Evaluation of near miss medication errors

Susan M. S. Williams

Medical University of Ohio

Follow this and additional works at: http://utdr.utoledo.edu/graduate-projects
Evaluation of Near Miss Medication Errors

Submitted by

Susan Williams

In partial fulfillment of the requirements for the degree of
Master of Science in Nursing

Date of Presentation:

November 18, 2005

Major Advisor
Debra Buchman, Ph.D., R.N.

Academic Advisory Committee
Sue Idczak, Ph.D., R.N.

Dean, College of Nursing
Jeri A. Milstead, Ph.D., R.N., FAAN

Dean, College of Graduate Studies
Keith K. Schlender, Ph.D.
Susan Williams

Medical University of Ohio

Evaluation of Near Miss Medication Errors

December, 2005
Statement of the Problem

Medication errors are preventable events that can lead to possible patient harm. According to the Institute of Medicine (1999), there is a great deal of research focusing on medication errors and the serious risk it presents for hospitalized patients. Not all medication errors result in actual patient harm, but they can be very costly for hospitals. Breakdowns within any stage of the system can lead to medication errors and are seldom the result of one person’s action. According to the Institute of Medicine (1999), approximately 98,000 deaths that occur in hospitals each year are the result of preventable events. The Institute of Medicine (1999, p. 101) states, “most errors result in less or no harm, but may represent early warning signs of a system failure with the potential to cause serious harm or death”. Every reported near-miss medication error is an opportunity to learn and correct system failures as well as providing an opportunity to learn from potential errors before harm reaches the patient (Mutter, 2003; Jones, Cochran, Hicks and Mueller, 2004). Many nonhealth care industries, such as the aviation industry, have advanced reporting systems involving near miss events and use the information to uncover system weaknesses and processes (Santell, Hicks, McMeekin & Cousins, 2003).

Statement of Purpose

The purpose of this project is to evaluate a group of “near-miss” medication errors reported at an academic health center to determine the types of errors and possible patterns involved in these types of medication errors. Determining the types of errors
commonly involved in the near-miss category may reveal any patterns or common characteristics of near-miss medication errors.

Theoretical Framework

James Reason (1992) has developed a framework of human error theory that can be used in understanding and explaining errors. Reason (1992) has divided this complex system into two categories: active failures and latent failures. Active failures are those errors associated with “front-line” operators of a complex system, also referred to as sharp-end personnel (Reason, 1997). These are the errors that are most frequently found immediately after the error occurred. Active failures are often the result of unsafe acts committed by people in direct contact with the system. Latent errors are referred to as those most likely to be caused by those not directly involved and include things such as poor design, poorly structured systems, and bad management decisions (IOM, 1999). These latent errors are referred to as the blunt end. Latent errors may lie dormant for long periods of time and are more difficult to detect and predict. According to Reason (1997), latent conditions can increase the likelihood of active failures and can aggravate the consequences of unsafe acts.

Reason (1997) uses a “Swiss cheese” trajectory model to represent these active and latent failures. In an ideal world, all defensive layers would be intact and not allow the penetration of possible accident trajectories to pass through. However, in real world instances these defensive layers each contain their own weaknesses and gaps and are likened to the holes of Swiss cheese. These “holes” are dynamic in nature and represent active and latent failures. Most often, these holes will not line up simultaneously and will
block error commission. However, when these holes line up an accident trajectory has been created and represents several simultaneous system failures.

Reprimanding individuals is often used in responding to active failures, but is not useful in dealing with latent failures (Brown, 2001; Gladstone, 1995). According to the Institute of Medicine (1999), blaming individuals does not make the system safer, as single events are most often due to a convergence of multiple contributing factors. Allowing latent failures to remain in the system may make the system more susceptible to failure. Health care provider’s response to medication errors has been known to be so inadequate that it actually perpetuated errors rather than decreased errors (Pape, 2001). Blaming individuals rather than processes is the norm in the current culture of health care, when in fact errors are more commonly the result of inadequate processes or systems of care (Washington State Department of Health, 2000). Determining the deficits in systems and not focusing on individual performance will offer better insight into the medication process and the errors associated with it. Focusing on circumstances of the error versus the individual who made the error is more helpful in identifying patterns associated with medication errors. Most often errors are looked at based on their consequences, rather than looking at underlying problems. The current culture in health care is one that expects perfectibility and uses many quick fixes rather than redesigning the system to account for human fallibility.

Research questions

What proportion of medication errors reported during a three month period at a mid-western academic health center were near-miss medication events? What are the
most common types of error involved in near-miss medication events? Are there any patterns involved in near-miss medication errors compared to errors that resulted in an error that reached a patient?

**Assumptions**

This study is based on the assumption that the medication system is a complex and open system. One component of the system can interact with multiple other components of the system in ways that are unexpected or intangible (Institute of Medicine, 1999). Another assumption is that medication errors at this academic health center are not unique and are similar to those that occur in other hospital settings and the details of the reported events were documented accurately.

It must also be assumed that not every medication error and near miss medication error that occurs is reported, as several studies have found that the true extent of medication errors that actually occur are underreported (Antonow, Smith & Silver, 2000; Wakefield, Wakefield, Borders, et al. 1999 and Stratton, Blegen, Pepper & Vaughn, 2004). Antonow et al. (2000) found that only errors that actually reach the patient are likely to be reported and the exclusive use of incident report data may be incomplete data when looking at medication errors. In the study by Wakefield et al. (1999), nurses from 29 Iowa hospitals were surveyed. The survey contained 3 general content areas: nurse’s perceptions of the reasons medication errors occur, their perceptions of the reasons medication errors are not reported, and their estimates of the percentage of medication errors actually reported. According to the data it was suggested that only about 60% of medication administration errors are actually being reported (Wakefield et al., 1999).
The understanding of what constitutes a medication error is vital to the reporting of errors. Several studies have described nurses’ perceptions as to what qualifies as a medication error (Osborne, 1999; Walters, 1992; Gladstone, 1995). In a study by Walters (1992), a questionnaire contained examples of medication errors. According to hospital policy and procedure, all instances on the questionnaire were considered medication errors and required an incident report to be completed. Of the 238 respondents, only 13% indicated that they would complete an incident report for all the examples listed. Similarly, other studies by Gladstone (1995) and Osborne (1999) indicated that not all nurses were inclined to report medication errors. Lack of knowledge of what constitutes a medication error and fear of managerial reactions are common reasons for underreporting errors (Gladstone, 1995). In a study by Schmidt & Bottoni (2003), it was found only half (n=29) of respondents would report a “near miss” error and 57% stated they would report an error made by a colleague (actual or potential error). In order to understand factors associated with medication errors it is essential that errors be reported.

**Review of the literature**

*Types and frequency of medication errors*

In a prospective cohort study by Bates et al. (1995) 247 adverse drug events were found in two hospitals including all adult nonobstetric patients. Of these events, 28% (n=70) were found to be preventable. Out of 194 potential drug errors, 57% (n=111) were intercepted prior to reaching the patient. Among preventable and potential events (n=264), the primary error occurred in the ordering stage in 49% (n=128) of the cases; 11% (n=30) occurred in the transcription stage; 14% (n=38) in the dispensing stage; and
26% (n=68) occurred in the administration stage. Interception of the error was much more likely to occur early in the medication process, as 48% (n=62) of errors were intercepted in the ordering phase, 23% (n=7) in the transcription phase, 37% (n=14) in dispensing, and none of administration errors were intercepted. Wrong dose was the most common type of ordering error, followed by wrong choice, known allergy, wrong frequency, and drug-drug interaction (Bates et al., 1995). A study investigating all reported errors from a national database (Medmarx) was conducted by the US Pharmacopeia (Santell, et al., 2003) in which omission errors were found to be the most common type of medication error, followed by wrong dose. This report was a compilation of data collected over a three year, in which 403 health care facilities reported 154,816 medication errors. The US Pharmacopeia study (Santell et al. 2003) found initial errors to occur in the administration phase (37%) most frequently. These errors submitted to Medmarx represented less than 10% of all US hospitals and may have included hospitals that only report errors that result in patient harm. This may account for the differences seen between the USP study and Bates et al. (1995).

*Use of technology in medication errors*

In a study by Bates et al. (1998), a computer order entry system in a large tertiary care center decreased medication errors 55% in a before-after comparison between baseline and after implementation of computerized physician order entry (CPOE). The decline in this study was found in all stages of the medication process with 19% decrease in the ordering stage, 84% reduction in the transcription stage, 68% decreased in the dispensing stage and 59% in the administration stage. There was even a larger decrease
in near miss errors, as 84% of potential errors were reduced from 5.99 to 0.98 per 1000 patient days (Bates et al, 1998). The use of other technology such as bar code medication administration has been studied as well. Bar coding can ensure the correct medication is given to the correct patient and records when the medication was given, ensuring the correct time as well. Coyle and Heinen (2005) reported a 66% reduction in medication errors over a 5 year period after implementing a bar code medication administration system.

Methods

Patient Population

This study was a secondary analysis using a database of all medication errors reported in a three month period at a small mid-western academic health center. The database included a coded event date, type of error, outcome category, and a brief narrative description of the event. Each event was evaluated to determine if the reported outcome category was consistent with the description of the event. Changes were made to the outcome classification based on the description of the medication error.

Classification of event outcome

Severity of medication errors can be categorized into nine patient outcome categories according to the National Coordinating Council for Medication Error Reporting and Prevention (1998). Categorization of medication errors by outcome, according to the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) (1998), are described as:

Category A: Circumstances or events that have the capacity to cause error.
Category B: An error occurred but the error did not reach the patient.

Category C: An error occurred that did reach the patient but did not cause patient harm.

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.

Category E: An error occurred that may have contributed to or resulted in temporary harm to the patient and required intervention.

Category F: An error occurred that may have contributed to or resulted in temporary harm to the patient and required initial or prolonged hospitalization.

Category G: An error occurred that may have contributed to or resulted in permanent patient harm.

Category H: An error that occurred that required intervention necessary to sustain life.

Category I: An error occurred that may have contributed to or resulted in the patients’ death.

Near-miss medication errors or potential errors, according to this study, are defined as category A and B using the NCC MERP classification system. It is defined as an occurrence that could have resulted in an adverse event but did not by chance, skillful management, or timely intervention (Dunn, 2003).
Medication error is described by Dunn (2003), as any unplanned event that deviates from the intended course of prescribing, transcribing, dispensing or administering medications.

Classification of stages of medication incidents

The prescribing stage of the medication process is where a therapeutic intervention or medication is ordered either verbally or in writing by a health care provider, usually a physician or health care provider with prescriptive authority. The transcribing stage of the medication process is where the medication order is taken from the initial order sheet, and entered into the pharmacy system, and verified by nursing. The dispensing stage of the medication process is where the medication is distributed to the patient care area from the pharmacy. The administration phase is the last and final stage of the medication process where the health care provider, usually a nurse, gives the medication to the patient.

Results

During the three month study period there were a total of 440 medication errors evaluated. Out of all the medication errors, 63% (n=277) were near-miss errors, or intercepted before reaching the patient (Category A and B), and 37% (n=163) were actual errors that reached the patient (Category C-F). There were no Category G, H, or I errors reported during this period. A comparison of the types of medication errors between the total sample, the near miss errors and all other errors are presented in table 1.
Table 1 Comparison of types of errors between total errors, near miss errors and all other errors

<table>
<thead>
<tr>
<th>Type of error</th>
<th>Near Miss (A-B) N=277</th>
<th>All other (C-F) N=163</th>
<th>Total (A-F) N=440</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Prescribing</td>
<td>208 (75)</td>
<td>11 (7)</td>
<td>219 (50)</td>
</tr>
<tr>
<td>Transcribing</td>
<td>49 (18)</td>
<td>15 (9)</td>
<td>64 (15)</td>
</tr>
<tr>
<td>Dispensing</td>
<td>7 (3)</td>
<td>7 (4)</td>
<td>14 (3)</td>
</tr>
<tr>
<td>Administering</td>
<td>6 (3)</td>
<td>101 (62)</td>
<td>107 (24)</td>
</tr>
<tr>
<td>Multiple stages</td>
<td>7 (3)</td>
<td>29 (18)</td>
<td>36 (8)</td>
</tr>
</tbody>
</table>

Of all combined medication errors, 50% (n=219) were prescribing errors, 15% (n=64) were transcribing errors, 3% (n=14) were dispensing errors and 24% (n=107) were administration errors. Eight percent (n=36) of errors involved multiple stages of the process, in which two or more phases were attributed to the error. Evaluating all other errors compared to near miss errors revealed a large difference in prescribing errors and administration errors. Only 7% (n=11) of prescribing errors alone resulted in an actual error, whereas 75% (n=208) of prescribing errors were near miss errors. Whereas administration errors accounted for only 3% (n=6) of near miss errors and 62% (n=101) of the errors that reached the patient.

Types of prescribing errors

The results of types of prescribing errors are listed in Figure 1.
Evaluation of all prescribing errors found 35% (n=78) were due to incorrect dosage or frequency, 17% (n=37) were due to unclear order (no route specified or more information was needed), followed by known allergy, wrong choice, dangerous abbreviation or trailing zero, wrong patient, illegible, drug interaction or multiple factors involved. There were no apparent differences in the type of prescribing errors for near miss errors and all errors. There were only 11 prescribing errors involved in all other medication errors in which the error actually reached the patient.

Types of transcription errors

The results of transcription errors were evaluated and are listed in Figure 2.
Evaluation of transcription errors found 46% (n=37) were attributed to no addressograph or unreadable addressograph. The addressograph is used for patient identification and includes information such as patient name and room number. Nineteen percent (n=15) of transcription errors were due to incorrect transcription of the original medication order to the medication administration record. Other types of transcription errors were no weight documented; order was not flagged or signaled that a new order was written; missing chart or order sheet; and fax machine not working.

Discussion

The objective of this study was to examine near miss medication errors in relation to other medication errors. The findings in this study resemble those found in Bates et al. (1995), in which the prescribing stage of the medication process was the most common occurrence for preventable or near miss medication events. The medication system is a
large set of interacting systems that involve several different disciplines (physicians, pharmacists, nurses, and clerical staff). Ordering errors appear to be most likely to result in near miss errors. This is probably due to the fact that once an order is written it is reviewed by several disciplines, such as nursing and pharmacy. Ordering medications could be considered at the blunt end of the medication system, whereas administration of medications is at the sharp end. Using Reason’s theory of human error there appears to be less layers or defenses between the administration of a medication and an error occurring. Therefore adding layers of defenses will likely decrease the probability of an accident trajectory.

CPOE has gained much attention over the past several years in dealing with prescribing errors. The results of this study support the use of CPOE and a bar coding system. Of the prescribing errors identified in this study, 9 of the 11 categories identified could be prevented with CPOE. CPOE allows the professional to prescribe orders directly into a computer and can address issues such as allergies, possible side effects and monitoring. It also addresses all aspects of ordering medications such as frequency, route and dosage and the order is legible. CPOE prevents ambiguity in the ordering of medications. CPOE also provides valuable information and support in ordering medications, which may prevent such errors such as wrong choice as this function allows the prescriber direct access to information on medications. Transcription errors would also be addressed with CPOE, as there is less chance for error in transcribing the medication from the initial order to the MAR. There is no need to rewrite the medication order with the use of CPOE, thus less opportunity for error to occur. The majority of
types of transcribing errors found in this study could be resolved with CPOE. For example, the number one type of transcribing error in this study was unreadable or no addressograph, with CPOE the system would identify the patient when the health care professional entered the medication. It would also alert the prescriber when allergies or doses dependent on weight are an issue.

Despite the benefits of CPOE and BCMA there are currently only a very small percentage of institutions that have launched such systems (Doolan & Bates, 2002). Lack of mandates by the health care industry has been recognized as a reason CPOE has not been utilized despite its benefits (Bates, 2000). Information technology has the ability to interface with other systems, such as laboratory values, allergies and patient’s weight and can alert the prescriber to the risks associated with specific patient kidney and liver functioning. These electronic systems not only provide immediate assistance to the user, but also provide robust reporting mechanisms as well as track near miss errors.

According to Doolan and Bates (2002) only 17% of 633 responding hospitals had only partial availability to CPOE. Since it appears that several institutions are not using CPOE there are actions that can be taken in making the prescribing and transcribing of medications safer. It is the utilization of adding layers of defenses that can reduce the likelihood of an accident trajectory occurring. Targeting certain interventions can be used as a bridge for those institutions that do not have CPOE. Utilizing safeguards and adding barriers in the system can benefit those institutions that do not yet have CPOE. Also understanding what risks are associated at each step of the process can uncover latent errors and reduce the “holes” in each layer of defense. The following Figure 3
provides a typical example of how the flow of prescribing and transcribing of medications takes place. The squares represent an example of the typical flow of prescribing and transcribing medications with each circle representing an added layer of defense or “slice of cheese” according to Reason’s Swiss cheese model. Each added layer of defense provides more protection to the system and less chance of an accident trajectory from forming.
Figure 3. Sample flowchart for medication order prescription and transcription with examples of added layers of defense

1. Healthcare professional writes medication order on order sheet or verbal order given to other provider
   - Verbal orders are repeated back to the professional giving the order
2. Order flagged for notification that new order has been written
   - Appropriate systems for flagging new medication orders and prompt review
3. Order reviewed by nursing and hand written onto MAR
   - Resources available for nursing to review appropriateness of drug, dosage and monitoring
4. Order sent to pharmacy
   - Appropriate system for timely transfer of information to pharmacy
5. Order reviewed by pharmacy
   - Resources available for pharmacy to review appropriateness of drug, dosage, monitoring
6. Order entered into electronic system by pharmacy and entered onto MAR
   - Computer system able to red flags for incorrect dosages, monitoring
7. Daily review of new MAR and original orders by nursing
   - Pharmacist’s daily review of MAR, original orders, monitoring lab values
Implications

CPOE is not a panacea for all medication errors, although it has been proven to effectively decrease the amount of prescribing and transcribing errors. With the introduction of any new process comes with it the risk of creating new types of errors. Whether dealing with CPOE or not human factors must be considered with medication events. Bridging the gaps between human factors and technology must start prior to the implementation of new technology.

Establishing a “reporting culture” where the right kind of data is gathered, will build a system in which errors can be thoughtfully examined. The information gathered should be analyzed by the people that use it. Reason (1997) refers to this type of system as an informed culture, which is one that is managed and operated by those who have knowledge in the human, technical, organizational and environmental factors that make up the system. In order for errors to be understood, the information related to each and every error should be examined by those who were involved with the error. Having causal data will provide valuable information in uncovering system weaknesses. However, the only way to know how and when errors are occurring is in the reporting of errors and near miss errors. The success of the data gathered will depend on how willing the practitioners are to reporting the incidents of medication events and near misses. However, errors are most often not reported due to shame, guilt, fear of retaliation and extra time and effort spent compiling incident reports. Also, often in hospitals the reporting of medication errors and near miss errors lack specific information that enables root-cause analysis (Stump, 2000). When those in close contact with the system, such as
the health care providers on the sharp end are involved with error investigation, the more likely latent conditions will become more visible and better to manage. Situational contributors can be examined, rather than personal factors.

Near miss error reporting offers a unique opportunity to investigate why errors occur rather than simply reporting the error and finding a quick fix to the problem. Reason (1997) relates to this as “firefighting” the last error rather than anticipating and preventing the next one. Near miss errors are not necessarily costly from a patient perspective, but are costly in the aspect of time wasted. Near miss errors are more frequent, as seen in this study and several other studies, yet they continue to plague the system. They are a continual reminder of how vulnerable the medication system is to human error. Building in systems that take into consideration human fallibility, such as computerized physician order entry and bar code medication administration, will hopefully construct a safer health system. The data revealed in this study indicates that there needs to be a systematic review of all medication events and near miss events. Many near miss events in this study were found to be similar in nature to other studies. Establishing multi-disciplinary teams to evaluate errors and near miss errors can assist in providing ongoing feedback in order to improve the medication system. Providing ongoing feedback to staff will expectantly keep staff involved and facilitate staff members to continue to provide contributions and identify problems. Identifying weaknesses in the system is the first step in strengthening them. A reporting culture must first be established in order for health care providers to be comfortable in moving the profession forward by becoming involved in the reporting system. In order to function
safely, an organization needs to understand the risks so that it can minimize them by building in defenses and safeguards. These risks can only be identified if there is a commitment to an open culture of reporting throughout the organization. Removing blame and shame will create a relaxed atmosphere for professionals to look at not only active failures, but can broaden the scope to include latent conditions that may involve multiple levels of the system. The process must include all disciplines involved with the medication system and include specific details to the events that lead up to the error and circumstances surrounding the error or near miss error.

Limitations

Several caveats apply to the review of the data presented in this study. First, the data was descriptive in nature and not collected for the purpose of this study, as this was a secondary analysis. Second, the data was voluntarily self-reported and it was not systematically collected to exclusively examine near miss errors. Third, the study included one tertiary care center, thus the results may not be generalizable to other health care settings.

Future research

The first suggestion for future research would be to define clear and standard definitions to what constitutes a medication error and near miss medication error. Terms such as adverse drug event may differ from medication event, in that adverse drug events are unforeseeable. For instance, an adverse drug event may occur after a patient takes an antibiotic for the first time and has an allergic reaction, whereas a medication event is the patient receiving an antibiotic in which there was a known allergy to the antibiotic.
Secondly, little research has focused specifically on near miss errors and near miss error reporting systems. Finding what professionals perceive to be a near miss error and how likely they are to report it will provide further information on near miss errors. Understanding the barriers to reporting near miss errors will uncover some of the stigmas associated with reporting near miss errors. Future research should determine how health care providers perceive near miss errors and circumstances that prevent them from reporting near miss errors. Effective prevention of errors requires knowledge of how and why errors occur.
Abstract

Evaluation of Near Miss Medication Errors

Susan Williams, BSN, RN, MSN/FNP student at the Medical University of Ohio

According to the Institute of Medicine (1999), approximately 98,000 deaths that occur annually in hospitals are the result of preventable events and most errors result in less or no harm. Every reported near-miss error is opportunity to learn and correct system failures before harm reaches the patient (Mutter, 2003; Jones, Cochran, Hicks and Mueller, 2004). The purposes of this study were to determine what proportion of medication errors reported over a three month period in a midwestern teaching hospital were classified as “near miss” and to evaluate all of the “near miss” errors to determine the most common types and characteristics. Near miss were all errors in Category A (capacity to cause error) or B (error occurred but did not reach the patient). Each error was also typed as an error in prescribing, transcribing, dispensing or administering. A total of 440 medication errors were evaluated and 63% (n=277) were near miss errors. Near miss errors most frequently occurred during prescribing (75%, n=208), whereas all other errors most frequently occurred during administration (62%, n=101). Evaluation of near miss prescribing errors revealed that the most frequent error was incorrect dose/frequency (35%, n=78) and unclear orders (17%, n=37).
References


Institute of Medicine (1999). *To err is human: Building a safer health system.*


