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Association of medication errors with drug classifications, clinical units, and consequence of errors: Are they related?

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ABSTRACT

Registered nurses (RNs) play an important role in safe medication administration and patient safety. This study examined a total of 1276 medication error (ME) incident reports made by RNs in hospital inpatient settings in the southwestern region of the United States. The most common drug class associated with MEs was cardiovascular drugs (24.7%). Among this class, anticoagulants had the most errors (11.3%). The antimicrobials was the second most common drug class associated with errors (19.1%) and vancomycin was the most common antimicrobial that caused errors in this category (6.1%). MEs occurred more frequently in the medical-surgical and intensive care units than any other hospital units. Ten percent of MEs reached the patients with harm and 11% reached the patients with increased monitoring. Understanding the contributing factors related to MEs, addressing and eliminating risk of errors across hospital units, and providing education and resources for nurses may help reduce MEs.

1. Background

Medication errors (MEs) are one of the major causes of preventable errors among inpatients, leading to at least 1.5 million preventable adverse drug events (ADEs) each year in the United States (Institute of Medicine [IOM], 2006). Errors in the medication-use process can harm patients significantly and can even result in death. It has been reported that as many as 98,000 deaths are caused by MEs each year in the United States (Kohn, Corrigan, & Donaldson, 2000). Although safe medication management has received considerable attention from healthcare researchers and organizations in the past two decades, MEs remain a major patient safety issue in nursing care. The economic impact of MEs is also substantial to patient, hospital management, and the overall cost of the healthcare system. A study examining costs associated with anticoagulant-related ADEs found that most hospitalization expenditures were attributable to nursing costs ($33,189 per ADE), followed by pharmacy costs ($7451 per ADE) (Piazza et al., 2011).

In clinical settings, registered nurses (RNs) administer most medications directly to patients. Hence, promoting inpatient medication safety through high-quality medication management greatly relies on their participation in safe medication administration practices. Although the medication-use procedure is a multidisciplinary process, RNs take direct responsibility for administration and monitoring of all medications. Thus, the risk of error in medication administration is a major concern in patient safety during nursing care delivery. Studies suggest that high occurrence of errors is during the ordering and transcribing stages and administration stage (Carayon et al., 2014; Latif, Rawat, Pustavoitau, Pronovost, & Pham, 2013). The patients requiring a greater number of medications have a higher risk of preventable and potential ADEs than patients requiring fewer numbers of medications, particularly patients with more complex care such as those in ICU (Carayon et al., 2014; Holdsworth et al., 2003; Latif et al., 2013). While consistent research evidence of MEs involving RNs in medication administration exists, the knowledge of actual MEs and interventions to promote patient safety are often limited and weak (Hughes & Blegen, 2008).

While researchers have investigated MEs, few focused on types of drug classification and specific drugs involved in errors as well as consequences of these errors associated with RNs. Limited research has compared different hospital units where MEs occur in inpatient settings, as much of the literature has focused on MEs in a specific unit (Carayon et al., 2014; Holdsworth et al., 2003; Kopp, Erstad, Allen, Theodorou, & Priestley, 2006; Latif et al., 2013; Osmon et al., 2004; Treiber & Jones, 2012). Given the number of new medications available as well as rapidly widespread use of technology surrounding the medication delivery system in the recent years, more studies are needed to identify key factors associated with MEs. Despite the reported effectiveness of new technologies, such as barcode medication administration and decision support software for improving medication safety at healthcare settings (Nuckols et al., 2014; Radley et al., 2013), human errors still occur

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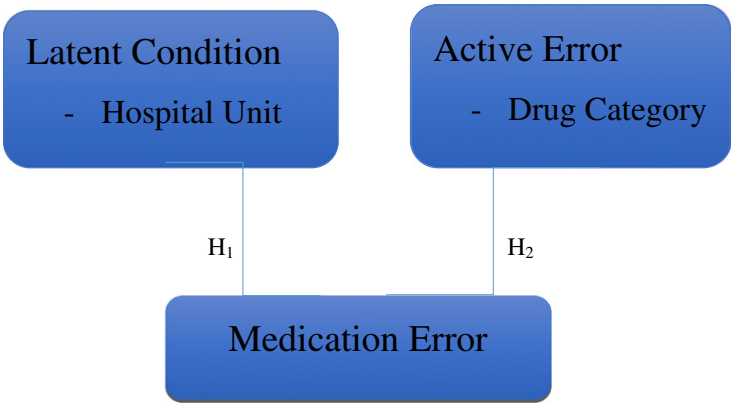
(Piazza et al., 2011). This is due, in part, to the complex aspects of the series of medication-use process (Carayon et al., 2014; Leape et al., 1991). For example, excessive anticoagulation administration such as international normalized ratio (INR) remains the most common error—up to 72% of all ADEs despite the use of medical technologies (Piazza et al., 2011). Further research is needed to test interventions that will optimize medication administration safety. Currently, there are no studies about MEs related to the types of drug classifications and specific medications involving RNs. Therefore, we examined the MEs involving RNs and the MEDLINE/PubMed electronic database was used to search literature. We found only one relatively recent study in the United States that focused on a specific drug and categories associated with MEs but the study was based on clinical pharmacists' self-reported errors (Kuo, Touchette, & Marinac, 2013). However, this study had major limitations: short duration of data collection period (14 days) and self-reports from voluntary participants, which could produce results that differ from those based on the actual hospital ME incident report. Based on our literature review, studies that examined the associations of drug classes, sub-classes, and individual drugs associated with MEs committed by RNs are lacking. Nurses are the most vulnerable to MEs as they are at the last layer of the defense system against error (Hughes & Blegen, 2008). Previous systematic review of the literature focusing on medication administration errors suggests that complex hospital environments, such as greater number of medications given per patient, are at higher risk for MEs and likely to have an increased ME risk if the systematic defense barrier is not working properly rather than solely errors made by individual actions (Carlton & Blegen, 2006; Holdsworth et al., 2003; Hughes & Blegen, 2008). A health care worker who is competent and diligent in delivering care and services still makes mistakes as activity increases (Rex, Turnbull, Allen, Vande Voorde, & Luther, 2000). Further, previous research repeatedly suggests that certain types of drugs are associated with MEs such as antimicrobials (Carayon et al., 2014; Ford et al., 2010; Kuo et al., 2013; Leape et al., 1991), cardiovascular drugs (Kuo et al., 2013; Leape et al., 1991; Piazza et al., 2011), and electrolytes (Carayon et al., 2014; Ford et al., 2010) more than other types of drugs. It is believed that despite a hospital's ongoing efforts to protect patients from MEs, its defense barrier is vulnerable when it comes to potential high risk drugs.

Reason's theory was used as the conceptual framework to guide this study. Reason's theory suggests that MEs occur as a result of an individual provider's (e.g., nurse) failure to respond to a patient's needs (active errors) and weaknesses of the layered defense system to error provoking conditions (latent conditions). The latent conditions include staffing, workload, skill mix, turnover, organizational policies and protocols, patient acuity, and experience and training (Hughes & Blegen, 2008). Active errors can be displayed at the front liner level such as dose calculation errors, lack of knowledge, and violations of following rules and procedures. Existing literatures suggest that complex hospital environments, such as a greater number of medications given per patient are at higher risk for MEs (Osmon et al., 2004), and are likely to have an increased ME potential if the systematic barriers and safeguards are not working properly rather than solely active errors (Carlton & Blegen, 2006; Hughes & Blegen, 2008). Even a health care worker who is competent and diligent in delivering care and services makes mistakes as activity increases (Rex et al., 2000). Therefore, we hypothesized that a hospital unit with more activity coupled with complex medication administration that may trigger some latent conditions (e.g., insufficient staffing, heavy workload) is associated with an increase in MEs;H_1 shown in Fig. 1. Further, since previous research repeatedly suggests that certain types of drugs are known to associate with MEs such as antimicrobials (Carlton & Blegen, 2006; Holdsworth et al., 2003; Hughes & Blegen, 2008; Radley et al., 2013), cardiovascular drugs (Hughes & Blegen, 2008; Radley et al., 2013), and electrolytes (Manias, Kinney, Cranswick, & Williams, 2014) more than other types of drugs, we hypothesized that certain drug categories (cardiovascular drugs, antimicrobials, and electrolytes) that lean towards active errors (e.g., dose calculation errors) are associated with an increase in MEs; H_2 shown in Fig. 1.

2. Methods

The study at hand utilized ME incident reports obtained from the risk management department of five hospitals. We extracted the data from a previous research done at five hospitals from the southwest region of the United States in November 2011 through July 2014 (Shen et al., 2015). A total of 2336 observations were collected ($n = 1276$ ME case group, $n = 1060$ control group). Our study focused on the 1276 ME cases in the case group and excluded the control group that was not related to MEs. An approval from a university's Institutional Review Board and the Western Institutional Review Board was obtained prior to any research activities. Patient information was not collected. All information related to nurses' identification number was removed



H1: Hospital unit wherein more activity coupled with complex medication administration that may trigger some latent conditions is associated with an increase in MEs

H2: Certain drug categories (cardiovascular drugs, antimicrobials, and electrolytes) that lean towards active errors are associated with an increase in MEs

Fig. 1. Reason's model on factors contributing to medication error. H1: A hospital unit with more activity coupled with complex medication administration that may trigger some latent conditions is associated with an increase in MEs. H2: Certain drug categories (cardiovascular drugs, antimicrobials, and electrolytes) that lean towards active errors are associated with an increase in MEs.