Patient Safety

Fifteen Best Practice Recommendations for Bar-Code Medication Administration in the Veterans Health Administration

Emily S. Patterson, Ph.D.
Michelle L. Rogers, Ph.D.
Marta L. Render, M.D.

Estimates of rates of adverse events in hospital settings range from 3.7% based on chart review[1] to 17.7% based on direct observation,[2] with medication errors the most commonly documented cause of adverse events in hospitals.[3] In an analysis of 334 medication errors from 11 acute care wards, 38% of the problems occurred at the time of administration by nursing personnel.[4] Although some believe that bar-code technology reduces medication errors and tracks near misses, supporting empirical evidence is limited.[5,6]

Bar-code scanning is the oldest machine-readable identification system and has been widely used in industrial manufacturing, shipping, and inventory control.[7,8] Compared with typing, which produces about one error every 300 keystrokes, bar-code scanning error rates range from one character in 15,000 to one in 36 trillion.[9] The use of bar-code medication administration (BCMA) systems to improve patient safety has been recommended by many organizations, including the Institute of Medicine, the National Patient Safety Foundation, the American Society of Health-System Pharmacists, and the National Alliance for Health Information Technology. On February 25, 2004, the U.S. Food and Drug Administration finalized a rule for bar-code labeling medications and blood components to prevent adverse events.[10] The rule requires placement of a linear bar-code label containing the National Drug Code number on most prescription drugs and certain over-the-counter drugs within two years. In addition, the Joint

Article-at-a-Glance

Background: Since 2000, the Veterans Health Administration (VHA) has pioneered the development and deployment of a bar-code medication administration (BCMA) system. Based on VHA experience, 15 "best practices" for BCMA implementation, integration, and maintenance are recommended.

Methods: Data were collected on potential barriers to the effectiveness of BCMA to improve patient safety by direct observation of medication administration, simulated BCMA use in a laboratory setting, a survey of nursing informatics specialists regarding policies and procedures, and 30 unstructured interviews with diverse stakeholders.

Recommendations: Fifteen practices were proposed, categorized by implementation and continuous improvement, training, troubleshooting, contingency planning, equipment maintenance, medication administration, and maintenance of paper patient wristbands. For example, Recommendation 15 ("Periodic replacement of wristbands") advises weekly bar-coded wristband replacement in long term care settings to improve the scanning reliability.

Discussion: Lessons learned about best practices to address challenges may offer insight to others considering implementation of bar-code technology.

Commission on Accreditation of Healthcare Organizations is considering requiring that bar-code technology for patient identification and for matching patients to their medications and other treatments be operational in all health care accreditation programs by January 1, 2007.[11]

VHA has used its relatively mature BCMA system since 2000, and BCMA is deployed in all VHA facilities across the United States. Nurses access BCMA software by using a laptop computer attached to a wheeled medication cart and linked by a wireless network to electronic databases. If the scanned medication bar-code data do not match what is ordered for a patient identified by scanning a bar-coded wristband, the nurse is alerted to the discrepancy by the software (Figure 1, page 357).

As with any new technology, system effectiveness is dependent on myriad design, implementation, and maintenance choices. In addition, the introduction of any new technology, regardless of how effective the technology, generates negative, unanticipated side effects because of the complex, interconnected nature of the medication administration process. Recent research has identified five unintended side effects from the introduction of BCMA in VHA:[12]

- Missed doses when nurses were unaware of the automated removal of medications after a period of time
- Reduced access to medication administration data for physicians
- Nurses employing workaround strategies to increase efficiency during busy periods
- Nurses prioritizing activities that can be monitored with BCMA data over activities that are not able to be easily monitored
- Reduced efficiency for nonroutine activities

Nursing "workaround" strategies reduce the effectiveness of various BCMA systems in acute care and long term care settings.[13,14] To address challenges identified from these studies and the collective VHA BCMA experience, a set of best practice recommendations is offered for VHA and other organizations considering the implementation and use of BCMAs.

Identifying Barriers to BCMA's Effectiveness

Between 1999 and 2003, data were collected on potential barriers to BCMA's effectiveness in VHA by direct observation of medication administration, simulations of BCMA use in a laboratory, a survey of nursing informatics specialists on policies and procedures, and unstructured interviews (Table 1, page 358). To address the challenges identified from these data, in March 2004 a set of best practice recommendations was proposed to the VHA's Office of Information and then disseminated by the Director of the National BCMA Joint Program Office to points of contact at every VHA facility.

Recommendations

Fifteen practices to maximize the effectiveness of the use of BCMA and reduce the risk of iatrogenic injury to patients are proposed (Table 2, page 359). The practices are grouped into the following categories: implementation and continuous improvement, training, troubleshooting, contingency planning, equipment maintenance, medication administration, and maintenance of paper patient wristbands. The rationale and supporting data are summarized in each recommendation to help non–VHA hospitals considering or using other systems to gauge their potential applicability.

1. Put in Place a Standing Interdisciplinary Committee

Recommendation. A standing interdisciplinary committee composed of nursing, pharmacy, computer support, and, when possible, biomedical representatives should implement and proactively conduct continuous improvement on implementation and use. One method for obtaining feedback from front-line staff should include rounds on the floors on a frequent and continuous basis (for example, weekly or biweekly). Actions taken to address problems should be reported back to end users (for example, through e-mail and handouts).

Rationale. Integrating BCMA into medication administration is extremely complex and requires changes to how work is conducted by nurses and other personnel. Proactive attempts to solicit feedback and improve systems will reduce workaround strategies that circumvent system use.

Supporting Data. The supporting data are as follows:

- 11 of the 16 VHA hospitals have a standing interdisciplinary committee to troubleshoot when problems arise and to discuss opportunities for continuous improvement.

Primary BCMA Screen for Fictional Patient

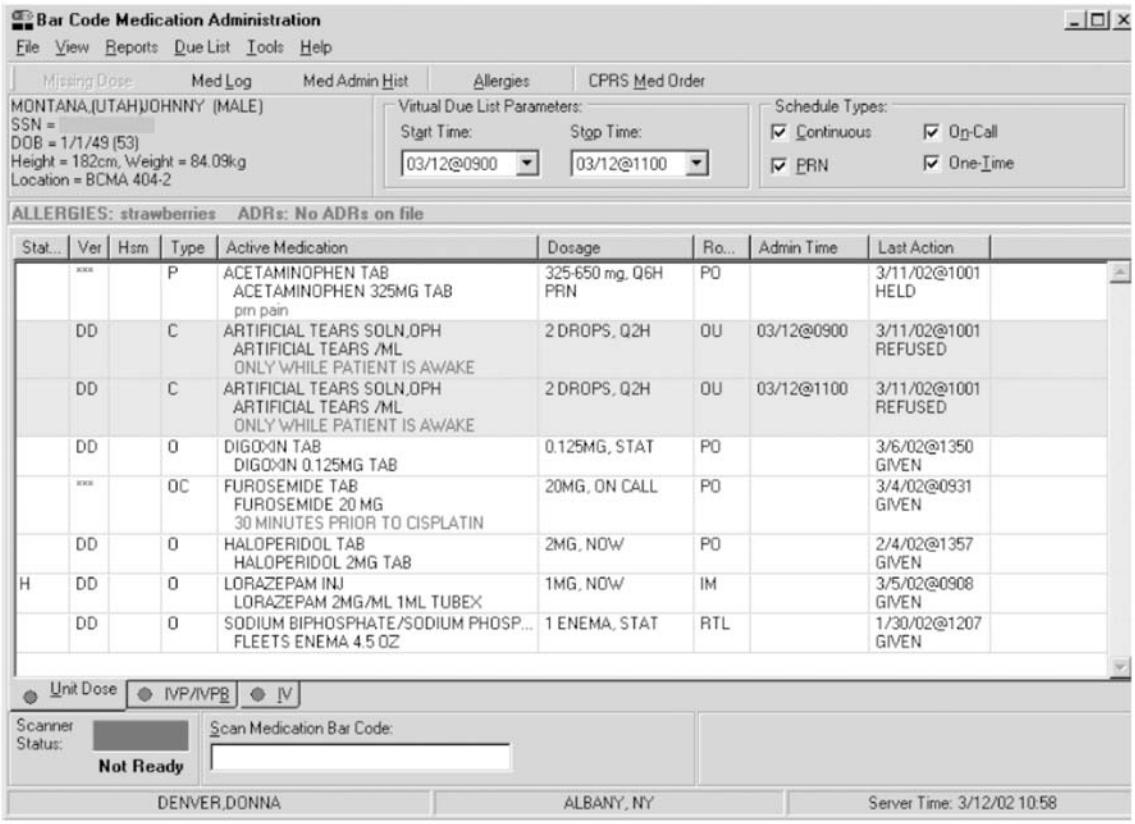

Figure 1. *This sample screen shot displays the physician-ordered and pharmacist-verified 9–11 A.M. medications for a patient identified by scanning a bar-coded wristband.*

- 7 of the 16 VHA hospitals have instituted rounds on a routine basis.
- 10 of the 16 VHA hospitals use a mail group to identify problems and to alert users to problems and, less frequently, to communicate what has been done in response to the problems.

2. Train All Users. Cross-Train Pharmacists and Certain Physicians

Recommendation. All personnel administering medications, medicated ointments, or respiratory treatments need to receive significant training on BCMA software. Develop a process for informing personnel about software updates, particularly for "super-users" (nurses who serve as resources to other nurses) and temporary (agency) nurses. Cross-train all pharmacists on the nursing features in BCMA. Recruit certain physicians to serve as super-users and informal trainers on how to write orders in the provider order entry software programs that are compatible with BCMA.

Rationale. The BCMA software is sufficiently complex that new paths to medication errors can result from software use without adequate training. Use of alternative systems that require less training, such as printed medication administration records (MARs), to administer medications can lead to missed dose and double-dose errors and confusing gaps in the electronic documentation. It is particularly important that super-user nurses and agency nurses be familiar with the latest changes to the software. In many hospitals, pharmacists help nurses to troubleshoot when medications do not scan as expected, and it is helpful for them to know the system as seen by a nursing user. The use of BCMA affects how physicians need to enter their orders (for example, 20 mg needs to be written as "20 mg" rather than "20mg" for the medication's bar code to scan correctly).

Table 1. Summary of Methods*

Method	Description
Direct observation of medication administration by 3 trained observers with Ph.D.'s in human factors engineering	Prior to implementation, observation of the following: ■ 21 hours, 7 nurses on acute care wards at a 155-bed hospital with 9,000 admissions per year ■ 25 hours, 5 nurses in the medical ICU and surgical ICU of a 327-bed hospital with more than 12,000 admissions per year After implementation, observation of the following: ■ 24 hours, 5 nurses on acute care wards with 99 beds and 5 nurses on long term care wards with 460 beds at a hospital with 3,000 admissions per year ■ 48 hours, 19 nurses on acute care wards with 155 beds with 9,000 admissions per year ■ 33 hours, 5 nurses on acute care wards at a 327-bed hospital with more than 12,000 admissions per year and 3 nurses on long term care wards at a 180-bed nursing home
Simulations of BCMA use in a laboratory	After implementation, observing simulated use of the following: ■ The initial version of BCMA software; 5 nursing participants Prior to implementation, observing simulated use of the following: ■ BCMA Version 2.0 early prototype with additional IV medication features and a multi-tabbed interface; 5 nursing participants ■ BCMA Version 2.0 revised prototype with an additional pop-up warning dialog box when there were active medications on background tabs; 4 nursing participants ■ BCMA Version 2.0 advanced prototype with a feature that allowed ICU nurses to scan bar-coded medications prior to physician order entry and pharmacy verification; 2 nursing participants ■ Wireless medication administration for a handheld device designed by an external vendor to simulate BCMA functionality; 5 nursing participants
Open-ended survey of hospital policies and procedures for BCMA on challenging issues	■ 16 e-mail responses to survey posting to 578 nursing informatics listserv recipients from most VHA medical centers ■ 1 phone, 1 e-mail response to survey posting to National Patient Safety Foundation listserv with nearly 2,000 recipients
Interviews on perceived barriers to intended system use and reactions to draft recommendations	■ 30 unstructured interviews with nurses, nurse managers, pharmacists, computer support personnel, administrators, patient safety experts, and physicians from public and private hospitals

* ICU, Intensive care unit; BCMA, bar-code medication administration.

Supporting Data. The supporting data are as follows:

■ 11 of the 16 VHA hospitals formally employ super-users, one has informal super-users, and one employed super-users during implementation but dropped the program later because of the complexity and frequency of changes to the software.

■ Two agency nurses at a VHA hospital reported that they did not feel adequately trained to use BCMA. One of the nurses had the covering registered nurse (R.N.) administer her medications, and the other passed medications using a printed MAR report, thereby leaving a gap in the electronic medical record.

■ 5 of the 5 nursing participants did not administer at least one ordered medication for at least one simulated patient because they did not look on all three medication tabs during a usability test of a BCMA version 2.0 prototype.

■ 3 of the 16 VHA hospitals cross-train pharmacists. A nursing informatics survey respondent noted, "I would

Table 2. Summary of Recommendations

Topic	Recommendation
Implementation/continuous improvement	1. Standing interdisciplinary committee
Training	2. Train all nurses; cross-train others
Troubleshooting	3. Communicate known problems
	4. Contact information for types of problems
Contingency planning	5. No double documentation as a backup
	6. Schedule downtimes to minimize disruptions
Equipment maintenance	7. Replace malfunctioning equipment during its servicing
	8. Procedures to clean equipment
Medication administration	9. Scan wristbands and medications prior to administration
	10. Caregiver documents at time of administration
	11. Verify displayed allergy information
	12. Use printed worksheet as overview
	13. Print missed medications report once a shift
	14. Alert nurses to new stat orders
Wristband maintenance	15. Periodic replacement of wristbands

recommend that all sites train pharmacists on the nursing side of BCMA. We are just beginning to do this."

3. Communicate Known Problems

Recommendation. Develop a process (for example, Web site, help line) for interested people to view examples of national problems at any time (24 hours a day, seven days a week).

Rationale. Although there already is a VHA national help desk that is continuously staffed, technology can be used to build a "community of knowledge" that enables easy viewing of known problems, the status of resolution of those problems, other frequently asked questions (FAQs), and locally developed solutions. This approach would reduce calls to the help desk and make it more efficient to see whether problems are national or local. Knowing national problems reduces time wasted trying to troubleshoot locally, while knowing that problems are not national makes it easier to troubleshoot and resolve local problems.

Supporting Data. The supporting data are as follows:

- VHA Hospital 9: "Other problems are usually in line with nationally reported issues, and we wait for solutions. We recommend actions locally until national solutions are programmed."
- VHA Hospital 11: "Core group of staff communicate findings and responds to questions. This group includes the nursing education coordinator, two nurses in nursing informatics, pharmacy (computer specialist), inpatient pharmacy supervisor, and a computer equipment specialist. Nurses are encouraged to contact this core group and staff pharmacist and nurse supervisor. Problems are handled in real time by any of these personnel. If the problem cannot be resolved, the national help desk is contacted for resolution. Patient safety alerts to all clinical users are sent if system problem is presently uncorrectable."

4. Display Contact Information for Resources to Resolve Different Types of Problems

Recommendation. Prominently display contact information for resources to resolve recurring types of problems. Update list as necessary.

Rationale. Time spent locating appropriate resources to aid in troubleshooting reduces the available time to provide patient care. This process can be facilitated, particularly for nurses new to an organization or when systems are first implemented, by making it easier to identify appropriate resources to contact (for example, computer personnel for hardware problems,

clerks for problems in scanning wristbands, pharmacy for problems in scanning medication bar codes, specialized personnel for software problems, engineering or computer personnel for problems with the wireless network).

Supporting Data. The supporting data are as follows:

- VHA hospital: "We believe that we have a best practice for this issue. We staff a help desk for everything related to the electronic medical record. . . . Three nurses, a dietitian, a social worker, and a radiology technician comprise the clinical informatics staff, which responds to help desk calls continuously 6:30 A.M.-5:30 P.M. Monday through Friday. Rather than a system of "page me if you need help" and then wait for them to get back to you, you dial 'H-E-L-P' and someone immediately answers the line. We can resolve the problem in 5 rather than 45 minutes this way. If not, we can forward the problem to the technical or hardware staff. Nursing supervisors perform this function on off-tours. We have information resource management (IRM) on-call during off tours and weekends. We think of IRM as the hardware people and clinical informatics as the software people. People who answer the help desk also do the teaching for the software and know the ins and outs of the software packages they support. This allows them to better assist the users and to troubleshoot problems in the software."
- One cluster of VHA hospitals made mouse pads with troubleshooting hints on them.
- One VHA hospital instituted a hot-line number in pharmacy and an e-mail address for scanning problems and provided a sheet on each medication cart with names and numbers to contact for specific issues.

5. Do Not Employ a Double-Documentation System

Recommendation. Do not employ a paper-based medication administration system in parallel with a BCMA for more than a few weeks.

Rationale. A double-documentation system reduces nursing productivity. Different nurses will use different systems as the primary system, leading to the possibility of missed medications, double-dose medications, and confusing documentation gaps.

Supporting Data. The supporting data are as follows:

- At one hospital with a double documentation system that had been in place for approximately one year, documentation was done only on the paper MAR and not BCMA for the following reasons:
  - BCMA was unavailable because of maintenance.
  - Nurse was unable to log in.
  - Staff members administering medications were not trained on BCMA.
  - Patient record was unavailable because it was in use by another user.
  - Nurse had problems scanning a medication.
  - Medication was ordered but not in BCMA, in some cases because the orders were automatically dropped from BCMA several hours after the scheduled administered time.
  - Administration time was not changed in BCMA.
  - Covering nurse administered a medication for another nurse.
  - "Batch documentation" was done on the paper record in the absence of the realization that one medication was not administered using BCMA.
  - A nurse forgot to scan a medication and so the administration was only documented in the paper record.
- During the same observations, documentation was done only in BCMA and not on the paper MAR because of the following:
  - A nurse forgot to document a medication on the MAR.
  - A nurse documented in BCMA that a nursing assistant in a long term care facility administered a topical cream, a standard practice in some VHA long term care facilities, that was not actually administered.
  - A set of medications was scanned for a patient who was not available, and so the medications were documented as administered but not administered at that time.
  - A patient refused a scanned medication, and so the medication was documented as administered although it was not.
  - A medication was held due to vital sign data after it was scanned, so it was documented as administered although it was not.

6. Schedule Planned Downtimes to Minimize Disruptions

Recommendation. Planned downtimes should be scheduled to minimize disruptions to the hospital, with

the possible exception of testing back-up plans. The specific plan for downtime should take into account facility-specific factors such as availability of troubleshooting support and medication administration schedules.

Rationale. Planned downtimes are less disruptive than unplanned downtimes. Unexpected downtimes may result in missed doses or double doses due to confusing gaps in documentation.

Supporting Data. The supporting data are as follows:

- 13 of the 16 VHA hospitals schedule downtimes during low-volume medication administration times.

7. Replace Malfunctioning Equipment During its Servicing

Recommendation. Each hospital should have a minimum of two complete replacement units (laptop, mouse or stylus, battery, scanner, cables, power pack) available in a location that is accessible at any time (24 hours a day, seven days a week) so that malfunctioning equipment can be serviced without reducing nursing productivity.

Rationale. Productivity is reduced if users must wait for equipment to be serviced. Equipment taken out of circulation can undergo spot checks of the entire setup, with reduced time pressure to put the equipment back in circulation, including verifying that equipment is reliably functional and that all software upgrades have been properly installed. Ideally, equipment can also be cleaned by biomedical personnel, which may reduce the risk of nosocomial infections. Some facilities might need substantially more than two backup units, depending on their size and structure.

Supporting Data. The supporting data are as follows:

- VHA Hospital 6: "Since there are no backups, we can't take any to biomed to clean it, so unless it's being fixed it's never cleaned."
- VHA Hospital 9: "We [nursing informatics personnel] keep extra supplies, mouse hardware, laptops, batteries, scanners, cables, power packs, etc. in our office, and as each nurse has a problem we go to the ward and fix or replace. We save the user time by just taking a new setup and bringing the old one back to our office, where either we identify and fix the problem, or we enter a [service request]. . . . Our nursing supervisors have access to our backup equipment and help the staff on evenings, nights, weekends, and holidays."
- VHA Hospital 10: "Upon patch install [software upgrade] the technical support person inspects every laptop and scanner."

8. Develop a Procedure for Cleaning BCMA-Related Equipment

Recommendation. A procedure should be developed, ideally in collaboration with experts in infection control, to routinely clean BCMA-related equipment to reduce the risk of nosocomial infections. This procedure should include a process for monitoring that the tasks are carried out as planned.

Rationale. Maintenance of equipment cleanliness will be variable and difficult to monitor without explicit standards of practice and clear communication and monitoring of expectations. Risks of nosocomial infections can be reduced by improving cleanliness.

Supporting Data: The supporting data are as follows:

- 3 of the 16 VHA hospitals had policies that nurses were responsible for maintaining a clean work area in general, which implicitly includes BCMA equipment.
- 8 of the 16 VHA hospitals reported that their hospitals' policies and procedures regarding cleaning BCMA-related equipment were inadequate.

9. Scan Wristbands and Medications Prior to Medication Administration

Recommendation. Nurses should scan a bar-coded wristband on the patient to verify patient identity prior to medication administration. Nurses should scan bar-coded medication immediately prior to medication administration to verify that it is the same name, dose, route, and time as the ordered medication. If not, the nurse should identify the discrepancy and apply professional judgment as to how to proceed. If the nurse cannot identify the discrepancy personally, other personnel (e.g., nurse manager, pharmacy) should be recruited to help troubleshoot before medication administration when the delay to administration will not adversely affect the patient. Exceptions to this practice include the following:

- Patients in isolation. In this case, a wireless device (scanner or handheld) can be used that is protected by a clear thin plastic bag that is thrown away after a single use. Alternatively, there can be a dedicated device in the patient's room if the patient is not in contact isolation.

- Patients who physically cannot wear a wristband, patients who have a disruptive behavioral response to scanning, when a scanner is tethered to a medication cart that does not fit into a patient's room, or when a backup system is in use that does not enable scanning of wristbands.
- Incorrect or missing bar code on medication. In this case, pharmacy should be alerted to the problem, in order to better detect if incorrect bar codes have been applied to multiple medications, to improve bar coding of medications, and to help identify cases where the nurse has erroneously assumed that the bar code is incorrect.
- Pharmacy unavailable to resolve discrepancies (for example, no pharmacy personnel on "off-tours"). In this case, problems should be communicated to pharmacy personnel when available and an alternative plan designed by the facility should be used.

Rationale. BCMA is designed to reduce medication errors by having the machine verify the identity of the patient and of the ordered medications immediately prior to administration. In exceptional circumstances, the system cannot be used as designed, in which case alternative plans are required.

Supporting Data. The supporting data are as follows:

- 6 of the 16 VHA hospitals have nurses type the social security number for patients that are in isolation.
- 5 of the 16 VHA hospitals have a clear thin plastic bag placed over a wireless scanner for patients that are in isolation.
- 2 of the 16 VHA hospitals have nurses scan patients that are in isolation without touching patients.

10. Caregivers Should Personally Document at the Time of Medication Administration

Recommendation. Caregivers (for example, R.N.'s, licensed practical nurses, respiratory therapists, nursing assistants who administer ointments in long term care facilities) who administer medications, medicated ointments, or respiratory treatments should personally document administration at the time of administration.

Rationale. Relying on communication to know when a medication was administered is less reliable because of memory and communication limitations than having the person who administered it document it at the time of administration.

Supporting Data. The supporting data are as follows:

- 6 of the 16 VHA hospitals have nursing assistants self-document their administration of creams and ointments in long-term care facilities: two in BCMA and four on paper treatment sheets.
- 4 of the 16 VHA hospitals have licensed nursing personnel document administration of creams and ointments by nursing assistants in long term care facilities, often with the requirement of adding a comment that it was administered by the nursing assistant.

11. Verify Allergy Information Displayed in BCMA Prior to Administration

Recommendation. Nurses should verify the allergy information displayed in BCMA before administration with information from another source (for example, allergy bracelet, asking patients to recite allergies before medication administration).

Rationale: The prominent display of allergy information in red on the primary BCMA interface is not sufficient to deter nurses from administering medications that are ordered to which a patient is known to be allergic. In addition, allergy information displayed in BCMA is not always accurate.

Supporting Data. The supporting data are as follows:

- All 15 nursing participants administered a medication to which a (simulated) patient was allergic during usability tests. All reported that they were unaware of the displayed information.
- 3 of the 16 VHA hospitals include allergy information on a wristband—either the BCMA wristband or an additional wristband.

12. Support Staff Personnel Should Print a Report at the Beginning of a Shift for Nurses to Use as an Overview Worksheet

Recommendation. The long-term recommendation is for two-page overview reports to be designed that are tailored to the acute care, intensive care unit, and nursing home settings. In the short term, one of the currently available reports should be printed by support personnel for use by a nurse at the beginning of a shift to serve as an overview worksheet. This report should serve only as a supplementary tool because the information can be outdated within minutes and so should

not be used for administration or documentation purposes. In addition, it is important for nurses to periodically refresh the information displayed in BCMA so that they are administering medications from the most current information.

Rationale: Nurses can better plan medication administrations if they can see at a glance an overview of the recent medication history and what medications are ordered for administration during their shift. They will also make fewer errors of omission if they quickly jot down notes in a temporary location because their notes will remind them to do activities, including pass along information during the handoff to the next shift.

Supporting Data. The supporting data are as follows:

- 8 of the 16 VHA hospitals had policies for nurses to use printed reports as overviews, and several hospitals had support staff print them for the nurses.
- 7 of the 16 VHA hospitals had no policy but observed that nurses frequently print paper reports to use as an overview sheet.

13. Nurses Should Print Missed Medication Reports Once a Shift.

Recommendation. Like other systems, BCMA has a Missed Medication Report, which lists ordered medications that were not documented as administered. We recommend that organizations develop a process for tracking that this report is reviewed by nursing personnel. The process should not involve extensive documentation or time commitments by nursing personnel or add to the duties of the charge nurse without reducing patient load. In addition, nurse managers should not rely on missed medication reports to file medication error reports. To avoid reducing productivity, the tracking process should avoid extensive time or documentation commitments for nurses and charge nurses. In addition, to continually improve the safety culture, the reports must not be used for punitive purposes and so ideally would not contain practitioner identifiers.

Rationale: Missed medications, particularly one-time order and on-call medications that are removed one hour after the ordered time because of provider or pharmacist mis-entry and one-time orders that are needed to remain active for more than 12 hours can be reduced by nurses reviewing the medications that were ordered but not yet administered. Without a process for tracking (for example, nursing personnel might place printed reports in the nursing manager's mailbox, so that the reports are reviewed and thrown away once a week), report use will be variable and difficult to monitor.

Supporting Data. The supporting data are as follows:

- 7 of the 16 VHA hospitals require nurses to print and review missed medication reports.
- 9 of the 16 VHA hospitals monitor that nurses are printing and reviewing missed medication reports.

14. Alert Nurses to New Stat (Urgent) Orders

Recommendation. Particularly for urgent orders and orders in the intensive care unit, it is important for nurses to know when new medication orders have been written. In many hospitals with the paper-based MAR, this is accomplished by having printouts of new orders arrive on labels in a central location. Nurses are alerted to new orders by the sound of a new printout. With BCMA, it is no longer necessary to have labels printed, and seeing an updated view of orders sometimes requires a manual refresh command. Methods to alert nurses to new stat orders, such as by having an overview display on a dedicated monitor in a central location with information about new orders, should be developed. In addition, physicians should inform the nurse verbally when a new stat order has been written.

Rationale. Relying on nurses to continuously access the electronic medical record to detect new orders is inefficient and contributes to delayed or missed medication orders, some of which may be critical to patient safety.

Supporting Data. The supporting data are as follows:

- VHA Hospital 4: "During med[ication] pass, the nurse does a refresh . . . to see if new orders had been processed that did not appear on the due list."
- VHA Hospital 9: "We require that each nurse administering med[ication]s run a DUE List for their tour of duty and even rerun the list after morning physician rounds."
- VHA Hospital 15: "Routinely, nurses print at the start of their shift the "Due List," which lists all current meds both prn (as needed) and scheduled. This is very popular with all units. They are continually reminded that this is for planning purposes only as the due list is only current at the time printed."

■ At two VHA hospitals, a dedicated monitor in a central location in the intensive care unit was observed to display new orders for patients (for example, "Mr. Smith has four new orders").

15. Replace Wristbands as Needed and Periodically in Long Term Care

Recommendation. Wristbands in the VHA are printed on inexpensive paper with no folds. We recommend replacing worn, missing, or inaccurate wristbands as soon as discovered by any personnel. In long term care settings, support staff personnel should replace wristbands periodically (for example, weekly). Install wristband printers on every ward and allow nurses, nursing assistants, and ward clerks access privileges to print new wristbands. If wristbands cannot be applied (for example, when patients who physically cannot or refuse to wear a wristband), they may be applied to items unique to the patient (for example, stapled into the patient's paper charts) but not to items that are not unique to the patient (for example, on a bedside table, outside the room, in a patient's medication drawer, on top of a medication cart or computer console).

Rationale. Scanning wristbands to verify patient identity is more likely to occur when wristbands reliably scan on the first attempt. Wristbands become worn between several days and two weeks after application. Acute care patients rarely stay long enough to warrant periodic replacement, but long term care patients have longer lengths of stay. Application of wristbands is a potentially error-prone step. Facilities should consider how to increase the reliability of wristband replacement, such as by requiring verification of patient identity during application.

Supporting Data. The supporting data are as follows:

■ 16 of the 16 VHA hospitals replace wristbands on as-needed basis in acute care.

■ 11 of the 16 VHA hospitals replace on an as-needed basis in long term care, 4/16 VHA hospitals replace once a week in long term care (3 printed by clerk, one by morning shift).

■ 16 of the 16 VHA hospitals have installed wristband printers on every ward.

Discussion

Deployment of technology in the clinical setting requires a thoughtful and comprehensive approach. In addition to the need to tailor technologies to particular contexts, it is important to identify opportunities to continuously improve the use of a technology over time. We believe that the lessons learned from the VHA, the recognized leader—both in time and scope of implementation—in the use of bar-code technology to identify patients and medications, about challenges and best practices to address challenges should be valuable to others considering procurement and implementation of bar-code technology.

There are several limitations to these recommendations. First, although the introduction of BCMA affects all hospital personnel, minimal research was conducted with non-nursing personnel. Second, these recommendations are solely based on experience with the BCMA system used in VHA hospitals. Because of context-specific variables, it is not expected that all recommendations will apply to all hospitals with BCMA in every situation. Third, none of these recommendations has been evaluated for its efficacy in improving quality of care or reducing iatrogenic injury and may even create unintended consequences that generate new paths to failure. Fourth, recommendations are based on Version 2.0 of Bar Code Medication Administration; future changes might necessitate changes to the recommendations. Fifth, in all the studies that informed these recommendations, the hospitals and participants were convenience samples and represented a small percentage of the overall hospitals and employees in the VHA and so might not be representative or might otherwise be biased. Finally, although we believe that these recommendations might be of interest to hospitals using software packages other than the BCMA software developed for VHA, generalization needs to be done with care because of diversity of organizational structures and infrastructure in hospitals and the myriad choices in design and implementation of a software package. For example, with respect to Recommendation 12, systems might already have overview worksheets available for printing or might have chosen not to remove nonadministered medications after a specified time window. J

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Emily S. Patterson, Ph.D., and **Michelle L. Rogers, Ph.D,** are Research Physical Scientists, Getting at Patient Safety (GAPS) Center, Veterans Affairs Medical Center (VAMC), Cincinnati, and Volunteer Research Assistant Professors of Clinical Medicine, University of Cincinnati, Cincinnati. **Marta L. Render, M.D.,** is Director, VA GAPS Center, and Professor of Clinical Medicine, University of Cincinnati. Please address requests for reprints to Emily S. Patterson, Ph.D., patterson.150@osu.edu.

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