Categorization, Frequency, and Cost Impact of Medication Errors

Final Report

December 16, 2003
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Executive Summary

Medication errors are a problem in health care facilities worldwide, and occur at the University of Michigan Hospital at the rate of 30 to 40 errors per week. In addition to degrading the quality of patient care the Hospital is able to offer, medication errors are a significant source of financial loss. Prior studies have been conducted that have examined the rate at which errors are reported, the correlation between the severity of the error and its cost, as well as the thoroughness of several methodologies for finding and reporting errors.

The goals of this project were to find:

- Annual cost of medication errors to the University of Michigan Hospital
- Annual cost of each category in the NCC MERP Index for Categorizing Medication errors
- Average cost of an incident from each category in the NCC MERP Index for Categorizing Medication errors

This study found the total cost on a case-by-case basis for 809 medication errors that occurred in the University of Michigan Hospital between March 1 and September 21, 2003. Each incident was categorized according to the NCC MERP Index, and using the incident report submitted by clinical nurses and full chart reviews when necessary, the cost of specific procedures and staff time needed to remedy the situation was identified for each case. A Microsoft Excel Database “CostTracker.xls” was created to organize the large amounts of data, and aid in generating summary statistics and graphs.

All NCC MERP Categories had similar amounts of staff time necessary in order to document and resolve the incident. We defined these to be “standard charges” and included time for the clinical nurse to observe and respond to the error, the time for a physician to give new orders, administrative consultation time, and time for nurse managers to document the error and counsel involved staff members. This “standard charge” of $36.19 was applied as a base amount for incidents in every category (category A is the only exception, as it does not include physician time for a total cost of $34.01). Standard charges were the total cost of every medication error incident in categories A, B, and C. Some incidents (25%) within category D only required standard charges, and thus category D was broken into two new categories, “D1” (only standard charges) and “D2” (requires additional procedures and or staff time to resolve incident).

For NCC MERP Categories A through E sufficient sample sizes were observed during our time period to make recommendations for the expected cost of each type of incident. These findings are organized below.
<table>
<thead>
<tr>
<th>NCC MERP Category</th>
<th>Expected Incident Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$34.01</td>
</tr>
<tr>
<td>B</td>
<td>$36.19</td>
</tr>
<tr>
<td>C</td>
<td>$36.19</td>
</tr>
<tr>
<td>D1</td>
<td>$36.19</td>
</tr>
<tr>
<td>D2</td>
<td>Between Median = $84.99 and 95th percentile trimmed mean = $108.55</td>
</tr>
<tr>
<td>E</td>
<td>Between Median = $81.54 and 95th percentile trimmed mean = $139.58</td>
</tr>
</tbody>
</table>

In the time period of this study only 8 incidents of NCC MERP Category F were observed. With a range of over $150,000, standard deviation of $50,098 and mean of $7,995 our team recommends that more F category cases be evaluated before an average or expected cost is determined.

The projected annual cost is given below for each NCC MERP Category, along with the projected annual total cost:

<table>
<thead>
<tr>
<th>NCC MERP Category</th>
<th>Projected Annual Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$181</td>
</tr>
<tr>
<td>B</td>
<td>$5,026</td>
</tr>
<tr>
<td>C</td>
<td>$33,058</td>
</tr>
<tr>
<td>D1</td>
<td>$2,062</td>
</tr>
<tr>
<td>D2</td>
<td>$26,172</td>
</tr>
<tr>
<td>E</td>
<td>$73,238</td>
</tr>
<tr>
<td>F</td>
<td>$367,359</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$507,098</strong></td>
</tr>
</tbody>
</table>

These numbers assume the same distribution and variance of NCC MERP Category occurrences that we observed in our 205-day study period over an entire year. With the absence of any G, H, or I Category incidents however, we question whether our distribution of samples was representative of the underlying true distribution for an entire year. Taking into account the findings of a study conducted at two hospitals in the Netherlands during 2002, (the majority of costs come from a few severe cases) and our own observation of increasing cost per incident by category severity, it is reasonable to expect the true annual cost of medication errors (given several more severe medication error incidents) could exceed $2.5 million.
Introduction

Background
The University of Michigan Hospital System (UMHS) Department of Pharmacy along with Risk Management realizes that medication errors occur in the hospital. Reducing the number of medication errors is a goal of the entire hospital. Gathering and analyzing data regarding these incidents will expedite implementing a new or improved system that reduces or eliminates errors. Although a regimented process exists for ordering, transferring, dispensing and administering the 84,600 weekly doses of medication to patients, medication errors are reported in the hospital at a rate of 30 to 40 errors per week. Multiple checkpoints exist in the process to prevent errors from reaching patients, and errors are often corrected before reaching the patient. Other times an error seems to find the right hole past each phase to reach a patient. A spectrum of possible results may occur, ranging from no patient harm being done, to the extreme cases of necessitating life sustaining intervention, and even contributing to or resulting in death.

Pharmacy Services along with Risk Management have been collecting data on incidents of medication errors in an Access database since January 2000, although the data has been historically collected in paper format. These data include a description of the error and the additional procedures needed to monitor and correct the effects of the error. Our project considered data from this database from March 1, 2003 to September 21, 2003.

Although reducing the number of medication errors is a priority goal of UMHS, the cost of medication errors must first be determined to justify expenditure for a new process and system of dispensing medication.

Therefore, the purpose of this project was to determine the frequency of occurrence in the UMHS for as many categories of the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) Index for Categorizing Medication Errors (see Appendix II) as the time length of the project would permit and to find the associated cost to UMHS. Our goal was to determine the objective costs for each category of medication errors (additional lab work and procedures, room costs, etc.) along with the associated subjective costs (administrative work, required return visits, legal settlements etc.) We hope our findings will be complete enough to justify a specific cost for corrective measures, and help improve the level of patient care at the UMHS.

The purpose of this final report is to present all findings that our team has collected, researched and analyzed throughout the semester. This report presents our findings and recommendations for future changes within the UMHS.
**Literature Search Findings**

Medication errors that occur everyday can range from getting an extra dose of Ibuprofen to receiving a power of 100 over dose, resulting in permanent damage to internal organs. These medication errors may occur due to patient allergies, misread prescriptions, misdiagnoses and many other causes. Unfortunately, the consequences of these errors can have dire effects.

The results of a medication error not only affect the patient, but also have severe consequences for the hospital involved. One study found that about “two out of every 100 admissions experienced a preventable adverse drug event, resulting in average increased hospital costs of $4,700 per admission,” (Kohn, 1999. 2). Medical errors carry a high financial cost. The Institute of Medicine (IOM) report estimates that medical errors cost the nation approximately $37.6 billion each year; about $17 billion of those costs are associated with preventable errors. About half of the expenditures for preventable medical errors are for direct health care costs (Agency for Healthcare Research and Quality). With such severe financial penalties, there is strong motivation to reduce the frequency of all medication errors.

A recent study at Harvard University focused on preventing and solving medical errors. The study evaluated how systems could be improved, rather than blaming people who make mistakes. One root issue is that many medical errors are not reported, as people fear the consequences. A goal of Harvard’s study is to promote safety and create “an environment where people feel safe reporting errors, where incidents are investigated to determine roots causes… to ensure changes are made,” (Humphries, 2003).

Medication errors negatively affect all hospitals across America, but they are a global issue as well. In two Dutch hospitals (TweeSteden Hospital and St. Elisabeth Hospital, Tilburg, Netherlands) all medication orders were analyzed that dealt with prescribing errors. After dividing the errors into groups based on their severity, a cost benefit analysis was completed. One hospital had an alarming rate of 9.9% of orders containing errors. The costs associated with these errors were top heavy, and 80% of costs were associated with four major cases. A final cost benefit analysis found that the benefits of preventing medication errors outweigh the time investment (van den Bemt et al. 2002).

While there has been research on medication errors internationally and within the United States, there is still a need to solve these problems. To find a solution, it is necessary to quantify how much and where finances are being allocated resulting from medication errors. The research done internationally and within the United States seems to be useful, but most beneficial to those completing the study. Individual hospitals will benefit most by completing studies within their own doors, as type, cost, and results of medication error vary from institution to institution. This project has been taken on for the UMHS to quantify the cost more specifically by type of error outcome, rather than relying on one overall average.
Current Situation

The current status of the environment and process surrounding the problem is as follows. Medication errors are reported to the hospital by nurses and physicians through both paper reports and electronically via a reporting form on the UMHS intranet. Every time a medication error occurs, the primary nurse caring for the patient files an Incident Report to document the event. Completion of this form is non punitive, yet findings from our literature search suggest that not every medication error within the UMHS is documented (Humphries, 2003).

After medication errors are documented, they are discussed during weekly meetings between members of Risk Management, the department of Pharmacy and the Office of Clinical Affairs to look over the medication errors that occurred within the previous week. From these meetings, NCC MERP category assignments and appropriate severity levels are discussed for each error that occurred during the previous week. After the severity level has been confirmed for each medication error, the error data is updated in the Medication Error Database for the hospital.

Methodology

To obtain the average cost and projected annual cost for each NCC MERP category, our team created an Excel database “CostTracker.xls” to handle all costs that applied to medication errors in the time period March 1, 2003 through September 21, 2003. For our project we examined Risk Management’s Medication Error Database that lists medication error instances including descriptions of the medications and procedures required for each patient in an incident report. John Mitchell, Susan Anderson, and Elaine Commiskey reviewed the incident reports from the period of study to determine what specific procedures and medications were necessary to correct effects of the medication error.

To determine the associated costs for tests and procedures that were due to medication errors, our team researched within the UMHS by calling department labs related to specific tests, querying online charge listings, and searching patient bills. Specific procedure costs were entered into our excel database “CostTracker.xls” for each case. In addition to direct costs such as tests and procedures, we needed to find indirect costs for each case. This required finding appropriate salary figures for nurses, physicians, and administrators, including 30% for benefits. Each error requires time for a nurse to report the error to a physician and to submit an electronic form with details of the incident. Weekly meetings are also held in which Risk Management, Pharmacy, and Office of
Clinical Affairs staff review the medication error cases. Additionally, there are Adverse Event medical reviews by administration for the more serious cases.

To determine the amount of time required for a clinical nurse to submit an error report online, our team performed a time study in which we simulated 20 samples of filing an electronic report for a medication error incident. We took this time and multiplied it by a weighted average of clinical nurse salaries to affix a cost that applies to each medication error event. Fifteen minutes of time for a clinical nurse manager was added to each case to assess the cause of the error, counsel staff, and ensure corrective measures are being followed.

The cost of weekly meetings held by Risk Management in order to discuss recent medication errors was determined by collecting Risk Management staff salaries and allocating 2 minutes per case. Using salaries of other administrators from the Office of Clinical Affairs, Quality Improvement, Department of Pharmacy and other hospital staff the cost of 39 hours was found for each case requiring an Adverse Medical Event Review.

For each case in our period of study, staff and procedure costs were recorded and summed in our Excel database “CostTracker.xls”. By looking at the cost for each case and its respective NCC MERP category assignment, we were able to derive average and total costs for each category. By observing category costs and frequencies we projected a total annual cost to the University Hospital.

**Findings and Conclusions**

**Preface to Conclusions**

This project resulted in the determination of average and total costs for the NCC MERP categories A, B, C, D, E, and F to the University of Michigan Hospital System (UMHS), as well as a projected annual cost to the hospital as a whole. These findings were based upon the analysis of medication error incident data collected in the Medication Error Database from March 1, 2003 to September 21, 2003 by the department of Risk Management. No conclusions could be drawn about categories G, H, or I, as there were no such incidents within the time frame of this study. Additionally, the projected annual cost does not factor in the cost of any G, H, or I occurrences. This leads us to believe that our period of study yielded final costs much lower then could be expected in a time frame with high severity cases (van den Bemt et al. 2002).

Prior to the main data collection period and analysis of this project, a concern arose that the majority of our findings might come under close administrative scrutiny. Our client John Mitchell decided that our assumptions regarding the identification of procedures due to medication errors and estimates of charges having ranges of values should be conservative to avoid concern as to the validity of the results. Thus, although our findings provide an excellent and sound minimum assessment of cost, all reported category costs could be expected in actuality, to be higher than we have reported.
To assess the “cost” of medication errors to the hospital, our team recognized the importance of using a consistent gauge to measure the “cost” of additional procedures and staff time required in response to errors. In dealing with the financial aspect of the problem, it was recognized that the bare cost to the hospital of performing any procedure “X” differed from what the patient was billed for procedure “X”. For the reasons that it was extremely difficult to find the bare cost to the hospital of performing a specific procedure, and that “costs” to the hospital did not capture the many indirect costs of performing procedures, we used the amount that patients are charged for a procedure when tallying the total cost of care required for that patient due to a medication error.

The exception to the above rule was in assigning costs for the staff time involved in carrying out patient care. The cost to the hospital may easily be identified by employee salary or wage rate. Additionally the cost of employee benefits was rolled into the cost for any staff time in the amount of 30% of their salary.

**Administrative Factors**
For every medication error that occurred, our team identified “standard charges” that are attributed to the minimum required nursing, physician, and administrative efforts to resolve and document the incident. Included in standard charges are:

- 24.3 minutes of nursing time
- 15 minutes of nurse manager time
- 5 minutes of physician time
- 8 minutes of administrative time (Department of Risk Management)

Whenever a medication error occurs, the nurse who discovers the error must page the resident physician for orders on how to remedy the situation. A prior study conducted by the Department of Program and Operation Analysis found that every time a nurse paged a physician, they spent an average of 17 minutes locating a computer to page the physician, waiting for the page to be returned, and carrying out the initial orders of the physician. It was also found in this study that nurses only used this time productively 36% of the time. It was estimated that the nurses spoke with the physician for 5 minutes in the instance of a medication error. Additionally, nurses must also complete an online form or paper form documenting the circumstances of a medication error incident. Our team conducted a time study (see Appendix III) to find the average time required to complete this form, which was found to be 7.3 minutes. Nurse Managers spend 15 minutes reviewing the circumstances of the case and counsel the involved individuals about standard safety procedures, and other issues regarding the specific incident. Four administrators from the Department of Risk Management, Department of Pharmacy and the Office of Clinical
Affairs hold a weekly 1-hour meeting to review the 30 to 40 medication errors from the previous week. Assuming only 30 errors occur each week, each incident receives at minimum 2 minutes of discussion by 4 administrators.

“Standard Charges” were applied for every medication error (excluding NCC MERP category “A” incidents), at a cost of $36.19 to the Hospital per incident. The most severe medication errors in terms of patient harm require Adverse Medical Event Reviews (AMERs) to properly identify and address the circumstances, causes, effects, and implications of the event. AMERs require 39 hours of staff time distributed as follows:

Three 1-hour meetings involving: 2 physicians (1 HO II level, 1 OCA officer), 2 pharmacists, 4 Clinician III Nurses, 1 Risk Management Administrator, 1 Quality Improvement officer.

One 1-hour meeting involving: 1 OCA officer, 1 Risk Management Administrator, 1 Quality Improvement officer.

An additional 6 hours of Risk Management administrative time.

The administrative staff cost of a medication error AMER was calculated to be $2,122 dollars. Seven incidents required an AMER in the time frame of our study.
NCC MERP Category Findings

Frequency of Occurrence

The 809 medication error incidents we reviewed were distributed amongst the NCC MERP Categories as shown in Figure 1 below.

![Histogram showing distribution of medication error incidents](image)

Figure 1: Distribution of Medication Error Incidents

The histogram shows a somewhat skewed right distribution of incidents amongst the various NCC MERP Categories. As could be expected most medication errors result in no harm to the patient (A, B, C) or merely increased monitoring (D1, D2), while the cases in which some degree of harm was done to the patient decreases in frequency as severity increases.
Category Averages
In addition to “standard charges”, each medication error event had associated procedure charges, and a few required AMERs. Generally as the severity of the error classification increased, so too did the number and cost of the required additional procedures. For each NCC MERP Category A through F, the average cost per category is given below in Figure 2.

The average cost of NCC MERP Categories B, C, and D1 are all $36.19 because only standard charges apply (Category A excludes 5 minutes physician time). The average cost per incident rises after category D1. These results are explained in detail in the following sections.
NCC MERP Category A
“Circumstances or events that have the capacity to cause error”

Every category "A" incident we reviewed had a cost to the hospital of $34.01 that was attributed solely to standard charges without the cost of 5 minutes physician time. The percentage of total “A” incidents is most probably so low because category “A” may be thought of as complaints regarding procedures or conditions that have been brought to the attention of physicians and administrators.

NCC MERP Category B
“An error occurred but did not reach the patient”

Every category “B” incident we reviewed had a cost to the hospital of $36.19 that was attributed solely to standard charges. For this category it is impossible to have additional procedure charges for the patient, as the error never reaches the patient and thus does not have an opportunity to cause harm.

NCC MERP Category C
“An error occurred that reached the patient but did not cause patient harm”

Every category “C” incident we reviewed had a cost to the hospital of $36.19 that was attributed solely to standard charges. Because category “C” incidents cause no patient harm, no additional procedures can be required. Category “C” had the highest number of occurrences.

NCC MERP Category D
“An error occurred that reached the patient and required monitoring to confirm that it resulted in no harm to the patient and/or required intervention to preclude harm”

A significant number of “D” category incidents (roughly 25%) we evaluated only involved “standard charges,” which our team felt would dwarf the significance of category “D” incidents that had additional procedures associated with them. Our team therefore decided to split category “D” into two sub categories, “D1” and “D2” in order to distinguish between “D’s” that only involved standard charges and “D” incidents that necessitated additional monitoring.
As in categories B and C, the D1 category incidents only involved standard charges, and thus the cost of each D1 incident was $36.19. The ninety-five D2 category incidents though had an average cost of $155 dollars, with the cost per incident distributed as shown below in Figure 3:

![Incident Cost Distribution, Category D2](image)

Figure 3: Cost Distribution of the D2 Category. n = 95

The D2 Category had an average cost of $155 (standard deviation of $255), but a median of $85 dollars. Because the data set is skewed right, outliers give undue leverage on the average, creating a higher average value then should be expected for the majority of D2’s. Over time and many samples, one could expect the average cost of a D2 incident to fall in the range of the median $85 and 95th percentile trimmed mean of $108.
NCC MERP Category E

“An error occurred that may have contributed to or resulted in temporary harm to the patient and required intervention”

Category E is the first to deal with errors that cause at least temporary harm to the patient, for which an increase in staff time and procedures are necessary to bring the patient back to health. This explains the marked increase in average cost per incident up to $514 dollars, with the costs per incident distributed as shown below in Figure 4.

![Incident Cost Distribution, Category E](image)

Figure 4: Cost Distribution of the E Category. n = 80

The “E” Category has an average cost of $514 dollars per incident, but a median of $81.54 dollars. Because the data set is skewed right, outliers give undue leverage on the average, creating a higher average value then should be expected for the majority of E’s. The outlier of $17,772 especially has excessive influence on the mean, and is not typically expected. The expected cost of an “E” category incident is expected to fall within the range of the median of $81.54 and 95th percentile trimmed mean of $140.
The sample size of 80 incidents for category E is large enough to give a very good estimate to the actual behavior of the distribution, although further sampling to 300 incidents may be desirable to more fully determine the influence and frequency of outliers, which may reveal a bimodal distribution, which would alter our analysis of this category.

NCC MERP Category F
“An error occurred that may have contributed to or resulted in temporary harm to the patient and required initial or prolonged hospitalization”

For category “F” there is an increase in the average cost per incident, reaching $25,791 dollars. One of the largest costs in hospitals is room charges, and errors that result in patients needing to stay additional days will dramatically impact the costs.

The distribution of costs per incident for category “F” is shown in the table below.

<table>
<thead>
<tr>
<th>Incident Total</th>
<th>Average</th>
<th>Median</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$36.19</td>
<td>25790</td>
<td>7995</td>
<td>50098</td>
</tr>
<tr>
<td>70.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>180.19</td>
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<td>4041.17</td>
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<td></td>
<td></td>
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<td>11948.93</td>
<td></td>
<td></td>
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<td>12540.17</td>
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<td>30361.19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>147147.17</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One may readily observe that the costs per incident vary from one case to the next. With only eight samples for this category, it is recommended that additional samples be taken to further understand the distribution of charges, and what the expected cost to the hospital would be. The current average of $25,790 dollars is significantly larger then the median of $7,995 dollars, although neither number would be considered completely accurate given the small sample size of eight and high level of variation.
Summing all of the costs due to medication errors per category, we arrive at the total cost over the period of study to the hospital per NCC MERP Category. This allocation is shown in Figure 5 below.

Figure 5: Total Cost Per NCC MERP Category

Summing the category totals, we arrive at a total cost of $284,808 dollars due to medication errors for the time period March 1, 2003 to September 21, 2003 (205 days). Assuming our observed distribution of errors and of services for each NCC MERP category over an entire year, we may project an annual cost to the hospital due to medication errors by extrapolating the calculated cost of medication errors over an entire year of 365 days, giving a predicted annual cost of $507,098 dollars.
One must keep in mind that these are the observed patterns for a 205-day period, during which no G, H, or I NCC MERP Category events were observed. All reports are “floating numbers”, meaning that from one year to the next, dramatic increases or decreases in cost may be observed, if an unusually high or low number of outlier events occur in that time period. With a total projected annual cost of less then half a million dollars, the significance of 809 medication error incidents could be dwarfed by a multi-million dollar settlement for the occurrence of one I Category event. Assuming 80% of total medication error costs occur in the highest severity categories (van den Bemt et al. 2002) the total cost in a given year could exceed $2.5 million. Therefore it is understood that the financial analysis from quarter to quarter, or year to year is not necessarily an indicator for improvement or decline in the prevention of medication errors if unlike sample bases are observed.

Further Observations
Comparing the two Figures for average cost per category and frequency per category, it is interesting to note that the most costly category “F” had the fewest number of occurrences (excluding “A”) and that the most prolific category “C” was only the 3rd most costly. This raises the question which categories are the most important to address? Patient care and safety is obviously the primary concern of the hospital, yet, saving money in order to provide a higher level of care for all patients is also a major concern.

Separating the data obtained from incidents that occurred in Mott’s Children Hospital from the main Hospital yields an interesting observation. For incidents requiring additional monitoring or intervention (Categories D and higher) the cost of Pediatric cases is significantly higher then for Adults.

Table 2. Comparison of Pediatric and Adult Category Averages

<table>
<thead>
<tr>
<th>NCC MERP Category</th>
<th>Pediatric Average</th>
<th>Adult Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>D2</td>
<td>$270.03</td>
<td>$111.28</td>
</tr>
<tr>
<td>E</td>
<td>$1033.60</td>
<td>$234.48</td>
</tr>
<tr>
<td>F</td>
<td>$54,576</td>
<td>$8,519</td>
</tr>
</tbody>
</table>

Although the cost of medication errors can be tabulated and determined with our database, it must be remembered that we can only base this cost on reported errors that occurred within the University of Michigan Hospital between March 1, 2003 and September 21, 2003. The number of incidents during our period of study could have been under-reported (van den Bemt et al. 2002); therefore our cost benefit analysis could still not be completely accurate, and the true cost to the hospital could be much higher than anticipated.
The hospital already implements a non-punitive reporting policy, but it is possible that the entire staff is not fully aware of this policy. We recommend that this policy be repeated to the entire staff to ensure full knowledge of the non-punitive reporting policy and increase the probability of errors being reported. Although this may lead to an increase in reported incidents, it does not improve conditions to reduce the occurrence of errors.

The error reporting form that nurses complete should also be improved, as currently numerous fields can be left blank, causing confusion to those who read and review these reports, as well as an insufficient picture of what occurred. We recommend that fields on the form be made mandatory to fill out. This may lead to increased time for error reporting, but could save more time down the line if it means a more accurate error report. Elaine Commiskey is currently working on a new form that may include these recommendations.

In this project, we have found the cost of errors, but the cause and location of these errors is unknown. There is a long path from the pharmacy to the patient; therefore it is difficult to know exactly where an error occurred. There are also many factors that may play into the cause of each medication error, which also makes the cause of each medication error difficult to find. We recommend that along with our cost benefit analysis for medication errors, the cause and location of each error be researched. This will allow a full-scale analysis of medication errors within the University of Michigan Hospital, and would hopefully reduce the number of errors that occur.
Appendices

I. Bibliography

Agency for Healthcare Research and Quality (AHRQ)
http://www.ahrq.gov/qual/errback.htm
http://www.ahrq.gov/qual/errorsix.htm (Main Index)


Harvard Medical International “Tackling Medical Error”

Institute of Medicine (IOM), To Err Is Human: Building a Safer Health System (2000)
http://books.nap.edu/books/0309068371/html/index.html

Journal American Medical Association
Medication Errors and Adverse Drug Events in Pediatric Inpatients
http://jama.ama-assn.org/cgi/content/short/285/16/2114


The LeapFrog Group “Computer Physician Order Entry”


II. NCC MERP Index for Categorizing Medication Errors
III. Incident Report Data Entry Analysis

To calculate a standard rate for data entry of Medication Error Incident Reports, a study was completed based on 15 incident reports between 10/10/03 and 10/14/03 by Chris Lawless, Howard Chang, Matt Newcomb and Will Uhl.

<table>
<thead>
<tr>
<th>Member</th>
<th>Time to Complete Report (min)</th>
<th>Type Rate (wpm)</th>
<th>Focus</th>
<th>Time to Open Form (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chris</td>
<td>5.1000</td>
<td>60</td>
<td>100%</td>
<td>0.091</td>
</tr>
<tr>
<td>Howard</td>
<td>5.1165</td>
<td>55</td>
<td>115%</td>
<td>0.091</td>
</tr>
<tr>
<td>Matt</td>
<td>4.9994</td>
<td>50</td>
<td>125%</td>
<td>0.091</td>
</tr>
<tr>
<td>Will</td>
<td>6.6171</td>
<td>35</td>
<td>95%</td>
<td>0.091</td>
</tr>
<tr>
<td>Average</td>
<td>5.4583</td>
<td>50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This was calculated using the following equation:

\[
\text{Standard Time} = \text{Time to Complete Report} \times \left( \frac{\text{Typing Rate}}{\text{Nat'l Avg Typing Rate}} \right) \times \text{Focus} + (\text{Constant}) \times \text{Time to Open Form}
\]

Focus was a subjective measurement gauging the amount of focus and effort put forth when completing the reports.

Using the average time to complete a report with adjustments made for typing rate and individual focus, a standard time was calculated of 7 minutes 16 seconds.

The table below shows the normalized standard times for each team member. These numbers are based on the time it took each member to complete the reports and the amount of focus/effort each member displayed.

<table>
<thead>
<tr>
<th>Member</th>
<th>Standard Times (min)</th>
<th>Samples Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chris</td>
<td>7.3767</td>
<td>4</td>
</tr>
<tr>
<td>Howard</td>
<td>7.7962</td>
<td>7</td>
</tr>
<tr>
<td>Matt</td>
<td>7.5306</td>
<td>6</td>
</tr>
<tr>
<td>Will</td>
<td>5.3295</td>
<td>3</td>
</tr>
</tbody>
</table>

Using the data above, we calculated a weighted average to reflect the number of samples completed by each member.

\[
\text{Weighted average} = 7.3767 \times (4/20) + 7.7962 \times (7/20) + 7.5306 \times (6/20) + 5.3295 \times (3/20) = 7.2626 \text{ minutes}
\]

Assuming every nurse is focused 100% when entering the data and with a national average typing rate of 42 words per minute (wpm), the standard time is 7 minutes 16 seconds.

*Nation average wpm of 42, [www.src.co.uk/about/articles/corpoffice.html](http://www.src.co.uk/about/articles/corpoffice.html) - October 2003