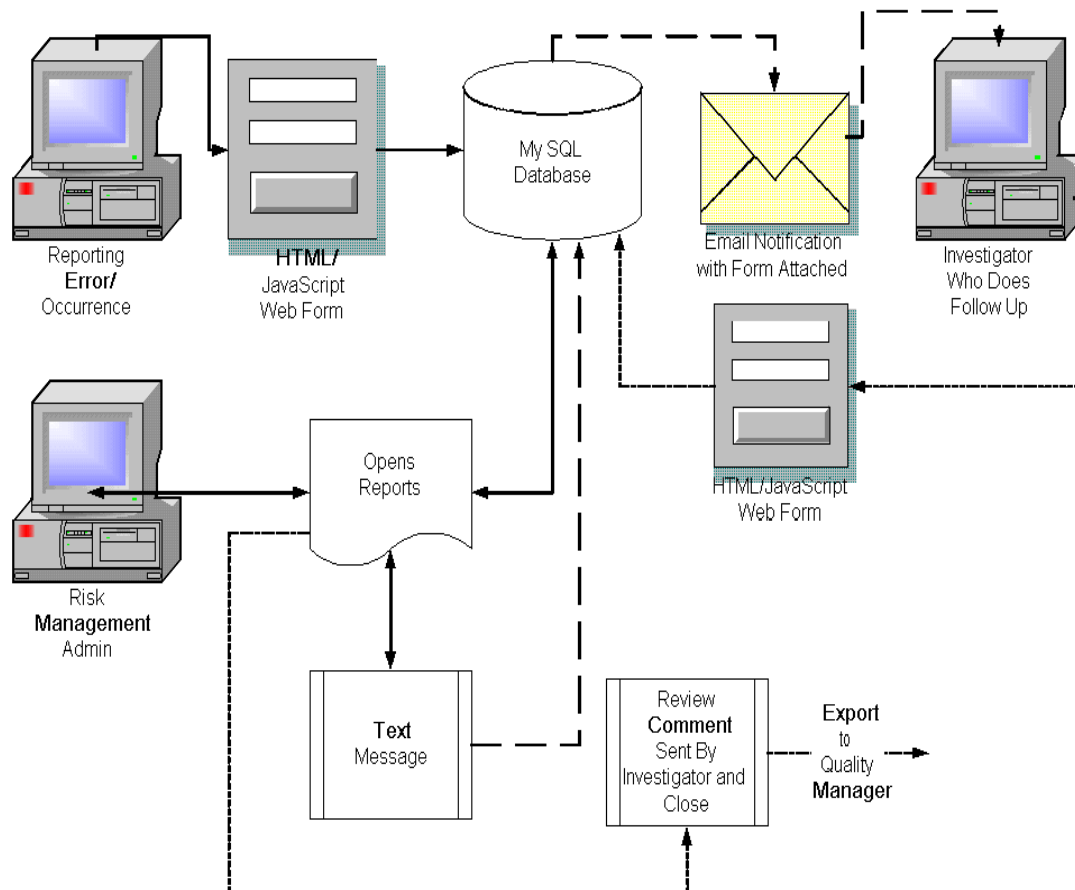
8) Symposium on patient safety in Mississippi. Educational seminars were hosted that focused on activities that lead to medication use variances. Project team members provided educational activities to healthcare providers on each floor of the UMMC hospital. As part of our methodology, these seminars included "real" examples of poorly written or inappropriately completed prescriptions and "real" examples of errors that occurred because of variances in prescription format. All levels and disciplines in the healthcare delivery team were encouraged to participate in the seminars.

The statewide symposium was planned for mid-September 2006. Partnering with Institute for Quality Healthcare, a coalition for patient safety was developed; members included participants from the University Medical School, IQH, MS Hospital Association, and State Nursing Association. Its primary purpose, at least

initially, was to support and assist in the development of the symposium. Regrettably, this date was only 2 weeks after Hurricane Katrina wiped out the Mississippi Gulf Coast. Heavy damage was sustained well inland. We felt the date was too close to such a natural disaster; thus, the event was canceled.

9) Partnership with Private Industry (SoftMed and Decision Q). An integral part of the success of this project was our partnership with industry. In addition to using products, we worked closely with both SoftMed and Decision Q in product enhancement. First, with SoftMed, we worked closely with both designers and product managers in their Quality Manager program. Through this collaboration, we added flexibility to the design and added an automated e-mail notification of the medication error (Figure 3).

Figure 3.



This new design became the basis of their Risk Manager software and was extended to collection of all occurrence reports. In addition to the above, using Visual Basic, we added automated e-mail medication error report functionality and a way for different providers to access their raw data. Second, with Decision Q, we have worked on improving the system's user interface and report mechanism. The Decision Q software is a Bayesian modeling program used for QA purposes and to model intervention initiatives.

List of Publications and Products

Refereed Publications:

Brown, C.A., Bailey, J., Garrett, P., and Rudman, W.J. (2006) "The pharmacist-physician relationship in the detection of ambulatory medication errors." The American Journal of the Medical Sciences. (January); 331(1): 22-24.

Brown, C.A., Bailey, J., Miller-Davis, M., Garrett, P., and Rudman, W.J. (2005) "Improving Patient Safety Through Information Technology." Perspective in Health Information Management. (Fall) 2;5:1-12

Rudman, W.J., Brown, C.A., Bailey, J., Hope, C. (2005) "The impact of a Web-based Reporting System on Variations in Medication Error Occurrence Reports: Comparing Web-based Occurrence Reports to Paper Occurrence Reports." Advances in Patient Safety: From Research to Implementation Vol. 3:195-205.

Bailey, J., and Rudman, W.J. (2004) "The Expanding Role of the Health Information Management Professional: Where Research and the Health Information Management Role Intersect." Perspective in Health Information Management (Sept.) 20:1,7

Cohn, F., and Rudman, W.J. (2004) "Integrating Ethics Education into the Clinical Setting." Academic Exchange Quarterly (Fall) 8,3.

Rudman, W.J., Brown, C.A., Hewitt, C., Carpenter, W., Campbell, B., Tubbs, T., Noble, S.L. (2002) "The Use of Data Mining Tools in the Identification of Medication Error Near Misses and Adverse Drug Events." Topics in Health Information Management 23:2:94-101.

Brown, C.A., Rudman, W.J., Hughes, G., Rogers, H., Smith, M. (2002) "Addressing Ambulatory Care Errors in Mississippi." Topics In Health Information Management 23:2:47-58

Journal Editor:

Rudman, W.J., Brown, C.A., Hughes, G. (2002) Issue Editor Topics in Health Information Management. (November) Lippincott Press. Vol. 23:#2 Aspen: Lippincott Williams & Wilkins

Reyes, C., Rudman, W.J., and Hewitt, C. (2002) Issue Editor Women & Health. Domestic Violence and Healthcare: Policies and Prevention Vol. 35 #2. Hayworth Medical Press

Paper Presentations:

Hart-Hester, S., Brown, C.A., Rudman, W.J., Fairley, K., Miller Davis, M. "The Impact of Using a Web-based Reporting System on Medication Error Reporting." AHRQ Annual Patient Safety Meeting, May 2006

Miller Davis, M., Brown, C.A., Rudman, W.J., Fairley, K., Hart-Hester, S. "Blunt End/ Sharp End." Perceptions of Patient Safety Culture: A Practical Approach to Developing Performance Improvement. AHRQ Annual Patient Safety Meeting, May 2006

Rudman, W. "Research Project in Mississippi." MSHIMA Annual Meeting, Jackson, MS, August 2005

Rudman, W., Bailey, J., Brown, C.A. "AHRQ update on UMMC initiatives for improving medication management in ambulatory and rural health care settings." AHRQ, Washington, DC, Gaps in Knowledge Symposium, May 2005

Hope, C., and Rudman W.J. "A Comparison of Neural Network and Decision Tree Models in Detecting Adverse Drug Events in a Medical Error Database." MedInfo 2004, San Francisco, CA, Sept 2004

Rudman, W.J. and Brown, C.A. "The Use of Web-based Occurrence Reports in Documenting Medication Errors: Part 1." Medical Record Institutes, 20th Annual Conference, Fort Lauderdale, FL, May 2004

Rudman, W.J. and Brown, C.A. "The Use of Web-based Occurrence Reports in Documenting Medication Errors: Part 2." Medical Record Institutes, 20th Annual Conference, Fort Lauderdale, FL, May 2004

Rudman, W.J. and Brown, C.A. "Evaluating a Web-based System of Medication Error Reporting of Occurrence Reports: Beyond the Numbers." Keynote Address: SoftMed User Summit, San Francisco, CA, March 2004

Rudman, W.J., Tubb, T., Rogers, H., Hart-Hester, S., Hewitt, C., Noble, S. "Evaluating the System of Medication Errors in an Inpatient Setting: Project Results of Studying Variables in Medication Use Collected Through an Automated System of

Medication Error Reporting. "American Society of Health System Pharmacists 38th Mid-Year Meeting, New Orleans, LA, December 2003

Tubb, T., Rogers, H., Rudman, W.J., Hart, Hester, S., Noble, S. "Evaluating the System of Medication Error in an In-Patient Setting." American Society of Health System Pharmacists 38th Mid-Year Meeting, New Orleans, LA, December 2003

Rudman, W.J., and Smith M. "Data Warehousing Technologies to Understand Medication Error Processes." AHIMA National Convention, Minneapolis, MN, October 2003

Rudman, W.J., and Smith M. "Use of Data Warehousing Technologies to Understand Medication Error Processes." Annual AAMI Conference, Long Beach, CA, June 2003

Rudman, W.J. and Brown, C.A. "ClinTrac Quality Manager and Data Mining Expedite Resolutions." Keynote Address: SoftMed User Summit, Chicago, IL, May 2003

Rudman, W.J. and Brown, C.A. "ClinTrac Quality Manager and Data Mining Expedite Resolutions." Keynote Address: SoftMed User Summit, Ft. Lauderdale, FL, March 2003

Rudman, W.J., and Smith M. "Use of Data Warehousing Technologies to Understand Medication Error Processes." Annual HIMSS Conference, San Diego, CA, February 2003

Rudman, W.J., Brown, C.A., Smith, M. "Using data warehouse to get a "Key Grip" on Medication Variance." Siemens Users Summit National Meeting, Las Vegas, NV, July 2002

Peden, A, Campbell, B., Rudman, W.J., Hewitt, C. "The use of data mining techniques in assessing medication errors." Mississippi Health Information Management Annual Meeting, Jackson, MS, June 2002

Rudman, W.J. "Understanding medication variance in Mississippi." 134th Annual Mississippi Medical Association Meeting, Biloxi, MS, 2002

Rudman, W.J., Hewitt, C., Carpenter, W. and Watkins D. "Use of data mining techniques in analyzing medication error data." American Health Information Management Association Meeting, Assembly on Education, Nashville, TN, June 2001