## USP Medication Safety Forum

# Errors Prevented by and Associated with Bar-Code Medication Administration Systems

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This department features medication error issues based on data collected by the United States Pharmacopeia (USP).

Adverse drug events, which include preventable medication errors, are a leading cause of harm to patients.[1] One technological solution to prevent frequent medication errors is bar-code medication administration (BCMA). BCMA technology involves placing a unique identifier (bar code) that is machine readable by an optical scanner on each medication. The medication bar code encodes the National Drug Code (NDC), which includes the drug company labeling the package for sale, the name of the drug and its dose, and the type of packaging.[2] For hospitalized patients, an additional bar code is affixed to the patient's wristband or identification bracelet to ensure positive patient identification.[3] BCMA technology has been endorsed by a number of patient safety organizations, including the Agency for Healthcare Research and Quality and the Institute of Medicine and has been widely implemented in organizations such as the Veterans Administration.[4] In a 2005 national survey of hospital pharmacy practice, the American Society of Health-System Pharmacists reported that 9% of hospitals used BCMA technology.[5] A 2005 survey of small rural hospitals with fewer than 50 beds found that 3% had implemented BCMA and that 50% had plans to implement this technology within the next three years.[6]

The effectiveness of BCMA to prevent medication errors before they reach a patient has been documented.[2–4,7] This ability is particularly important in the administration phase of the medication use process, where fewer opportunities exist to intercept errors than in the prescribing, transcribing, or dispensing phases. Before medications are administered, BCMA matches the right medication with the right patient at the right time.

Technology alone, however, does not ensure a safe medication use system. For example, computerized physician order entry has demonstrated the ability to reduce errors originating in the prescribing phase, but process changes accompanying the technology can introduce new sources of error.[5] The unintended consequences of BCMA technology have been described using the experiences of individual organizations.[3,7–9]

The purpose of this article is twofold. First, to illustrate the BCMA technology's effectiveness we describe ways in which it prevented medication errors. Second, we describe reported errors associated with BCMA so that institutions that implement this technology can minimize the likelihood of similar errors. We used reports of errors submitted to MEDMARX®, a national database of voluntarily reported medication errors, to describe how BCMA technology can improve the safety

**Table 1. Types of Errors Prevented by BCMA Technology by Phase of Medication Use Process***

| | Dispensing (*N* = 51) | | Administration (*N* = 19) | |
|---|---|---|---|---|
| Type of Error Prevented | *n* | % | *n* | % |
| Incorrect medication dispensed | 18 | 37 | 0 | 0 |
| Incorrect dose dispensed | 14 | 28 | 0 | 0 |
| Stocking or storage errors | 11 | 22 | 0 | 0 |
| Early dose warning | 2 | 4 | 11 | 58 |
| No drug order | 4 | 8 | 8 | 42 |
| Other | 2 | 4 | 0 | 0 |

* BCMA, bar-code medication administration system. No reports originated in the prescribing or transcribing phase of the medication use process.

of the medication use system, but may also be an unintended source of error. MEDMARX enables subscribing hospitals and health systems to document and analyze medication errors in a standard format and to compare this analysis with other subscribing institutions.

Between June and August 2006, we examined MEDMARX reports of medication errors associated with BCMA technology by performing a free-text search of the error description using variations of the phrase "bar code" that had been submitted from January 1, 2000 through December 31, 2005. This search identified 2,783 error reports from 65 hospitals and related health systems. Approximately 80% (2,237) of these reports were submitted by one facility and were excluded from the analysis. Thirty-one errors occurred in a clinic or ambulatory care environment and are not described in this analysis. The remaining 515 reports were divided into two categories: 70 reports in which BCMA technology prevented an error from reaching the patient, thus illustrating the effectiveness of the technology; and 445 reports in which the reported error was a consequence of the BCMA technology. For both categories of error reports, we describe the phase in the medication use process in which the error originated and specific BCMA-related causes on the basis of the free-text description of the event in each report. For the 445 BCMA-related error reports, we also describe the outcome of the error using the National Coordinating Council for Medication Error Reporting and Prevention's (NCC MERP) Index for Categorizing Medication Errors, which defines the severity of the outcome of the potential or actual medication error to the patient using an alphabetical ranking, A through I.

## Errors Prevented by BCMA Technology

### Dispensing Phase of the Medication Use Process

Table 1 (left) summarizes the 70 reported errors that were prevented by BCMA technology and the phase of the medication use process in which they originated. Fifty-one (73%) errors originated in the dispensing phase. In 18 (37%) of these 51 dispensing errors, a nurse using BCMA technology to scan the product at the point of drug administration detected that a wrong medication had been dispensed by the pharmacy. In 14 (28%) of these 51 dispensing errors, providers detected the wrong dose of the correct medication. Often, these wrong dose errors were caused by similar packaging before the product was released from the pharmacy. Eleven (22%) of the 51 reported dispensing errors were stocking or storage errors, typically associated with automated dispensing devices. Two reports described storing stock medication bottles in wrong and potentially dangerous locations in the pharmacy.

***Case Reports****

1. A nurse reported that trimethobenzamide suppository had been stocked in an automated dispensing drawer intended for bisacodyl suppository. The error was caught when scanning the package's bar code and the wrong drug was not given.
2. A nurse reported that hydralazine had been stocked in automated dispensing location designated for hydrochlorothiazide. The error was detected by the product's bar code.
3. A pharmacy staff member reported that two strengths of levothyroxine are in similar bottles with similar labels and share similar colors. The error was discovered before the drug was dispensed to the floor using bar-code technology within the pharmacy.
4. During a period of short staffing, Lexapro 10 mg was retrieved for Lexapro 20 mg. The error was detected when the product's label was scanned before releasing the product for patient use.

* Case reports reflect actual error descriptions but may have been modified for clarity.

**Table 2: Types of Errors Associated with BCMA Technology by Error Severity***

| | Near Miss (Categories A and B) | | Nonharmful (Categories C and D) | | Harmful (Category E) | | Total (All Categories) |
|---|---|---|---|---|---|---|---|
| Errors Associated with BCMA Technology | *n* | % | *n* | % | *n* | % | *n* |
| Mislabeling of medication with incorrect bar code | 94 | 73 | 34 | 27 | 0 | 0 | 128 |
| Lack of bar code | 105 | 90 | 12 | 10 | 0 | 0 | 117 |
| Inability to scan bar code | 47 | 90 | 5 | 10 | 0 | 0 | 52 |
| Override of error warning | 2 | 9 | 20 | 87 | 1 | 4 | 23 |
| Bar code not scanned | 0 | 0 | 34 | 100 | 0 | 0 | 34 |
| Workarounds | 0 | 0 | 43 | 100 | 0 | 0 | 43 |
| Wrong patient | 2 | 29 | 5 | 71 | 0 | 0 | 7 |
| System not available | 0 | 0 | 4 | 80 | 0 | 0 | 5 |
| Miscellaneous | 34 | 92 | 3 | 8 | 0 | 0 | 37 |
| **Total** | 284 | 64 | 160 | 36 | 1 | <0.1 | 445 |

* BCMA, bar-code medication administration system. No Category F, G, H, or I errors were reported. Percentages have been rounded.

### Administering Phase of the Medication Use Process

Of the 70 prevented medication errors, 19 (27%) were intercepted by nurses using BCMA technology in the administering phase of the medication use process (Table 1). In 11 (58%) of these 19 reports, nurses received an "early dose warning," which averted the error. In eight (42%), the BCMA alert came when the nurse attempted to administer a medication for which no order existed. Although use of BCMA technology prevented administration of medications for which no order existed, the underlying causes of these "near miss" reports were not evident from the description.

*Case Reports*

1. A nurse scanned the bar code on the bottle of insulin and the system generated a "dose early" warning. The nurse did not give the insulin.
2. A nurse attempting to administer a dose of levofloxacin scanned the product at the patient's bedside and received a "no order in system" warning message. On chart review, the warning message that the product was not intended for that patient was affirmed.

## Errors Caused by or Associated with BCMA Technology

Error Severity and Node of the Medication Use Process. MEDMARX contains a number of error reports (*n* = 445) where BCMA was in place and the error was either caused by the technology or indirectly associated with the technology (Table 2, above). Of these 445 reported errors, 284 (64%) were either opportunities for error or actual errors that were intercepted by hospital staff before reaching the patient (Categories A and B). There were 160 (36%) errors that reached the patient but did not result in harm (Categories C and D). One error caused temporary harm (Category E). No errors were reported that caused prolonged hospitalization, permanent harm, or death (Categories F through I).

One-third (*n* = 146) of the reported errors that were caused by or associated with BCMA were identified as Category A and, thus, not associated with a specific phase of the medication administration process. Almost three-quarters of these Category A reports involved medications without bar codes or medications with bar codes that could not be machine read (*n* = 108).

For the 299 of the 445 reviewed reports that were actual errors (Categories B through E), 151 (51%) originated in the dispensing phase of the medication use process, 92 (31%) originated in the administering phase, 52 (17%) originated in the transcribing phase, and 4 (1%) originated in the prescribing phase.

### Failure Points Identified in BCMA

A content analysis of the descriptions of the errors either directly caused by or indirectly associated with BCMA revealed eight areas of actual or potential failure within the BCMA process (Table 2).

## Mislabeling

There were 128 reported mislabeling errors associated with BCMA technology, of which 94 (73%) did not reach the patient; 34 (27%) reached the patient and did not result in harm (Table 2). Sixty-five of the 128 reported mislabeling errors resulted from attaching a bar code associated with one product to a different product. Twenty-nine of the mislabeling reports indicated that the bar code was affixed to the correct medication, but the wrong strength of the product. Twenty mislabeling reports indicated that the bar code was affixed to the wrong dosage form of the right product. Fourteen of the reports related to mislabeling identified sound-alike medications (for example, Cefepime/Cefotan, Niaspan/Niacin) as the cause of the mislabeling error.

### *Case Reports*

1. Staff discovered metoclopramide 10 mg vials bar coded as norcuron 10 mg.
2. A pharmacy department dispensed ketorolac 30 mg syringes to the patient care unit in a zipped-lock bag with a bar code that scanned as heparin 5,000 units.
3. A nurse was preparing to administer a fentanyl patch 75 mcg. The machine indicated that the product was a fentanyl patch 100 mcg. The nurse contacted the pharmacy department, which determined that the patches were incorrectly bar coded manually by a technician.
4. An intravenous (IV) piggy back containing ampicillin 3 gm was prepared by a pharmacy department and sent to the floor. As the nurse was preparing to administer the medication, the bar-code system indicated that the product was gentamycin. On further investigation, it was found that two bar-code labels were on the piggy-back container, and the pharmacy resolved the discrepancy.
5. A physician wrote an order for sodium chloride 20 mEq. The pharmacy prepared the correction medication. At the point of medication administration, the bar-code system indicated that the product was potassium chloride 20 mEq. The pharmacy department resolved the discrepancy, and the correct medication was administered to the infant.

## Lack of Bar Code

For 105 (90%) of the 117 reported errors or near misses that were caused by medications lacking bar codes, drugs without bar codes were identified as safety concerns by staff and either administered correctly without using BCMA technology or returned to the pharmacy for appropriate labeling. The time required for a medication to be appropriately labeled or for a new dose to be dispensed frequently resulted in delayed treatment. Reports also described instances in which medications could not be appropriately bar coded. In 12 (10%) reported errors, the bar-coding system was not used and medications were administered in error.

### *Case Reports*

1. A nurse reported that all vials of regular insulin in the intensive care unit (ICU) were missing a bar code.
2. An evening dose of procainamide sustained release (SR) was ordered, but the pharmacy dispensed procainamide 500 mg (immediate release). The package contained no commercial or manual bar code. The nurse did not detect the incorrect dosage form and administered one and a half tablets in error.

## Inability to Scan Bar Code

For 47 of the 52 error reports describing medications with bar codes that could not be machine read, the practitioner either contacted the pharmacy and obtained the medication or performed visual validation of the correct product and correct dose and gave the medication. This action signals a regression to a manual system. In the remaining five cases, the medications were administered and resulted in nonharmful errors. Underlying causes of errors were not evident in most of the cases; 25 reports involved parenteral medications.

### *Case Reports*

1. A physician prescribed quarter normal saline (0.225%) with potassium phosphate, a solution that was prepared by the pharmacy as normal saline (0.9%) with potassium phosphate. However, neither the bar code nor pharmacy-applied label was readable, and the solution was returned to the pharmacy.
2. A patient was given hydromorphone 1 mg instead of meperidine 50 mg. The BCMA did not detect the error. On further investigation, it was found that the injectable containers purchased by the institution included the lot number with the bar codes, which rendered them unreadable.

## Overrides

Of the 445 BCMA-related errors, 23 (5%) occurred because providers ignored BCMA-generated warnings. All but two of these overrides reached the patient, and one error resulted in temporary harm. In each case, the technology identified the error before administration, but the error messages were ignored.

### *Case Report*

1. Although a physician ordered estradiol 0.1 mg/day weekly patch, pharmacy dispensed estradiol 0.1 mg/day biweekly patch. When a nurse was applying the patch, the package was scanned and BCMA generated an error warning, "Medication order not found." The nurse overrode the warning, administered the medication, and documented in the patient's charting that the scan did not locate the order.

## Bar Codes Present But Not Scanned

In 34 (8%) of the 445 BCMA-related error reports, bar codes were available on the medication but were not scanned. All these errors reached the patient. Some of the errors involved the wrong patient, some the wrong product, and some the wrong dosage form of the correct product. Medication administration was documented manually without using the BCMA technology. There were no indications from the error descriptions that the system was not available.

### *Case Reports*

1. A nurse intended to administer an IV infusion of pantoprazole. However, the nurse did not scan the solution bag and unintentionally initiated an infusion containing insulin, which was completed during a 30-minute period. As a result of the error, the patient underwent serial blood glucose monitoring every 15 minutes and an infusion of dextrose 50%. It was later determined that neither the patient's ID bracelet nor infusion bag had been scanned.
2. A nurse did not scan a "double-strength" magnesium drip before infusing the solution but rather selected the magnesium from the computer-generated list. As a result, the nurse programmed the infusion device as "single strength."
3. An order was written for warfarin 5 mg daily. The initial dose was administered and manually charted but not scanned. The BCMA system later showed an "overdue" dose. The evening nurse administered a second dose of warfarin using the BCMA system.
4. A physician gave orders for digoxin 0.5mg (IV) and amiodarone 100mg in response to sudden onset of rapid atrial flutter. Before pharmacy review, a nurse administered the correct dose of digoxin but an incorrect dose (200 mg) of amiodarone.
5. A nurse reported giving carvedilol 12.5 mg instead of captopril 12.5 mg, which resulted in the patient's transfer to an ICU. The wrong product had been dispensed to the patient's drawer, and the nurse did not scan the medication before administration. The two products' similar strengths also contributed to the error.

## Workarounds

Workarounds (the use of BCMA in ways that circumvent its safety advantages) by nursing and pharmacy personnel accounted for 43 (about 10%) of all BCMA-related error reports—all of which reached the patient. The most frequently reported nursing work-around involved scanning the patient's identification from the chart (rather than the patient's wristband at the bedside), and scanning medications at the nurses' station (rather than at the bedside) in preparation for passing medications.

## Wrong Patient

Seven reports (2%) associated with BCMA technology were for medications administered to the wrong patient. Causes of these errors included "stat" orders, medications being scanned after administration, and scanning a patient's ID from the wrong chart instead of using the patient's wristband. Each of the two reports involving "stat" orders was potentially serious; the medications were appropriately bar coded but were administered before the medications could be entered into the computerized medication system.

### *Case Reports*

1. A physician requested a stat dose of furosemide 40 mg to be administered intravenously. A nurse obtained the medication via override from an automated dispensing device and administered it to the wrong patient. Neither the patient nor the product had bar-code ID.
2. A wrong patient error resulted when a nurse scanned the patient's drawer (delivered from the pharmacy to the floor) rather than the wristband and administered the wrong medications.

### System Not Available

Four reports of BCMA technology-related errors, all of which reached the patients, were due to technology failure. For three of these errors, the BCMA system was temporarily unavailable. The remaining report described an instance where medication orders in the computer system were not transmitted to remote or handheld computers/scanners.

## Discussion

The analysis reported in this article indicates that BCMA technology can prevent medications errors and functions as an important safety net to prevent errors at the patient's bedside during the administration phase of the medication use process. This is especially important because there are few opportunities to intercept errors at the sharp end of care, where the patient and caregiver interface with the product. Data from MEDMARX indicate that once an error has reached the point of administration, it is least likely to be intercepted before reaching the patient as compared with other phases of the medication use process.[10] The analysis also demonstrates the value of reporting medication errors that do not reach the patient. Although completing such reports may be time consuming, reporting affirms both the effectiveness of the technology and contributes to knowledge regarding its use. Nearly two-thirds of all reports associated with BCMA technology were near misses. These reports offer an opportunity to identify latent system sources of error and make changes before a patient is harmed. Harmful medication errors and near misses with catastrophic potential should be examined by a multidisciplinary team to identify sources of system failures.

The most frequent cause of BCMA-related errors was mislabeling, with 27% of these errors reaching the patient. It is possible that mislabeling-associated medication errors are significantly underreported. Mislabeled medications can still be intercepted and reported when nurses compare the printed label to the information displayed by the BCMA system. When that comparison is not performed and the bar-code scan is the only system check, medications with the appropriate bar code affixed to an incorrect drug will be unknowingly administered to patients. Staff members cannot abandon professional responsibility for reading product labels after the BCMA technology confirms the correct medication and dose.

Because the consequences of giving the wrong medication can be catastrophic, these reports were analyzed to determine how mislabeling occurred. Two major themes emerged. First, the dispensed product was incorrectly labeled with a bar code belonging to another product; and second, the right drug was incorrectly labeled with either the wrong strength or wrong dosage form. Look-alike or sound-alike products were often sources of error. These errors were detected when astute nursing personnel went beyond "trusting the machine" and reviewed the packaging before administering the product. The reports indicate that health care organizations should incorporate a final check of any bar-code label affixed to repackaged material and need to carefully consider how best to apply bar codes to products with similar names. This additional check will have to be performed within the pharmacy for compounded injectable medications because manufacturer labeling will not contain additives. If a larger proportion of medications were available as unit doses from manufacturers, the need for hospitals to relabel medications would be reduced.

Medications without bar codes were the second most frequently reported cause of BCMA-related errors. This type of error was reported when staff attempting to administer the medication found no evidence of a bar code. Feedback such as this is necessary for local quality improvement activities to remedy the situation. The issue of purchasing medications without bar codes should largely be resolved by the Food and Drug Administration bar-code rule that went into effect in April 2006.[11] All reports in this analysis were submitted before this rule mandating bar codes for all existing drugs. This rule, however, does not require manufacturers to provide medications in unit-dose packaging. In some cases, manufacturers may decide to only offer a medication in bulk stock bottles. Medications that are not available from the manufacturer as unit doses must be labeled with an appropriate bar code by the dispensing hospital, which increases the likelihood that mislabeling errors will occur. Institutions adopting BCMA technology have found it necessary to devote additional information technology support personnel and pharmacy technician time to produce bar-code labels for unit dose medications.[12]

Other reported problems associated with reading bar codes included smearing or fading of bar codes on

medications or patient wristbands and differences in equipment used. Although technology using "pens" or wands is generally less expensive than using hand-held devices,[13] difficulties reading bar codes on curved or uneven surfaces have been reported when scanned with pens and wands. Manufacturers and pharmacies that affix bar codes to unit-dose medications must ensure the integrity of machine readability by selecting an appropriate color of ink for bar-code characters and placing the characters within a field where there is sufficient contrast between ink and packaging.

The reasons that BCMA-generated warnings were ignored by hospital staff cannot be determined from these reports. Organizations adopting or utilizing BCMA technology should insist that vendors' products incorporate standard override reports that can be readily reviewed by appropriate personnel. Follow-up of these reports can offer near real-time evidence about why the override occurred and can be useful for planning interventions to reduce these events in the future. Organizations must plan for false-positive warnings and institute policies and procedures that reduce the occurrence of such alerts. The consequence of frequent false-positive warnings is that staff members are likely to ignore warnings for real errors.

In some cases, medications with readable bar codes were not scanned. The consequences of not using the BCMA technology extend beyond increasing the likelihood that a wrong medication will be administered or a wrong patient error will occur. Because manual verification of administration on a paper medication administration record (MAR) doesn't update the computerized MAR, the BCMA system indicates that a dose was not given, which can result in extra dose errors. Workarounds using the paper system thereby circumvent the safety net of the BCMA system and also introduce an additional system source of extra dose errors. Errors resulting from "stat" orders were rare but potentially serious. Because stat orders circumvent many of the safety nets in the medication use system, prescribers should ensure that an urgent need exists and that a system is in place to minimize the risk that a medication error will occur. Stat orders may necessitate additional manual double checks between health care providers before a medication is administered.

The underlying causes for workaround errors were difficult to determine from the available error descriptions. It is likely that some errors result from pharmacists and nurses who purposefully circumvent the system to save time. Research regarding the sustainability of system changes indicates that change that is sustained must have benefits for process simplification and making jobs easier in addition to improving the safety of care.[14] Staff members from evening and weekend shifts and from unique patient care areas should be included when developing BCMA–related policies and procedures.

## Limitations

There are limitations to this descriptive study. Because MEDMARX does not currently collect causal information specific to BCMA technology, we created qualitative BCMA-related causes from the free-text description of the error. Error descriptions are generally abbreviated by the primary reporter and are therefore subject to misinterpretation. In addition, the error reports in this analysis do not include all reports submitted to MEDMARX from each hospital. Only reports containing variations of the words "bar code" were captured, so it is possible that additional errors related to BCMA technology were reported.

## Recommendations

Recommendations to reduce BCMA System Errors are listed in Table 3 (page 300). In addition, health care institutions using or considering BCMA must be aware of the failure points identified in this study and must develop policies and procedures to handle such occurrences. For example, when a pharmacy department obtains a commercial product without a bar code and repackages or relabels the original product, policies should direct the "checks and balances" needed to affirm that the product selected matches the new bar-code label. Once the "batch" has been completed, a second person could perform the first validation step in an uninterrupted manner, and a pharmacist should then perform the final review of the original container against the sample of the packages and confirm product name, strength, and dosage form. Furthermore, the new container's bar code should be scanned by a machine to affirm readability and a final confirmation of the product and strength before the product is placed in general stock. Pharmacy labels should incorporate the use of sufficient quality ink to avoid smearing. The label's adhesive nature must also be

**Table 3. Recommendations to Reduce Bar-Code Medication Administration System (BCMA) Errors**

1. Purchase unit of use medications with manufacturer bar codes whenever possible.
2. Double-check all hospital generated bar-code labels including compounded injectable medications before the product leaves the pharmacy.
3. Carefully review all BCMA override reports. Address system workarounds through process change and staff education.
4. Minimize false-positive warnings to reduce the likelihood that staff will ignore warnings for real errors.
5. Ensure that an urgent need exists for all "stat" orders as pharmacy review and advantages of bar code administration are usually circumvented.
6. Establish institutional policies and procedures that can be easily implemented when products fail to scan. Processes in pharmacy will likely be different than processes at the point of care.

considered. If the label is placed on a unit-dose medicine, it should be placed in such a manner that the original label from the manufacturer is still visible and does not cover product name or strength. Ideally, pharmacy departments should sufficiently plan to the extent possible that products with the same generic name but of different strengths are not manually repackaged on the same day to eliminate the opportunity for a wrong-dose error resulting from packing the wrong strength. As new products are placed on the formulary, the pharmacy department's information technology representative must contribute to the process of obtaining the new bar code and updating the bar-code database. Daily, the pharmacy department should also plan to examine override logs to determine why the override occurred, which may help identify particular equipment in need of attention or a unit that is having difficulty in implementing the patient safety plan.

Policies should be created to address inability to scan bar codes—for example, basic troubleshooting of the scanning equipment, and, if the equipment is found to be faulty, who to notify for replacement equipment. If the equipment is functional and the product still does not scan, the policy might stipulate that the scanning procedure be repeated with another package. If that package fails to scan, time permitting, the person administering the product should contact the pharmacy department and obtain a replacement dose that does scan. A pharmacy representative should respond to these calls in a timely manner to avoid wrong-time errors.

An override of the system should be of last resort for nonemergent doses. Should the staff member be forced to override and administer the medication, the BCMA system should allow a brief textual entry about the occurrence which provides as much information as possible. The original container that did not scan should be returned to pharmacy for additional evaluation. If feasible, a second person could verify the medication before administering, especially if a high-alert product is involved.

## Conclusions

This analysis of the errors associated with BCMA technology reported to MEDMARX indicates that adopting this technology does not alone eliminate medication errors. These errors, which most frequently entailed mislabeled medications, medications without bar codes, medications with bar codes that would not scan, and staff workarounds, demonstrate the need for double checks for all manually bar-coded medications, careful selection of labeling and scanning equipment, staff involvement on process development, and ongoing training that highlights the necessary role of professional decision making rather than reliance on a valuable but imperfect technology. The availability of manufacturer bar codes on unit-dose medications could eliminate the majority of reported errors described in this report. J

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