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ISMP

Long-Term Care AdviseERR™

Educating the Healthcare Community About Safe Medication Practices

Understanding human over-reliance on technology

The implementation of information technology in medication use systems is widely accepted as a way to reduce adverse drug events by decreasing human error.[1] Technology examples in long-term care (LTC) include computerized order entry systems, clinical decision support systems, barcode scanning systems, automated dispensing cabinets (ADCs),[2] and smart infusion pumps. These technologies are meant to support human cognitive processes and, thus, have great potential to combat the shortcomings of manual medication systems and improve clinical decisions and patient/resident outcomes. This is accomplished through precise controls, automatically generated cues and recommendations to help the user respond appropriately, prompts that promote the correct sequence of work or ensure the collection of critical information, and alerts to make the user aware of potential errors.

Information technology to support clinical decision making does not replace human activity but rather changes it, sometimes in unintended or unanticipated ways.[3] Instances of misuse and disuse, often to work around technology issues, and new sources of errors after technology implementation, have been well documented. Errors can also be caused by over-reliance and trust in the proper function of technology.[4] The technology can occasionally malfunction, misdirect the user, or provide incorrect information or recommendations that lead the user to change a previously correct decision or follow a pathway that leads to an error. Over-reliance on technology can result in serious consequences for patients/residents. In a 2016 *Safety Bulletin*,[5] our sister organization, ISMP Canada, highlighted human over-reliance on technology based on its analysis of an incident reported to a Canadian national reporting system. In the article, they discussed two related cognitive limitations: **automation bias** and **automation complacency**.

Incident Description

An elderly patient was admitted to the hospital with new-onset seizures. Admission orders included the anticonvulsant phenytoin (handwritten using the brand name **DILANTIN**), 300 mg orally every evening. Before the pharmacy closed, a pharmacy staff member entered the Dilantin order into the pharmacy computer so that the medication could be obtained overnight from an ADC in the patient care unit. The pharmacy staff member typed the first 3 letters of the medication name ("dil" in this case) into the pharmacy computer, which resulted in a number of possible medications from which to select from a drop-down list. The computer list contained both generic and brand names. The staff member was interrupted while entering the order. When this task was resumed, dil**TIAZ**em 300 mg was selected instead of Dilantin 300 mg.

On the patient care unit, the order for Dilantin had been correctly transcribed by hand onto a daily computer-generated medication administration record (MAR), which was verified against the prescriber's order and cosigned by a nurse. The nurse who obtained the medication from the unit's ADC noticed the discrepancy between the drug listed on the MAR and the drug listed for the patient on the ADC screen, but accepted the information that was displayed on the ADC screen as correct. The patient received one dose of long-acting dil**TIAZ**em 300 mg instead of Dilantin 300 mg as ordered. The error was caught the next morning when the patient exhibited significant hypotension and bradycardia.

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check it out

The use of technology is considered a high-leverage strategy to optimize clinical decision making—but only if the users' trust in the technology closely matches the reliability of the technology itself. The following strategies to address errors related to automation bias and complacency focus on:

- Improving the reliability of the technology itself
- Supporting clinicians to more accurately assess the reliability of the technology, so that appropriate monitoring and verification strategies can be employed

Analyze and address vulnerabilities. Conduct a proactive risk assessment (e.g., failure mode and effects analysis [FMEA]) for technologies to identify unanticipated vulnerabilities and address them before undertaking facility-wide implementation. Also, encourage the reporting of technology-associated risks, issues, and errors to the appropriate individuals, making sure that the senior leadership is aware of these issues.

Limit human-computer interfaces. Administrators should support the seamless integration of technology thereby limiting the need for manual human interaction with the technology for critical tasks, which could introduce errors. For example, using a bi-directional interface between the facility's electronic health record and the pharmacy's computer system prevents having to manually re-enter a change made in one system into the other system. Also, the use of "work-arounds" increases the human involvement and the risk of errors; for example, when different computer systems between the pharmacy and long-term care facility are used without a bi-directional interface.

Design the technology to reduce over-reliance. The design of the technology

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Automation Bias and Automation Complacency

The tendency to favor or give greater credence to information from technology (e.g., a computer display) and to ignore a manual source of data that provides contradictory information (e.g., a handwritten entry on the computer-generated MAR), even if it is correct, illustrates the phenomenon of automation bias.[4] Automation complacency is a closely linked, overlapping concept that refers to the monitoring of technology less frequently or with less vigilance because of a lower degree of suspicion of error and a stronger belief in its accuracy.[3] End-users of a technology (e.g., a nurse that relies on the computer display that lists medications to be administered) tend to forget or ignore that information from the device may depend on data entered by a person. In other words, processes that may appear to be wholly automated are often dependent upon human input at critical points and thus require the same degree of monitoring and attention as manual processes. These two phenomena can affect individual and team decision making and offset the benefits of technology.[3]

Automation bias and complacency can lead to decisions that are not based on a thorough analysis of all available information but that are strongly biased toward the presumed accuracy of the technology.[3] While these effects are inconsequential if the technology is correct, errors are possible if the technology output is misleading. An automation bias *omission* error takes place when users rely on the technology to inform them of a problem but it does not (e.g., lack of a warning when an excessive dose is ordered); thus, they fail to respond to a potentially critical situation because they were not prompted to do so. An automation bias *commission* error occurs when users make choices based on incorrect suggestions or information provided by technology.[4] In the Dilantin incident described above, there were two errors caused by automation bias: the first error was when the pharmacy staff member accepted dil**TIAZ**em as the correct drug in the pharmacy order entry system. The second error occurred when the nurse identified the discrepancy between the ADC screen and the MAR but trusted the information on the ADC's computer screen over that on the handwritten entry on the computer-generated MAR.

In recent analyses of health-related studies on automation bias and complacency, clinicians overrode their own correct decisions in favor of erroneous advice from technology between 6 to 11% of the time.[4] The risk of an incorrect decision increased by 26% if the technology output was in error.[6] The rate of detecting technology failures is also low—in one study, half of all users failed to detect any of the technology failures (e.g., important alert did not fire, wrong information presented) introduced during the course of a typical work day.[3,7]

Causes of Automation Bias and Complacency

Automation bias and complacency are thought to result from 3 basic human factors:[3,4]

- In human decision-making, people tend to select the pathway requiring the least cognitive effort, which often results in letting technology dictate the path. This factor is likely to play a greater role as people are faced with more complex tasks, multitasking, heavier workloads, or increasing time pressures—common occurrences in healthcare.
- People often believe that the analytic capability of technology is superior to that of humans, which may lead to overestimating the performance and accuracy of these technologies.
- People may reduce their effort or shed responsibility in carrying out a task when an automated system is performing the same function. It has been suggested that the use of technology convinces the human mind to hand over tasks and associated responsibilities to the automated system.[8,9] This mental handover can reduce the vigilance the person would use if carrying out the task independently.

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can affect the users' attention and how they regard its value and reliability. For example, the "auto-complete" function for drug names by simply entering the first few letters is a design function that has often led to selection of the first, but incorrect, choice provided by the technology. Requiring the use of the first 4-6 letters to generate a list of potential drug names could reduce these types of errors. To cite another example, studies have found that providing too much on-screen detail can decrease the users' attention and care, thereby increasing automation bias.[4]

Provide training. Provide training about the technology involved in the medication use system to all staff who utilize the technology. Include information about the limitations of such technology, as well as previously identified gaps and opportunities for error. Allow trainees to experience automation failures during the training (e.g., technology failed to issue an important alert; discrepancies between technology entries and handwritten entries in which the handwritten entries are correct; "auto-fill" or "auto-correct" errors). Experiencing technology failures during training can help to reduce errors due to complacency and automation bias by encouraging critical thinking when using automated systems.[4] Allowing trainees to experience automation failures may increase the likelihood of recognizing these failures during daily work.

Reduce task distraction. Although easier said than done, leaders should attempt to ensure those using technology can do so uninterrupted and are not simultaneously responsible for other tasks. Automation failures are less likely to be identified if the user is required to multitask or is otherwise distracted or rushed.[3]

SAFETY wire

Lidocaine as a diluent still needs an order. An order for cef**TRIAX**one 1 gram intramuscularly (IM) every 24 hours for 14 days was written for a resident and sent to the pharmacy. Typically, when cef**TRIAX**one was administered IM, lidocaine 1% was used as a diluent to reduce pain from the IM injection. The lidocaine needed to be or-

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Other conditions linked to automation bias and complacency are discussed below.

Experience. There is conflicting evidence as to the effect of experience on automation bias and complacency. While there is evidence that reliance on technology is reduced as experience and confidence in one's own decisions increases, it has also been shown that increased familiarity with technology can lead to desensitization, which may cause clinicians to doubt their instincts and accept inaccurate technology-derived information.[4] Thus, automation bias and complacency have been found in both naïve and expert users.[3]

Perceived reliability and trust in the technology. While once believed to be a general tendency to trust all technology, today, automation bias and complacency are believed to be influenced by the perceived reliability of a specific technology based on the user's prior experiences with the system.[3] When automation is perceived to be reliable at least 70% of the time, people are less likely to question its accuracy.[10]

Confidence in decisions. Because trust in technology increases automation bias and complacency, users are less likely to be biased if they are confident in their decisions.[4,11,12]

Technology plays an important role in the design and improvement of medication systems; however, it must be viewed as supplementary to clinical judgement. Although its use can make many aspects of the medication use system safer, healthcare professionals must continue to apply their clinical knowledge and critical thinking skills to use and monitor technology in order to provide optimal patient care. Please refer to the strategies listed in the **check *it* out!** column, starting on page 1, for ways to address errors related to automation bias and complacency.

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References

1) Mahoney CD, Berard-Collins CM, Coleman R, Amaral JF, Cotter, CM. Effects of an integrated clinical information system on medication safety in a multi-hospital setting. *Am J Health Syst Pharm.* 2007;64(18):1969-77.
2) Newman D. Automated dispensing cabinets. Jan 25, 2016. www.ismp.org/sc?id=2899
3) Parasuraman R, Manzey DH. Complacency and bias in human use of automation: an attentional integration. *Hum Factors.* 2010;52(3):381-410.
4) Goddard K, Roudsari A, Wyatt JC. Automation bias: a systematic review of frequency, effect mediators, and mitigators. *J Am Med Inform Assoc.* 2012;19(1):121-7.
5) ISMP Canada. Understanding human over-reliance on technology. *ISMP Canada Safety Bulletin.* 2016;16(5):1-4.
6) Goddard K, Roudsari A, Wyatt JC. Automation bias: empirical results assessing influencing factors. *Int J Med Inform.* 2014;83(5):368-75.
7) Parasuraman R, Molloy R, Singh IL. Performance consequences of automation-induced "complacency." *Int J Aviat Psychol.* 1993;3(1):1–23.
8) Coiera E. Technology, cognition and error. *BMJ Qual Saf.* 2015;24(7):417-22.
9) Mosier KL, Skitka LJ. Human decision makers and automated decision aid: made for each other? In: Parasuraman R, Mouloua M, eds. Automation and Human Performance: *Theory and Applications.* Mahwah, NJ: Lawrence Erlbaum Associates Inc. 1996;201-20.
10) Campbell EM, Sittig DF, Guappone KP, Dykstra RH, Ash, JS. Overdependence on technology: an unintended adverse consequence of computerized provider order entry. *AMIA Annu Symp Proc.* 2007. 2007:94-8.
11) Lee JD, Moray N. Trust, control strategies and allocation of function in human-machine systems. *Ergonomics.* 1992;35(10):1243–70.
12) Yeh M, Wickens CD. Display signaling in augmented reality: effects of cue reliability and image realism on attention allocation and trust calibration. *Hum Factors.* 2001;43(3):355–65.

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dered by the prescriber, but in this case, it was not. Thus, the pharmacy dispensed the antibiotic without the lidocaine. Rather than calling the prescriber for an order or the pharmacy for the lidocaine, the nurse obtained a lidocaine 1% vial that happened to be in an emergency kit and used it to dilute the antibiotic. The medication was administered to the resident.

There are two important issues here. First, lidocaine is a drug and requires an order, even if used as a diluent. In this case, the patient was not harmed. But a serious event could have occurred if the patient had an allergy to lidocaine, or if the drug was accidentally administered intravenously. If a nurse wants to use lidocaine as a diluent for an IM drug, the prescriber should always be contacted for an order.

Second, the nurse should only remove drugs from an emergency kit when it is a true emergency or, in non-emergency situations, when the pharmacy directs the nurse to do so. Had the pharmacy been contacted before removing the drug from the emergency kit, they would have informed the nurse that an order was needed. The pharmacist also could have checked to make sure the resident did not have a lidocaine allergy.

Worth reading...

Sliding-scale insulin use in long-term care

Woods J, Nadelson M. Sliding-scale insulin use in long-term care: an updated perspective. *Consult Pharm.* 2017;32(2):105-8.

Discusses recent recommendations that advocate against the use of sliding-scale insulin (SSI) only regimens in long-term treatment and new updates to several published guidelines regarding the use of sliding-scale insulin only regimens in elderly residents in long-term care.

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