PA PSRS
Pennsylvania Patient Safety Reporting System

Patient Safety Advisory

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Problems Associated with Automated Dispensing Cabinets

Traditionally, hospital pharmacies provided medications for patients by filling patient-specific cassettes of unit-dose medications, which were then delivered to the nursing unit and stored in medication carts. The Automated Dispensing Cabinet (ADC), a computerized point-of-use medication management system, is designed to replace non-automated floor stock storage, offer better control of medications that are available in the patient care area, and/or support the traditional patient cassette exchange drug delivery system. However, such systems cannot improve patient safety unless cabinet *design* and *use* are carefully planned and implemented to eliminate opportunities for wrong drug selection and dosing errors.

PA-PSRS has received a number of medication error reports that cite an ADC as the source of the medication. In fact, nearly 15% of all medication error reports cite ADCs as the source of the medication, and 23% of these reports involve high-alert medications. Many of these reports describe cases in which the design and/or use of ADCs has contributed to the errors. The types of errors include wrong drug errors, stocking/storage errors, and medications being administered to patients with a documented allergy.

Examples of contributing factors that may have led to these errors include:

- Lack of pharmacy screening of medication orders prior to availability for administration.
- Excessive use of overrides in cabinets with patient profiling, placing the patient at risk of allergic reactions, drug interactions, and other hazards.
- Failure to recognize look-alike names in the design of an ADC's alphabetic pick list or storage compartments, which can lead to choosing the wrong medication.

Types of Errors

One unsafe practice with the use of these devices includes the excessive use of overrides and workarounds to bypass pharmacy screening of medication orders prior to administration. The use of overrides, except in an emergency, results in circumventing the pharmacy verification process in order to obtain and administer medications prior to delivery by the pharmacy. Below are examples that have been reported to PA-PSRS:

> *A patient was ordered ZOSYN (piperacillin and tazobactam). The first dose was given in the emergency department, and a second dose was given on the medical unit. Both doses were retrieved from an ADC prior to review by the pharmacy. However, when pharmacy reviewed the order, it was noted that the patient had a documented allergy to penicillin.*

> *An order was given for a stat dose of morphine. The patient had a documented allergy to this drug. A pharmacist caught the error and contacted the physician, but not before the nurse had used the override function to take morphine out of the ADC and administered it to the patient.*

Luckily, neither of the above patients experienced serious adverse effects due to these errors.

Overrides are not the only examples of workarounds used to access medications from ADCs. Other types of workarounds include the removal of medications using the "inventory" function (designed to determine the current number of doses of a particular medication on hand) to gain access to medications for patients without pharmacy screening, removing a larger quantity of medications than ordered for one patient, and removing medications for multiple patients while the cabinet is open.

Choosing the wrong medication from an alphabetic pick list is another common contributing factor for medication errors arising from medication names that look alike. For example, one organization reported to

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the USP-ISMP Medication Errors Reporting Program (MERP) three errors regarding mix-ups between diazepam and diltiazem removals from the ADC in their intensive care unit. In one case, diazepam was given at the ordered diltiazem dose. In another, a physician noted the amber color of the diazepam vial as the nurse was drawing up the dose (of what the nurse thought was diltiazem).

The organization concluded that once the wrong drug was chosen, the cabinet seemed to "confirm" that the correct drug was chosen since the nurse assumed the correct drug was chosen from the menu and thought the correct drug was in the drawer that opened. The nurse "relied" on the ability to choose the right drug from the pick list and, in these cases, no physical check of the product or reading of the label was done. Also in these cases, the cabinet did not contain a patient profile system, which may have prevented this error. For example, the cabinet would not have allowed entry if diltiazem had been picked from the screen display since diazepam had been entered on the patient's profile.

Storing medications with look-alike names and/or packaging next to each other in the same drawer or bin is one of the major contributing factors leading to errors.[1] A common cause of these mix-ups is what human factors experts call "confirmation bias,"[2] in which one "sees" what one expects to see. When confirmation bias occurs, it is unlikely that the practitioner would question what is being read. This can occur both in the removal of medications and in the restocking of the ADC.

Examples of these type errors from PA-PSRS include:

> *During a cardiac catheterization procedure, a nurse received a verbal order for IV LOPRESSOR (metoprolol). However, when retrieving the medication from the ADC she withdrew LEVOPHED (norepinephrine) instead due to these look-alike medications being stored in adjacent bins. The patient received the incorrect medication and required an increased level of care.*

> *A nurse took a verbal order from a physician for hydroxyzine 25 mg IM every 3 hours as needed for itching and wrote the order correctly in the patient's chart. However, when she went to the ADC, she pulled hydralazine and administered 25 mg IM to patient, resulting in a significant decrease in blood pressure.*

> *A prescriber ordered HYDROmorphone 0.5 mg IV for a patient. However, when the ADC drawer was opened both morphine and HYDROmorphone were available for retrieval. The healthcare practitioner mistakenly retrieved morphine and administered it to the patient.*

Storing excessive quantities of medications in ADCs can set practitioners up to make errors. For example, in a report submitted to the MERP, an order was written for "calcium gluconate 1 g IV," but a nurse misread the label on the medication vial and believed that ten vials of 10% calcium gluconate were needed (each 10 mL vial containing 98 mg/mL of elemental calcium, or 980 mg total). Ten vials of medication (each containing 98 mg/mL) could have been removed from the ADC, but this error was avoided because the cabinet contained only six vials of calcium gluconate. The error was detected when the nurse contacted a pharmacist at home to obtain additional vials.[3] This error highlights the importance of limiting stock in ADCs.

The process of restocking medications into an ADC is primarily a pharmacy function. Unfortunately, cabinets that do not have bar coding capabilities must rely on individual vigilance or the use of a double check involving two individuals. That leaves the process vulnerable to errors, as illustrated by the following reports submitted to PA-PSRS:

> *A patient was ordered BUPRENEX (buprenorphine) 0.3 mg as needed for pain. The nurse found that NUBAIN (nalbuphine) was stocked in the Buprenex drawer. The patient was medicated with the correct medication which was found in a storage compartment beside the Buprenex compartment.*

> *A patient was ordered FIORINAL (aspirin, caffeine, and butalbital). However, the wrong medication, FIORICET (acetaminophen, butalbital, and caffeine), was stocked in the Fiorinal compartment. The patient received one dose of Fioricet instead of Fiorinal. The patient experienced no adverse effects.*

> *A nurse noted HYDROmorphone 4 mg injections had been stocked in the morphine 4 mg compartment in the ADC. Pharmacy was notified and it was found that two patients may have received the wrong drug.*

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In this last case, a serious error could occur if HYDROmorphone (DILAUDID) was used in place of an ordered morphine dose since HYDROmorphone is several times more potent than morphine.

The MERP has also received reports of similar occurrences. For example, one hospital reported placing the muscle relaxant tizanidine (ZANAFLEX), in the ADC compartment intended for tiagabine (GABITRIL), an anticonvulsant. The typical starting doses for each of these medications are similar as are their generic names, so the error was not discovered for a number of days; one patient received four incorrect doses but fortunately suffered no ill effects. In another hospital, a nurse found an Abbott Carpuject syringe of digoxin 0.25 mg/mL in the drawer that was to contain ketorolac 30 mg. Many of the Carpuject syringes look similar to one another, which could easily result in a mix-up during the stocking process. Until barcode technology is utilized during the stocking process, a check process after restocking automated dispensing cabinets may be as important as the check process conducted in the pharmacy.[4]

Strategies to Improve ADC Safety

Consider the following strategies to promote the safe use of ADCs:[3]

- If your organization is purchasing an automated dispensing cabinet, consider those that allow for patient profiling so pharmacists can enter and screen drug orders prior to their removal and administration.
- Consider purchasing or upgrading to systems that utilize bar-code technology for restocking of medications.
- Ensuring medication orders are screened by the pharmacy for the appropriateness of the drug, dose, frequency, and route of administration, therapeutic duplication, allergies or sensitivities, interactions between the prescription and other medications, food, and laboratory values, and other contraindications. This is particularly important for "high-alert" medications stored in ADCs.
- Considering the needs of each patient care unit as well as the age and diagnoses of patients being treated on each unit when deciding what drugs will be stocked in each unit's ADCs.
- Avoiding bulk supplies of medications (e.g., multidose vials, bulk oral solutions). Instead, try stocking drugs in ready-to-use unit doses.
- Using individual cabinets or storage drawers to separate pediatric and adult medications.
- Developing a check system to help ensure accurate cabinet stocking. Another staff member from pharmacy or nurse on the unit can verify accurate stocking by having pharmacy provide a daily list of items added to the cabinet. Employing bar-code technology during the stocking process can also help assure accuracy.
- Placing allergy reminders for specific drugs, such as antibiotics, opiates, and nonsteroidal anti-inflammatory drugs (NSAIDs) on the cabinet screens or with each individual medication's cube. Some systems allow staff to build alerts that appear on the screen when attempting to access selected drugs.
- Limiting the override function to *emergency* situations. A list of medications that can be obtained without pharmacy profile is not needed. Lists can give the false impression that certain medications may always be obtained rather than incorporating an understanding that only medications needed in an emergency situation can be obtained via override.
- Routinely running and analyzing override reports to help identify changes that need to be incorporated in the system.
- Removing only a single dose of the medication ordered. If not administered, returning the dose to the pharmacy or ADC return bin to allow pharmacy to replace it in the cabinet.
- Periodically reassessing the drugs and quantities stocked in each unit-based cabinet.

Notes

1. ISMP. ISMP Medication Safety Alert!® Acute Care Edition. 6 October 1999;(4)20.

2. Cohen MR. The role of drug packaging and labeling in medication errors. In: Cohen M, ed. Medication errors. Washington (DC): American Pharmaceutical Association; 1999.

3. ISMP. ISMP Medication Safety Alert!® Acute Care Edition. 2 December 1998;(3)24.

4. ISMP. ISMP Medication Safety Alert!® Acute Care Edition. 6 February 2003;(8)3.

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The 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, as contractor for the PA-PSRS program, is issuing this newsletter to advise medical facilities of immediate changes that can be instituted to reduce serious events and incidents. For more information about the PA-PSRS program or the Patient Safety Authority, see the Authority's website at www.psa.state.pa.us.

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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 non-punitive approach and systems-based solutions.

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