

# Does Systems Thinking Improve the Perception of Safety Culture and Patient Safety?

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**Introduction:** Adverse patient events are frequently associated with medication administration errors. Despite implementation of barcode technology, medication administration errors continue, often because of system issues. Integrating systems thinking into nursing practice facilitates identification and correction of factors that interfere with patient safety. Safety culture is positively associated with patient outcomes. The purpose of this study was to improve patient safety with respect to medication administration through an intervention designed to enhance systems thinking (Systems Thinking Education Program, STEP). **Aims:** Specific aims were to identify nurse workarounds during medication administration, to assess changes in the rates of medication events and workarounds after STEP, to assess changes in systems thinking and safety culture after STEP, and to correlate safety culture and systems thinking. **Methods:** This study was a pre-post comparison with a STEP intervention (including medication huddles) and organization-wide monthly education for 1 year. Outcome measures included perception of safety culture, as measured by the Safety Attitudes Questionnaire, and systems thinking, as measured by the Systems Thinking Scale. All organization nurses were invited to complete preintervention and postintervention electronic surveys via an e-mail link. Additionally, medication event rates and workaround rates were determined by direct medication administration observations on eight units (six inpatient and two ambulatory) that were conducted before and after intervention with trained data collectors. **Results:** A total of 1,652 medication observations before intervention and 1,998 observations after intervention were reported. The workaround rate was significantly lower after STEP (175 workarounds out of 1,998 observations; 8.8%) compared with before (305 workarounds out of 1,652 observations; 18.5%),  $p < .0001$ . The rate of medication events also decreased from 9.4% (156 of 1,652 observations) before intervention vs. 4.2% (84 of 1,998 observations) after intervention ( $p < .0001$ ). The survey response rate was 40% ( $n = 585$ ) before and 23% ( $n = 334$ ) after intervention. The nurses' perception of safety culture was more positive after the systems thinking program compared with before the program ( $p = .029$ ). Similarly, the systems thinking scores were higher after intervention compared with before intervention ( $p = .013$ ). Scores on the Safety Attitudes Questionnaire and Systems Thinking Scale were positively correlated ( $r = .297$ ,  $p < .001$ ). Medication timing with food and rate of intravenous fluid pushes were identified as problematic. **Conclusion:** The STEP intervention strengthened understanding of systems thinking and revealed the importance of addressing the nurse as a second victim of medication errors, which is likely to be central to safety culture for nurses. Medication huddles may be a useful intervention to improve systems thinking.

**Keywords:** Medication errors, patient safety, STEP program, systems thinking, research

Preventable adverse drug events occur at an alarming annual rate of approximately 1.5 million in the United States. Many of these adverse drug events result from administration errors (Weis & Elixhauser, 2013). Errors involving high-alert medications, such as opiates, anticoagulants, and insulin, can lead to devastating patient outcomes (Graham, Clopp, Kostek, & Crawford, 2008). An independent double check of high-alert medications is believed to decrease medication errors, but whether nurses follow this protocol is usually unknown. Despite new technologies, such as bar code medi-

cation administration (BCMA), electronic medication administration records, and computerized physician order entry, observational studies show that workarounds to known medication policies are common (Carayon et al., 2007; Koppel, Wetterneck, Telles, & Karsh, 2008). Although workarounds may be used to be more efficient and expedient in medication administration, they also increase the risk of error (Poon et al., 2010; Koppel et al., 2008).

Accurate assessment of the number of medication errors is challenging because fear of punishment may limit the report-

ing. Nurses' self-reporting of medication errors has been associated with the perception of the safety culture of the organization (Kagan & Barnoy, 2013). Safety culture is characterized by a blame-free environment, interdisciplinary collaboration to seek solutions, consistent adherence to evidence-based policies, and leadership's commitment to prioritize resources for safety concerns (Agency for Healthcare Research and Quality, 2012). When medication errors occur, the focus is on the reasons nurses acted as they did and the relationship between their behavior and their perceptions of the health care system environment, instead of on what has gone wrong (Armitage, 2009). Although learning from medication errors needs to occur at the individual, unit, clinic, and organization levels, systems-based practice is not typically emphasized in most nursing programs. Nurses have been educated to recognize personal responsibility, but they may not appreciate how safety culture influences their individual behavior (Dolansky & Moore, 2013; Johnson, Miller, & Horowitz, 2008). To engage in systems thinking, nurses "view problems as part of a chain of events of a larger system, rather than as independent events" (Dolansky & Moore, 2013, p. 6)

*Systems thinking* is "the ability to recognize, understand, and synthesize the interactions and interdependencies in a set of components designed for a specific purpose" (Moore, Dolansky, Singh, Palmieri, & Alemi, 2010, p. 5). Nurses should be encouraged to engage in systems thinking as they work with other members of the health care team to redesign health care processes to improve safety and quality of care (Dolansky & Moore, 2013).

The purpose of this study was to explore possible associations among systems thinking, perception of safety culture, and voluntary reporting of medication errors; to identify possible workarounds used during medication administration that may lead to medication errors and affect patient safety; and to test the efficacy of a Systems Thinking Education Program (STEP) based on a proactive, nonpunitive, and interdisciplinary approach to improve patient safety.

## Literature Review

### Systems Thinking

A study by Jeffs, Berta, Lingard, and Baker (2012) showed that reporting near misses did not result in feedback from management and that correction occurred only at the unit or individual level. That is, nurses identify and correct the immediate problem but do not act to prevent recurrences. Effective risk management depends on detailed analysis of errors to determine if they stem from active failures or latent conditions. "Active failures are unsafe acts committed by people who are in direct contact with the patient or system" (Reason, 2000, p. 395). "Latent conditions are the inevitable 'resident pathogens' within a system" (Reason, 2000, p. 395). Latent conditions include time pressure, inadequate staffing, equipment challenges, and inexperienced

staff (Reason, 2000). "Compliance to standards of care and standards of practice, regulatory and accreditation standards, and clinical outcomes are beginning to define the safety boundary as metrics in these areas become more reliable" (Morath, 2011, p. 5). Symptoms of unsafe practice include breakdowns of communication and teamwork, shortcuts, workarounds, and increased errors. Interdisciplinary teamwork and peer monitoring are required to perform within the acceptable operating point (Morath, 2011).

### Error Detection

"The most important barrier to improving patient safety is lack of awareness of the extent to which errors occur daily in all health care settings and organization" (Institute of Medicine, 2000). Medication error rates are typically a measure of the number of reported errors, not the actual number of errors or the quality of care given. Methods other than reported errors, such as direct observation, medical record review, and BCMA offer a more complete picture of medication errors and workarounds. Observation studies are more objective and reliable than voluntary reporting or medical record review (Prot et al., 2005). In a study of 2,556 doses, the detected error rate was 14.6% for direct observation, 0.9% for medical record review, and 0.04% for voluntary reporting (Flynn, Barker, Pepper, Bates, & Mikeal, 2002).

An evaluation study to explore work processes and sources of medication errors was conducted using an observation technique that examined nurses as they used BCMA and Smart IV pump technology (Carayon et al., 2007). The study focused on tasks (sequence of the medication administration process), technological issues and nurses' responses to them (BCMA alarms and functioning of technology), organization factors (shift worked, type and frequency of interruptions), the physical environment in which medication administration occurred (such as noise, location of medications), and patient factors (such as isolation). The study used two observers—a human factors engineer and a pharmacist—so one could observe while the other recorded. This method also enabled interception of medication errors, thus preventing them from reaching the patient. Based on 59 observations, the study identified 18 different sequences of medication administration using BCMA; only 23 observed processes (39%) reflected the sequence recommended in the medication administration policy. Ten had actions considered potentially unsafe (Carayon et al., 2007).

### Safety Culture

The association of safety culture and patient outcomes is an emerging area of research. Mardon, Kahanna, Sorra, Dyer, and Famolaro (2010) used the Agency for Healthcare Research and Quality's Hospital Survey on Patient Safety Culture, or HSOPS, comparative database to examine patient safety culture and adverse events in 179 hospitals. The patient outcomes were com-

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