PSNet
PATIENT SAFETY NETWORK

Medication Mix-Up Leads to Patient Death

November 30, 2023
Sanchez L, Romano PS. Medication Mix-Up Leads to Patient Death. PSNet [internet]. 2023.
https://psnet.ahrq.gov/web-mm/medication-mix-leads-patient-death

The Case

An 81-year-old man was transferred from an outside hospital and admitted to the intensive care unit (ICU) with a gastrointestinal bleed. The ICU physician referred the patient to a gastroenterology colleague to undergo diagnostic colonoscopy. The charge nurse – who was already caring for two other ICU patients – was assigned to prepare the patient for the colonoscopy. At 5:00pm, the ICU nurse mistakenly selected a jug of dialysis liquid rather than a polyethylene glycol solution commonly used to clean the colon for colonoscopy. When the barcode on the jug of dialysis liquid did not scan, the nurse called the hospital pharmacy for assistance. About 5 minutes later, the pharmacy sent a barcode label to the ICU via a tube system that is more commonly used to send and receive medications and supplies. The nurse successfully scanned the new barcode label and administered about 8 ounces of the dialysis liquid orally before the end of her shift. However, the patient complained of the solution's taste and was "unable to tolerate" larger amounts. The ICU physician who ordered the polyethylene glycol solution said that the patient had to take the full amount ordered, whereupon another nurse gave the patient the rest of the liquid through a feeding tube bag. The medication mix-up was identified around midnight and the patient died about 7 hours later.

The Commentary

by Luciano Sanchez, PharmD and Patrick Romano, MD, MPH

The authors of the Institute of Medicine's *To Err is Human* report argued that health care systems are not optimally designed to prevent errors. Even as modern medicine has continued to evolve and improve its processes since the publication of *To Err is Human*, current healthcare systems are still susceptible to medication errors.[1] Some authors have estimated that medical errors are the third most common cause of death behind heart disease and cancer.[2] Errors can occur in all facets of the medication process from prescribing to administration. The metaphorical example of an error occurring in a complex system is the Swiss Cheese Model. In the metaphorical cheese, hazards are prevented by barriers, but holes in the cheese represent opportunities for an error to occur. This case and commentary highlight the continual need for improvement, and how serious medication errors can occur despite obvious "red flags" at the bedside and technological tools that are intended to prevent such errors.

Cognitive Bias

Cognitive bias can contribute to errors in judgment or thinking leading to an incorrect response. One such cognitive error is inattention blindness, where an individual can fail to notice glaring and fully visible but unexpected objects or events. Inattentional blindness can sometimes be attributed to increased cognitive load, which has been defined as the mental effort or working memory resources needed to perform a task. The intrinsic component of cognitive load is based on the inherent complexity of difficulty of a task, whereas the extrinsic component comes from the organization of the task in an environment with unnecessary information and distractions. Cognitive load theory is based on the notion that working memory resources are finite; when the sum of intrinsic (non-modifiable) and extrinsic (modifiable) cognitive load overwhelms working memory, task performance suffers.[3,4,5]

Contrary to what might be assumed, cognitive errors are common among both novice individuals as well as experts, emphasizing the importance of system-based approaches to improving patient safety. A meta-analysis examining whether expertise reduces rates of inattentional blindness found that, on average, 62% of novices had inattentional blindness compared to 56% of experts (weighted odds ratio = 1.33; 95% CI, 0.78 to 2.28).[6] Improved skill in performing a task does not necessarily eliminate inattentional blindness and does not imply reduced cognitive load. If the extrinsic environment creates high cognitive load, then expertise may not lower the cognitive load and important information may be overlooked. For example, if a unit is poorly organized and important items are not stored in the usual or expected locations, then nurses may become inattentive to new stimuli (such as, in this case, failure of the medication barcode to scan and the patient's refusal to drink a solution that would have tasted very salty).

Inattention blindness may be related to confirmation bias, which is a process by which one is more likely to believe information supporting one's prior viewpoint or expectation. Given that health care professionals are highly trained and accustomed to working in teams, they develop trust in each other and may avoid direct confrontation.[7] However, decision density is high across all healthcare settings, but especially in intensive care. Thus, even if incorrect decisional responses are rare, they occur with sufficient frequency to impact patient outcomes. In this case, the pharmacist and the nurse both may have experienced confirmation bias as they believed the chosen medication bag was correct, they trusted each other, and they blamed the barcode medication administration (BCMA) process for causing a problem. Recent experience with BCMA failures – an example of availability bias – might have contributed to staff blaming the system instead of recognizing that the medication was incorrect.

Understaffing

In many healthcare organizations, understaffing is thought to aggravate the impact of cognitive load by increasing stress and burden on healthcare workers. Increased stress caused by understaffing can lead to coping strategies that manifest as safety workaround, in which healthcare professionals sidestep safety policies and practices to maintain productivity and efficiency.[8] A recent systematic review showed that the odds of death are 1.24 to 3.5 times greater with inadequate staffing in the ICU.[9] While there is no consensus on what represents an adequate nurse-to-patient ratio, California implemented a 1:2 (or fewer) nurse-to-patient ratio in all ICUs with beneficial effects noted for both patients and nurses, including lower mortality rates.[10] In this case, the ICU nurse may have been frustrated by the unexpected inability to scan the medication label, and the need to resolve the problem quickly given other patient care responsibilities. Although the adequacy of staffing is unknown in this case, understaffing may increase the likelihood of the cognitive errors in clinical decision making described above.

The Importance of Technology

BCMA implementation has been shown to provide safety benefits with respect to both the rate of adverse reactions and their severity.[11] However, the technology is only useful if it is properly used and functions correctly. Workarounds occur within healthcare systems and may lead to deviations from protocols while providing information about perceived system inadequacies or obstacles. A subset of these deviations (as in this case) can have serious consequences for patients. BCMA workarounds can be categorized into 3 groups: omitted steps, incorrect sequence, and unauthorized steps. Within these 3 categories, a total of 31 probable causes have been identified,[12] ranging from environmental factors to perceived overestimation of the extent to which BCMAs can eliminate all risks. Furthermore, suboptimal design or implementation of BCMA technologies can exacerbate or present new risks. For example, of 1,309 BCMA events reported to the Pennsylvania Patient Safety Authority from 2005 through 2016, 25.7% involved an equipment-related problem, including unreadable patient identification bracelets, uncharged scanners, missing or smudged barcode labels, or poor wireless connectivity.[13] In this case, BCMA technology failed in part because it replaced visual safety checks, and the pharmacist sent a label to force the BCMA system to function as confirmation bias expected.

The Traditional Rights of Medication Administration in Modern Healthcare

Nurses for decades have traditionally been taught the five “rights” of medication administration (right patient, medication, time, dose, and route). These “rights” focus on the standard procedure that should be followed before each medication administration. Critiques of the system have expressed that the rights are no longer siloed to nursing but that medication administration is a multidisciplinary process with multiple interconnected players.[14]

Within nursing alone, the process is not as straightforward as imagined. The modern healthcare system has non-routine episodes of medication administration that can lead to errors. One example is a hand-off, where one individual hands off a medication to another for administration, either at a change of shift or due to competing demands with multi-tasking. Delegation is another non-routine use of the “rights” where medication is checked by one individual but then delegated to another.[15] In this case the “rights” of medication administration were split among individuals, increasing the opportunity for cognitive biases to lead to medication errors.

Approach to Improving Safety & Patient Safety Metrics

One Label-One Medication

To reduce confirmation bias and inattentional blindness, education is important but insufficient and safer systems must be put in place. For example, standardized policies may require verification of a medication by a pharmacist with barcode scanning before a new label is produced. Furthermore, medication labels should not be sent without an attached medication when leaving the pharmacy, to ensure that the label is not inadvertently applied to the incorrect medication. A medication label that is not attached to a medication is like writing a blank check, forcing a BCMA system to perform in a way that is not intended.

Failure Mode and Effect Analysis (FMEA) of BCMA

BCMA is only useful when the intended user follows the intended steps. Failure mode and effect analysis should be implemented across all aspects of the BCMA system. In this process, a step-by-step approach to the workflow should be simulated and assessed for ways in which it might fail and the potential effects of failure. FMEA can help professionals see where deviations from the standard process occur and then improve implementation to meet in-the-field demands. For example, assessing data related to bar code overrides can identify areas of targeted improvement for specific medications, units, or personnel.

Improve staffing ratios

Nursing management should monitor their current staffing ratios and understand where poor nurse staffing ratios put patients at risk. Multiple studies have shown that inadequate nurse staffing, particularly shortages of registered nurses, has a negative impact on patient outcomes.[16-18]

Re-examining the Rights of Medication Administration: Trust but Verify

All healthcare personnel involved in medication administration should be re-educated about the “rights” of medication administration to ensure their understanding of safe practices. This process should address increased risks that may arise during handoffs of care or delegations of specific tasks. While this is a human-level approach and may not yield as much benefit as system changes, it provides context and understanding for healthcare professionals on the importance of appropriate procedures for medication administration.

Take-Home Points

- Policies should be implemented to ensure that medications are verified by a pharmacy staff member before a replacement label is issued for the bedside nurse.
- Failure mode and effect analysis should be implemented in the BCMA process to understand potential workarounds and to optimize implementation.
- Nurse-to-patient staffing ratios should be monitored and continuously addressed to prevent cognitive overload and reduce patient harm.
- Healthcare workers should be educated on frequent deviations from medication administration rights and how to avoid these deviations in high-risk situations (e.g., handoffs of care, delegations of tasks).

Luciano Sanchez, PharmD
Resident Pharmacist
Department of Pharmacy
UC Davis Health

lusanchez@ucdavis.edu

Patrick Romano, MD, MPH
Co-Editor-in-Chief, AHRQ's Patient Safety Network (PSNet)
Professor
Department of Internal Medicine, Division of General Medicine
UC Davis Health
psromano@ucdavis.edu

Editor's Note: this case was adapted from: Searcy L, Eads M. Medication mix-up blamed for death of a patient at Lexington hospital. *Lex18 News*. July 25, 2023.

References

1. Institute of Medicine (US) Committee on Quality of Health Care in America, Kohn LT, Corrigan JM, Donaldson MS, eds. *To Err is Human: Building a Safer Health System*. Washington (DC): National Academies Press (US); 2000. [Free full text]
2. Makary MA, Daniel M. Medical error—the third leading cause of death in the US. *BMJ*. 2016;353:i2139. [Available at]
3. Harry E, Pierce RG, Kneeland PP, et al. Cognitive load and its implications for health care. *NEJM Catalyst*. March 14, 2018. [Available at]
4. Collins R. Clinician cognitive overload and its implications for nurse leaders. *Nurse Leader*. 2020;18(1):44-47. [Available at]
5. Ehrmann DE, Gallant SN, Nagaraj S, et al. Evaluating and reducing cognitive load should be a priority for machine learning in healthcare. *Nat Med*. 2022;28(7):1331-1333. [Free full text]
6. Ekelund M, Fernsund H, Karlsson S, et al. Does expertise reduce rates of inattentional blindness? A meta-analysis. *Perception*. 2022;51(2):131-147. [Free full text]
7. Thirsk LM, Panchuk JT, Stahlke S, et al. Cognitive and implicit biases in nurses' judgment and decision-making: a scoping review. *Int J Nurs Stud*. 2022;133:104284. [Free full text]
8. Andel SA, Tedone AM, Shen W, et al. Safety implications of different forms of understaffing among nurses during the Covid?19 pandemic. *J Adv Nurs*. 2022;78(1):121-130. [Free full text]
9. Rae PJL, Pearce S, Greaves PJ, et al. Outcomes sensitive to critical care nurse staffing levels: a systematic review. *Intensive Crit Care Nurs*. 2021;67:103110. [Available at]
10. Hollowell A. California's mandatory nurse staffing ratios: key lessons 2 decades in. *Becker's Hospital Review.* 2023. Accessed November 29, 2023. [Free full text]
11. Truitt E, Thompson R, Blazey-Martin D, et al. Effect of the implementation of barcode technology and an electronic medication administration record on adverse drug events. *Hosp Pharm*. 2016;51(6):474-483. [Free full text]
12. Koppel R, Wetterneck T, Telles JL, et al. Workarounds to barcode medication administration systems: their occurrences, causes, and threats to patient safety. *J Am Med Inform Assoc*. 2008;15(4):408-423. [Free full text]
13. Magee M, Miller K, Patzek D, et al. Near-miss event analysis enhances the barcode medication administration process. *Pa Patient Saf Advis*. 2017;14(4). [Free full text]

14. Macdonald M. Patient safety: examining the adequacy of the 5 rights of medication administration. *Clin Nurse Spec*. 2010;24(4):196-201. [Available at]
15. Martyn J-A, Paliadelis P, Perry C. The safe administration of medication: nursing behaviours beyond the five-rights. *Nurse Educ Pract*. 2019;37:109-114. [Available at]
16. Bakerjian D, Boltz M, Bowers B, et al. Expert nurse response to workforce recommendations made by The Coronavirus Commission For Safety And Quality In Nursing Homes. *Nurs Outlook*. 2021;69(5):735-743. [Free full text]
17. Harrington C, Ross L, Chapman S, et al. Nurse staffing and coronavirus infections in California nursing homes. *Policy Polit Nurs Pract*. 2020;21(3):174-186. [Free full text]
18. Farid M, Purdy N, Neumann WP. Using system dynamics modelling to show the effect of nurse workload on nurses' health and quality of care. Ergonomics. 2020 2;63(8):952-964. [Available at]

This project was funded under contract number 75Q80119C00004 from the Agency for Healthcare Research and Quality (AHRQ), U.S. Department of Health and Human Services. The authors are solely responsible for this report's contents, findings, and conclusions, which do not necessarily represent the views of AHRQ. Readers should not interpret any statement in this report as an official position of AHRQ or of the U.S. Department of Health and Human Services. None of the authors has any affiliation or financial involvement that conflicts with the material presented in this report. View AHRQ Disclaimers