Medication Errors Involving Overrides of Healthcare Technology

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ABSTRACT

Users can bypass many of the safety features incorporated in medication-use technologies that provide warnings about possible unsafe conditions or errors. Analysts reviewed medication error event reports that indicated the use of overrides submitted from January 2013 through December 2014 to the Pennsylvania Patient Safety Reporting System. Of the 583 event reports related to the use of overrides, the most commonly mentioned technology was automated dispensing cabinets (77.0%, n = 449), followed by computerized prescriber order entry (8.2%, n = 48) and bar-code medication administration devices (7.5%, n = 44). The most common classes of medications cited were antibiotics (12.0%, n = 70), opioids, (12.0%, n = 70), and anticoagulants (7.4%, n = 43); and 26.4% (n = 154) of the reports involved at least one high-alert medication. Organizations may consider developing criteria for alerts that focus on real chances of patient harm while preventing alert fatigue, minimizing the need for or use of overrides. (Pa Patient Saf Advis 2015 Dec;12[4]:141-8.)

INTRODUCTION

The use of technologies to prevent and detect medication errors has been increasing over the past decade. A stratified random sample survey of pharmacy directors at 1,435 general and children's hospitals in the United States found that the large majority (97.1%) of hospitals use automated dispensing cabinets (ADCs) in their medication distribution systems, 88.4% use bar-coded medication administration (BCMA) systems to verify patient identity and electronically check doses administered by nurses, 80.9% use computerized prescriber order entry (CPOE) systems, and 80.5% use smart infusion pumps (infusion pumps that incorporate medication safety software and can contain a comprehensive library of drugs, usual concentrations, dosing units [e.g., mcg/kg/min, units/hr], and dose limits [minimum/maximum] that can be set according to institution-established parameters[1]).[2]

Each of these healthcare technologies provide the capability to alert users to possible unsafe conditions or errors with the use of a medication. Many technologies can record the number and types of alerts presented to users, the alert overrides, and the user's stated explanation for overriding the alert (from a standard list or a free-text explanation). While technologies employed in the medication-use process can generate reports delineating overrides, these reports do not always capture all of the factors that led to the decision to override, or provide the result of an error in which an override played a role. Other systems, such as an organization's internal event reporting system, also can be used to help capture the factors contributing to an event.

Analysis of events reported through the Pennsylvania Patient Safety Reporting System (PA-PSRS) has identified medication errors which involve an override of healthcare technology. This analysis reviews reports submitted to the Pennsylvania Patient Safety Authority mentioning the use of overrides to delineate factors that led to overriding an alert and the results related to the use of an override.

METHODS

When reviewing events reported through PA-PSRS, Authority analysts can further classify reports using a tag for future query opportunities. Analysts queried the PA-PSRS database for events reported as medication errors to the Authority from January 2005 through December 2014 that had been tagged as events involving overrides. Analysts also queried the database using the keyword search terms "overri*," "overro*," "overid*," and "overo*," where the asterisk represents a wild-card to include multiple endings to each search term.

The query yielded 5,399 medication error reports. The medication name, route, patient care area, event description, and harm score, adapted from the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) harm index,[3] were provided by the reporting facility. When a medication name data field was left blank but the name was provided in the event description, an analyst adjusted the medication name field. The reports were evaluated to determine what factors were associated with medication errors involving the use of healthcare technology and an override.

Authority analysts focused on the last two calendar years, which yielded 790 reports. Two hundred seven (26.2%) of these reports were excluded because the error did not result from the use of an override, because "override" was used in the event description of an event that clinically warranted the use of an override (e.g., to obtain medication during an emergent situation), or because an override could not be performed. Five

hundred eighty-three reports remained for qualitative analysis. Reports were analyzed and assigned a category or type of error (e.g., type of technology involved, potential cause of error) based on the analyst's interpretation of the event description. Analysts made note of events involving a high-alert medication, based on the *ISMP List of High-Alert Medications in Acute Care Settings*.[4]

RESULTS

Categorizing the reports by harm score shows that more than 75% of the events reached the patient (harm score = C through I) and only 0.3% (n = 2) resulted in patient harm (harm score = E through I) (Figure 1).

Overall, 57 unique types of care areas were associated with events involving an override; the most common were medical-surgical units. Intensive care units (ICUs) and emergency departments (EDs)—care areas that have patients with more acute conditions for which there may be a greater need to override an alert in order to obtain medications emergently—accounted for less than a quarter of the care areas cited in reports (Figure 2).

More than half of all reports involved elderly patients (65 years of age or older), and only 5.5% (n = 32) of the events involved a pediatric patient.

The most common classes of medications cited were antibiotics and opioids, with slightly more than a quarter of the events involving at least one high-alert medication.[4] Among events involving high-alert medications, the three classes most commonly cited were opioids (e.g., morphine), anticoagulants (e.g., warfarin, heparin), and insulin; combined, these medication classes represented 78.6% (n = 121 of 154) of the events involving a high-alert medication.

When looking at the types of technology that were overridden by users, over 75% of override events involved ADCs (Figure 3).

Figure 1. Harm Scores for Events Involving Overrides, as Reported to the Pennsylvania Patient Safety Authority, 2013 through 2014 (N = 583)
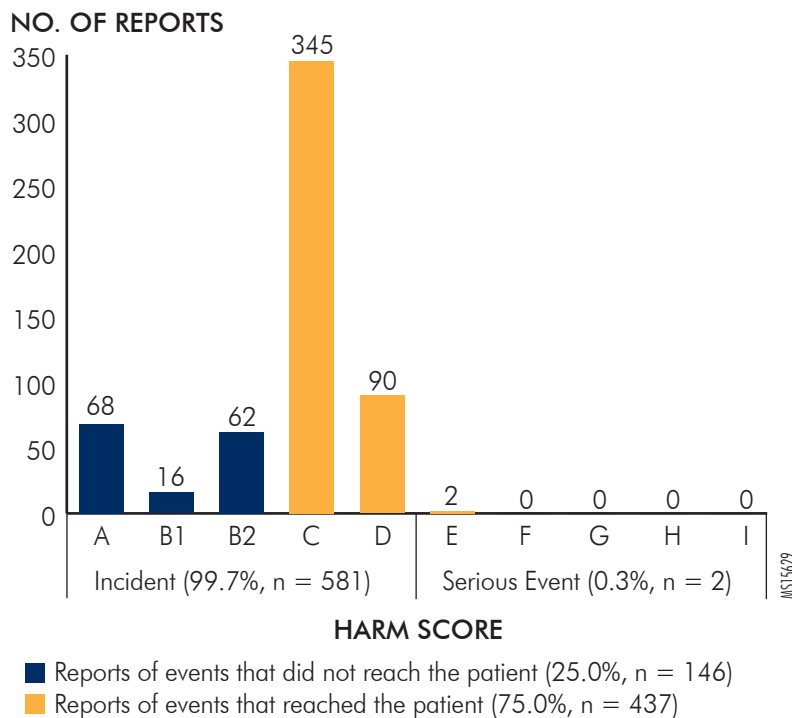
The most common type of event involving overrides of ADCs were unauthorized medications (e.g., obtaining a medication for a patient with no prescribed order for the patient), followed by wrong-drug events and wrong dosage form events (e.g., selecting a sustained-release product instead of the immediate-release form, selecting an oral formulation instead of the injection) (Figure 4). A majority of the unauthorized medication events specifically stated there were no orders for the medication, and over 30% of the unauthorized medication events involved a high-alert medication.

While most of the wrong-drug and wrong dosage form events did not include enough detail to determine additional causative factors for the event, 16.4% (n = 26 of 159 wrong-drug and wrong dosage form reports) mentioned
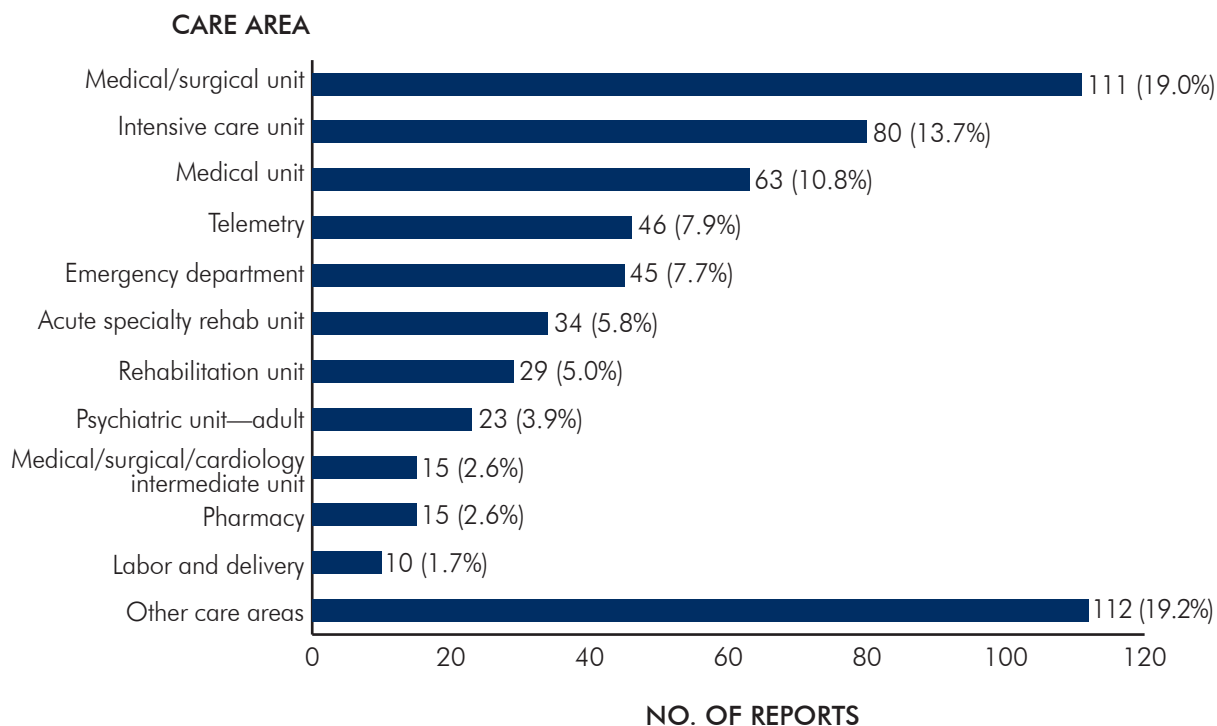
situations in which medications were withdrawn "on override" before a pharmacist reviewed the order or when the pharmacy was closed.

The following are examples of events in which a healthcare practitioner obtained high-alert medications from an ADC using an override.*

> *Nursing thought that the warfarin was ordered per the warfarin comment on the MAR [medication administration record]. There was no order written for the warfarin on the MAR, and the nurse mistook the 2 in the warfarin comment as a 2 mg dose. The error was discovered by the pharmacy when reviewing the*

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* The details of the PA-PSRS event narratives in this article have been modified to preserve confidentiality.

Figure 2. Care Areas for Events Involving Overrides, as Reported to the Pennsylvania Patient Safety Authority, 2013 through 2014 (N = 583)

CARE AREA

Care Area	No. of Reports
Medical/surgical unit	111 (19.0%)
Intensive care unit	80 (13.7%)
Medical unit	63 (10.8%)
Telemetry	46 (7.9%)
Emergency department	45 (7.7%)
Acute specialty rehab unit	34 (5.8%)
Rehabilitation unit	29 (5.0%)
Psychiatric unit—adult	23 (3.9%)
Medical/surgical/cardiology intermediate unit	15 (2.6%)
Pharmacy	15 (2.6%)
Labor and delivery	10 (1.7%)
Other care areas	112 (19.2%)

NO. OF REPORTS

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profile override report the next day. The pharmacy called the unit to ask if there was an order written for this dose, and there was not. Upon review of the MAR and speaking to the nurse involved, it was discovered that the warfarin comment was mistaken for an actual dose.

Patient was ordered sliding scale insulin using Humulin® R [insulin human injection, USP (rDNA origin)] insulin. The nurse removed Humalog® [insulin lispro injection, USP (rDNA origin)] insulin from the ADC machine on override and administered this instead of Humulin R.

Order entered for oxyCODONE ER [extended release] 40 mg po TID [by mouth three times a day] as well as morphine ER 100 mg po TID.

The pharmacist noted that this was unusual [concurrent prescriptions for two extended-release opioids] and put the order on pending status until clarified. The nurse told the pharmacist that since the patient was having pain, she had overridden and administered the oxyCODONE ER without pharmacy verification at a time when the pharmacy was open. Upon clarifying with the patient's pharmacy, the pharmacists determined that the patient was actually on oxyCODONE immediate release 40 mg po TID prn [as needed for] pain.

In 12.0% (n = 70 of 583) of the events, overrides occurred during the use of CPOE and/or pharmacist order entry systems. The most common types of alerts that were overridden were those for drug allergies, duplicate drug therapy,

and wrong dose/overdosage (Figure 5). High-alert medications were reported in 31.4% (n = 22 of 70) of these events; anticoagulants (50.0%, n = 11 of 22) was the class of high-alert medications most often involved.

Almost 20% (n = 13 of 70) of the high-alert medication reports mentioned overrides of *both* CPOE and pharmacy order entry system alerts for a given order, with a prescriber overriding an alert and the pharmacist also overriding the same type of alert. Of the reports that cited only CPOE systems (n = 48), 12.5% (n = 6 of 48) mention practitioners other than prescribers (e.g., nurses, unit secretaries) entering the orders into the system.

The following are examples of reports of errors associated with overrides involving electronic order entry systems.

Patient had a standing order for Coumadin® [warfarin sodium] 4 mg. The doctor ordered a 7.5 mg tablet but left the 4 mg order active. A duplicate therapy alert was generated and was overridden by the physician as "Not clinically significant." Pharmacist discontinued the existing 4 mg dose to avoid duplication of therapy, which could have resulted in patient getting 11.5 mg of Coumadin.

Lovenox® [enoxaparin sodium] treatment dose x1 ordered for patient in the ED. The physician received an alert since allergy field had heparin and related preparations. Physician entered override reason = "Give not a true allergy." Order verified and drug sent [by pharmacy] and was charted as given. Rapid response called the following morning. Platelets dropped to 30,000 platelets per microliter (mcL) [which is below the normal range]. However, after platelet value returned (and patient transferred off unit), pharmacist noticed the allergy field.

Patient's weight was accidentally entered into dose field by pharmacist. Patient received 74 units/kg/hr of heparin instead of 13 units/kg/hr, which exceeded maximum rate. Patient received 5,476 units of heparin over an hour instead of the ordered 962 units. Unclear why pharmacist overrode dose alert warning that fired. Nurse attempted to autoprogram pump but received alert and programmed pump manually.

A nurse took a telephone order from the doctor for potassium chloride 20 mEq po bid [by mouth twice a day], with the first dose given now. There was an override comment of "provider approved" entered, and the pharmacist verified the order without questioning if the patient should be on 2 separate potassium orders.

Overrides with the use of BCMA were cited in 7.5% (n = 44 of 583) of the

Figure 3. Technologies Overridden in Events Involving Overrides as Reported to the Pennsylvania Patient Safety Authority, 2013 through 2014 (N = 583)
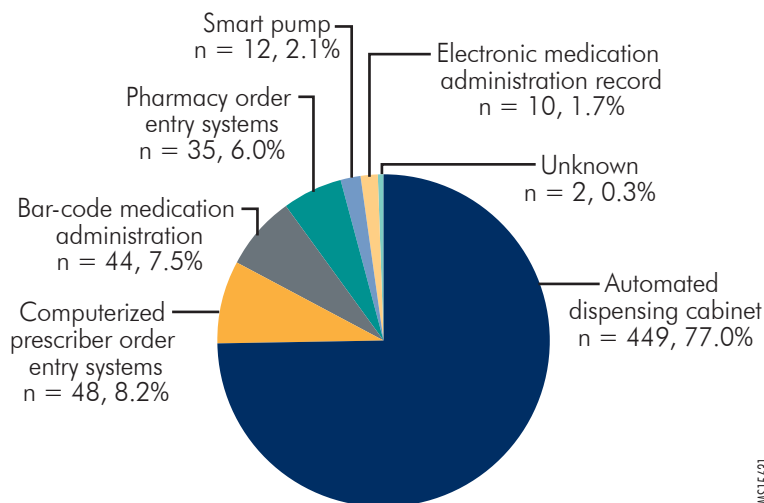
Note: Numbers add up to more than 583 because in 17 reports, multiple forms of technology were mentioned as being overridden within the same report.

events reported through PA-PSRS. The most common types of these events were wrong drug, wrong dosage form, and wrong dose/underdose (Figure 6). One out of four reports involving BCMA involved a high-alert medication.

Following are examples of reports of errors associated with overrides involving BCMA.

Patient received twice daily morning medications early prior to dialysis, including MS Contin® [morphine sulfate extended release] and Cellcept® [mycophenolate mofetil]. When patient returned from dialysis, the nurse gave the morning medications, including those that had already been administered. Early dose warnings had fired, but nurse overrode warning.

The nurse gave the patient the 5 mg dose of Coumadin that was for another patient. She did scan the patient, but she scanned the label on the bag instead of scanning the drug. She did receive a warning stat-

ing that this was not for the right patient, but she continued on and overrode the warning. The patient did get the correct drug and dose, but only because the two patients were ordered the same thing. The other nurse ended up having to call us for a missing dose.
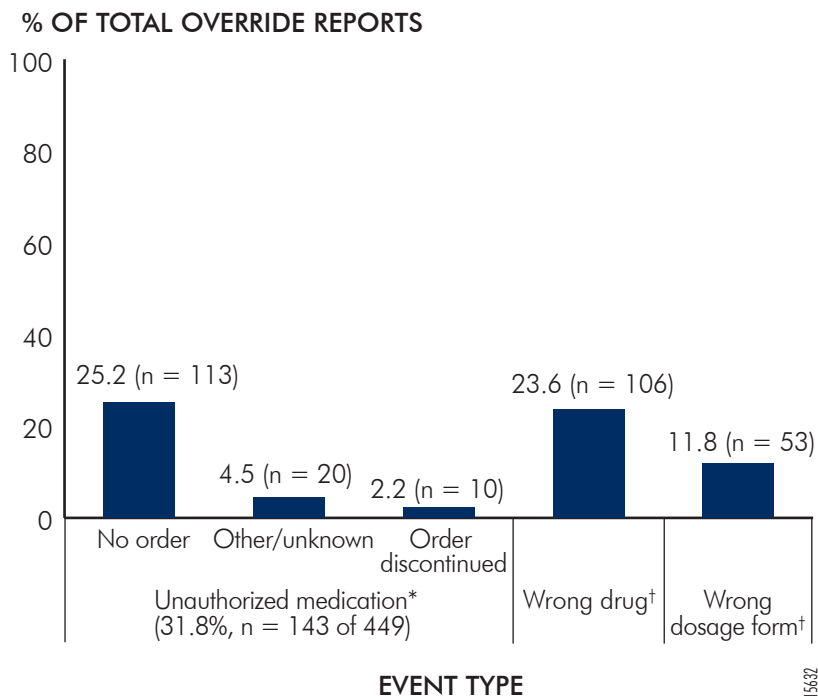
OxyCODONE [immediate release] 15 mg was dispensed from pharmacy instead of MS Contin 15 mg to [ADC]. Nurse removed [wrong] medication from Accudose and overrode the bar-code scan that indicated it was the wrong product.

DISCUSSION

ADCs can be linked to pharmacy computer systems (or "profiled") so that a pharmacist must review the appropriateness of a medication order prior to administration—most notably identifying drugs to which patients are allergic, unsafe doses, or unrecognized food or drug interactions—and approve that order

Figure 4. Common Event Types of Reports Involving Overrides of Automated Dispensing Cabinets, as Reported to the Pennsylvania Patient Safety Authority, 2013 through 2014 (N = 449)

% OF TOTAL OVERRIDE REPORTS

25.2 (n = 113)
4.5 (n = 20)
2.2 (n = 10)
23.6 (n = 106)
11.8 (n = 53)

No order   Other/unknown   Order discontinued   Wrong drug†   Wrong dosage form†

Unauthorized medication*
(31.8%, n = 143 of 449)

EVENT TYPE

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* 30.8% (n = 44 of 143) of the unauthorized medication events involved a high-alert medication.
† 16.4% (n = 26 of 159) of the reports mentioned situations in which medications were withdrawn "on override" before a pharmacist reviewed the order or when the pharmacy was closed.

before a nurse is able to remove the medication from the ADC.[5] These devices also allow for the use of overrides to bypass the pharmacist's review of a medication order when assessment of the patient indicates that a delay in obtaining a medication from the ADC (e.g., to wait for a pharmacist's review of the order) would harm the patient.
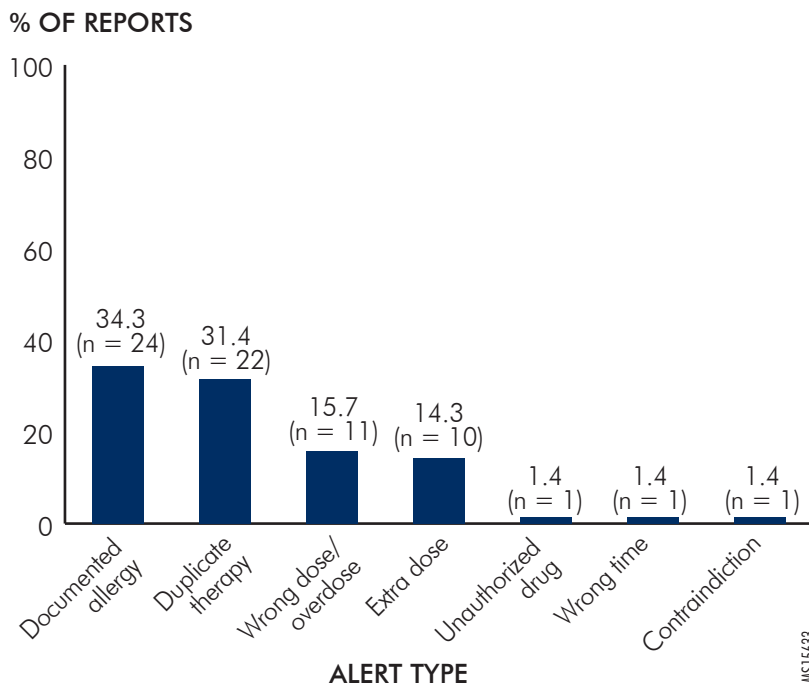
Organizations have developed lists, commonly called an "override list," of medications that can be removed from an ADC without a pharmacy review of the order. If there is an *urgent* clinical need for administering a drug before a pharmacist can reasonably be expected to review the order and/or dispense the drug, it is important to have readily accessible medications available on override in locations such as the ED and ICU. Therefore, the term "override" takes on a different meaning with this technology, as practitioners are not overriding or bypassing a clinical alert presented to them but are removing a medication before the pharmacist's review of an order. This practice can be unsafe when this crucial clinical review is routinely bypassed for convenience ("normalized deviance") or to remedy process problems such as excessive order turnaround time. After a review of 470 medication overrides, Kester et al. noted that 11.7% of overrides involved variances with written orders, and 85.5% of those variances were not appropriately documented.[6]

CPOE and pharmacy order entry systems have clinical decision support (CDS) systems, which can provide warnings about wrong dosages or other related prescribing conflicts, interactive computer programs, or other tools that are designed to assist physicians and other healthcare professionals with decision making.[7] CDS systems provide various forms and levels of alerts to indicate possible issues with medication orders, such as allergies to the prescribed medications, excessive doses, and therapeutic duplications. Unfortunately, little attention may be given to how the accuracy of these alerts should be best aligned with their appearance and degree of interruption. Many of these alerts are "soft stop" alerts, which can be interruptive and the user can dismiss by providing a simple override of the warning. The display of excessive numbers of alerts can lead to the phenomenon often referred to as "alert fatigue." The way alerts are prioritized and presented to the user may be as important as which alerts are presented. Alerts for very serious clinical situations (i.e., true positive alerts) may be ignored when lost in a sea of less clinically important or irrelevant ones (i.e., false-positives).

In a study involving adult primary care practices affiliated with a teaching hospital, Weingart et al. showed that physicians overrode 91.2% of drug allergy alerts and 89.4% of high-severity drug interaction alerts.[8] The physician reviewers in this study determined that 36.5% of the alerts were inappropriate. Slight et al. conducted a study (which included primary care practices affiliated with two Harvard teaching hospitals with over 1,700 prescribers) that evaluated the appropriateness of providers' drug-drug interaction alert overrides, the reasons why they chose to override these alerts, and what actions they took as a consequence of the alert.[9] The authors found that 68.2% of the drug-drug interaction alert overrides were considered appropriate. In addition, a detailed chart review revealed that of the appropriate alert overrides for which the provider

Figure 5. Types of Alerts Overridden in Computerized Prescriber Order Entry and Pharmacy Computer Systems, as Reported to the Pennsylvania Patient Safety Authority, 2013 through 2014 (N = 70)

LIMITATIONS

In-depth analysis by the Authority of overrides associated with the use of technology occurring in Pennsylvania hospitals is limited by the information reported through PA-PSRS, including the event descriptions and reasons why the event occurred. As a result, additional override events and associated causes may have been reported but were not identified by the query and analysis.

RISK REDUCTION STRATEGIES

The medication error events submitted to the Authority involving the use of overrides when using technology reveal the complex nature and variety of factors that contribute to errors. Some of those factors were an extension of the unique challenges associated with the use of each type of technology; however, many of the factors were similar across all forms of technology. It is also important to understand that the use of overrides is not a primary problem with the use of healthcare technology but rather a symptom of a larger problem of poor decision support design. Unfortunately, most of the reports did not provide much explanatory information about the errors, causes, and contributing factors. Even so, these reports, observations from the Institute for Safe Medication Practices, and recommendations in the literature do offer strategies that healthcare facilities may consider to decrease risk in the medication-use process.

General Strategies

Strategies that can be applied to all of these technologies include the following:

— Improve the positive predictive value (e.g., the number of true positive alerts compared with all positive alerts) of alerts, and adjust the presentation of the alerts (e.g., interruptive versus noninterruptive) according to how accurate they are.

indicated they would "monitor as recommended," only 35.5% actually did.

BCMA technology can improve medication safety through several levels of functionality.[10] At the most basic level, the system helps to verify that the right drug is being administered to the right patient in the right dose and at the right time. When one of these items does not match the patient record and order, most systems alert the practitioner prior to administration. For example, an alert may be presented when the patient does not have an active order or is allergic to the scanned medication or if the dosage strength scanned is higher than what was ordered. If BCMA systems detect mismatches between patient and medication or medication and medication order, audible and/or visual alerts are triggered.[11]

BCMA systems allow overrides if emergency administration of a medication is necessary, if the bar code on the medication's package is not recognized by the bar-code scanner, if the bar code is missing or unreadable, or if the patient's corresponding identification band cannot be scanned. In response to alerts, users either change their actions (e.g., find correct patient or medications) or override alerts and document their reasons for overriding the alerts. However, problems may occur when an alert is overridden. In a review of BCMA use at five hospitals that included analyzing BCMA override log data, Koppel et al. found that nurses overrode BCMA alerts for 4.2% of patients charted and for 10.3% of medications charted.[3] Possible consequences of those workarounds included administration of wrong medications, wrong doses, wrong times, and wrong formulations.

- Develop a mechanism to identify and remove alerts that provide little or no clinical value, which may contribute to alert fatigue.

- Solicit an explanation of the reasons or rationale for an override of alerts that are of high severity. Limit this strategy, as requiring an explanation for all alerts could further contribute to alert fatigue.

- Assess staff competency related to the safe use of technology and overrides, and provide education when indicated.

- Review and approve all override policies through the pharmacy and therapeutics (P&T) committee, medication safety committee, or an equivalent group.

- Review override reports to identify and address barriers to the safe use of healthcare technologies. Incorporate additional means to identify override hazards by reviewing the organization's medication error report data and external sources of information; conducting direct observation of the use of technology; and implementing conversations with end users to determine when and why staff use overrides.

Automated Dispensing Cabinets

The use of ADC overrides should be situationally dependent and should not occur merely because the desired medication is on a list of medications for which overrides are sometimes indicated.[12] While there may be a list of drugs with the potential to be obtained emergently, there may be many other situations when there is sufficient time for the pharmacist to review the medication prior to a nurse retrieving the dose. Establish criteria for system overrides that allow emergency access in circumstances in which waiting for a pharmacist to review the order before accessing the medication could adversely impact the patient's condition, but limit access before review in other

Figure 6. Types of Alerts Overridden in Bar-Coded Medication Administration Systems, as Reported to the Pennsylvania Patient Safety Authority, 2013 through 2014 (N = 44)
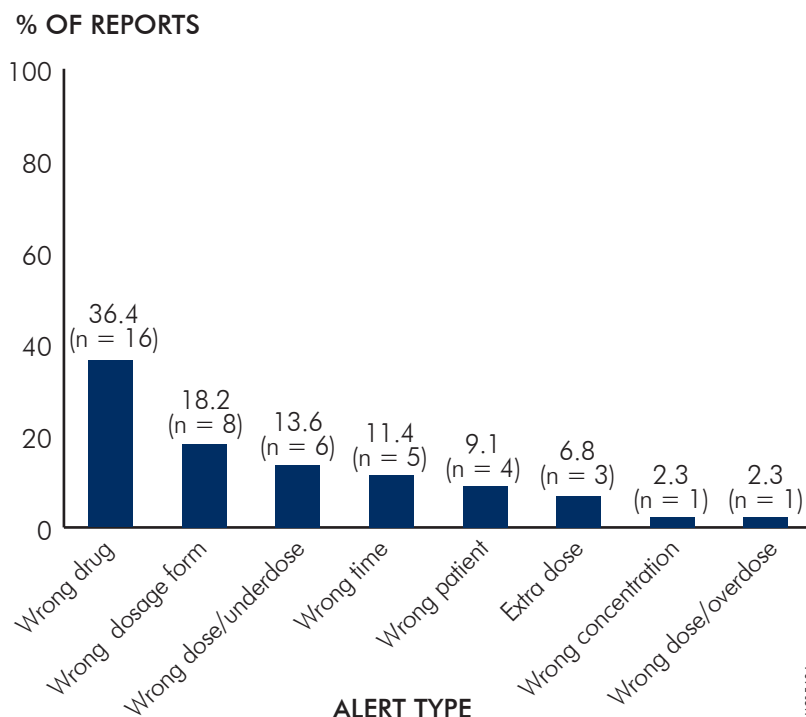
circumstances.[12] Additional strategies include the following:

- Developing clearly stated organizational policies and criteria for system overrides that limit access to medications before orders have been reviewed and approved by a pharmacist[13]

- Implementing strategies to reduce the risk of an error when an override is used, such as the following:[11,14]

  - Limit the quantity and number of drug concentrations available.

  - Minimize the use of multidose containers.

  - Ensure medications available for override are unit specific and removed only when there is an emergent need.

  - Use a process whereby the drug and dose are checked against the patient's allergies, and weight as appropriate, to determine if the drug and dose are appropriate.

  - Provide preparation instructions if the nurse is required to reconstitute or dilute a medication.

  - Require an independent double check with another licensed healthcare provider when using the override function to remove an organization-identified high-alert medication.

Computerized Provider Order Entry Systems

To realize the benefits of CDS, CPOE and pharmacy order entry systems need to be implemented correctly and used effectively. Too many alerts could lead to the

use of overrides, system rejection, or unanticipated outcomes such as an increased number of errors or adverse events.[15-17] Decreases in the volume of nuisance alerts have been shown to yield greater attention paid to potentially more valuable alerts.[18] Consider examining the alerts currently active in CPOE and pharmacy order entry systems, and evaluate if any may be turned off or relegated to a lower severity tier. Although vendor systems may allow alerts to be tiered, there is typically a significant amount of work necessary to vet any changes and carry out the technical work involved in the customization.

The combination of pharmacists' clinical knowledge of drugs and their experience with the interruptive alerts that have been present in pharmacy information systems for years provide pharmacists with a unique understanding of the many

implications of implementing medication-related CDS.[2] If organizations are in the process of implementing a CPOE system, consider and evaluate CDS components before CPOE implementation, keeping in mind that a high number of interruptive alerts may even threaten clinician acceptance of CPOE. Prescribers, pharmacists, and other practitioners, as appropriate, should participate in the development of medication-related CDS and should work with medical leadership—either through the P&T committee, an informatics committee, or another interdisciplinary committee—to decide how and when medication-related CDS will be customized and implemented.[2]

CONCLUSION

Healthcare practitioners use overrides when using various technologies related to

medication ordering and administration for a variety of reasons. Analysts identified 583 medication error events submitted to the Authority from 2013 through 2014 involving an override of technology that resulted in an error. A majority of event reports mentioned that these errors took place when healthcare practitioners were allowed to simply bypass a warning, with no other strategies in place to catch a resulting error.

Risk reduction strategies provided in this analysis may help organizations minimize the occurrence of override-related adverse events. Organizations may also consider providing criteria for the development of alerts (in any form of technology) that focus on real chances of patient harm while preventing alert fatigue.

NOTES

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PENNSYLVANIA PATIENT SAFETY ADVISORY

THE PENNSYLVANIA PATIENT SAFETY AUTHORITY AND ITS CONTRACTORS

The Pennsylvania Patient Safety Authority is an independent state agency created by Act 13 of 2002, the Medical Care Availability and Reduction of Error (Mcare) Act. Consistent with Act 13, ECRI Institute, as contractor for the Authority, is issuing this publication to advise medical facilities of immediate changes that can be instituted to reduce Serious Events and Incidents. For more information about the Pennsylvania Patient Safety Authority, see the Authority's website at http://www.patientsafetyauthority.org.

ECRI Institute, a nonprofit organization, dedicates itself to bringing the discipline of applied scientific research in healthcare to uncover the best approaches to improving patient care. As pioneers in this science for nearly 50 years, ECRI Institute marries experience and independence with the objectivity of evidence-based research. More than 5,000 healthcare organizations worldwide rely on ECRI Institute's expertise in patient safety improvement, risk and quality management, and healthcare processes, devices, procedures and drug technology.

The Institute for Safe Medication Practices (ISMP) is an independent, nonprofit organization dedicated solely to medication error prevention and safe medication use. ISMP provides recommendations for the safe use of medications to the healthcare community including healthcare professionals, government agencies, accrediting organizations, and consumers. ISMP's efforts are built on a nonpunitive approach and systems-based solutions.

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