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Leadership Strategies, An Interdisciplinary Team, and Ongoing Nurse Feedback: Ingredients For a Successful BCMA Project

EXECUTIVE SUMMARY

- ▶ Barcode medication administration (BCMA) implementation represents a change in a complex process requiring significant modifications in the work of nurses.
- ▶ Nurses' voices are critical for successfully implementing BCMA technology to support this change in nursing practice.
- ▶ Feedback from nurses who administered medications was critical to selecting and refining a BCMA system that supported their practice needs.
- ▶ Feedback regarding implementation status was critical for keeping key stakeholders across the institution informed of the progress and initial impact of the implementation.
- ▶ Nursing leadership engagement throughout the process supported the successful adoption of new workflow processes and technology.

A HEIGHTENED FOCUS on patient safety has permeated the U.S. health care system since the Institute of Medicine (IOM, 1999) highlighted safety issues in their landmark report which estimated medication administration errors have led to over 7,000 deaths per year. Although much had been done to improve the prescribing and dispensing of drugs via electronic medication orders by the time the IOM report was published, there was an absence of safeguards, beyond the vigilance of nurses, to ensure medications were administered safely at the point of care (Cescon & Etchells, 2008). As such, nurses are the final point of contact to intercept an error prior to medication delivery to the patient. Barcode medication administration (BCMA) is a technology developed in response to this absence of safeguards that has improved the safety of medication administration at the bedside (Bargren & Lu, 2009; Hassink, Jansen, & Helmons, 2012; Helmons, Wargel, & Daniels, 2009; Henneman et al., 2012; Hurley et al., 2007; McNulty, Donnelly, & Iorio, 2009; Poon et al., 2010; Young, Slebodnik, & Sands, 2010). Nursing engage-

ment in the development and implementation of this new process is critical for success in medication error reduction because BCMA interrupts nurses' usual workflows; involving nurses throughout the process ensures a better fit with the process and structure of nursing work (Holden & Novak, 2013).

In addition to its impact on safety, BCMA also has a substantial impact on the work of nurses (Holden & Novak, 2013). Medication administration is a complex, multistep process that can be challenging to accomplish safely and without errors. Acute care nurses spend nearly one-third of their time on medication-related activities (Keohane et al., 2008) and encounter numerous distractions during the medication administration process (Elganzouri, Standish, & Androwich, 2009). Because of the extent and significance of medication administration on the structure and process of hospital nursing practice, the leadership team implementing BCMA technology in their own institution must evaluate the impact of BCMA technology on nurse workflows carefully (Carayon et al., 2007; Early, Riha, Martin, Lowdon, & Harvey, 2011; Elganzouri et al.,

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2009; Holden & Novak, 2013; Keohane et al., 2008; Rack, Dudjak, & Wolf, 2012; Voshall, Piscotty, Lawrence, & Targosz, 2013) as well on nurse satisfaction (Hurley et al., 2008; Marini, Hasman, Huijter, & Dimassi, 2010). If BCMA fits well with nursing workflows, and if nurses are satisfied with a BCMA system, they are less likely to adapt or override the BCMA system thus creating “work-arounds” to the BCMA processes (Elganzouri et al., 2009; Holden & Novak, 2013; Hurley et al., 2008; Novak, Holden, Anders, Hong, & Karsh, 2013). For example, if the BCMA technology does not provide the flexibility to accommodate patients being away from their room when medications are due, nurses may work around scanning patient wristbands by printing extra wristbands and scanning those instead of the patient’s actual wristband.

During implementation, new medication administration technology issues often arise and need to be addressed in an ongoing, efficient manner (McNulty et al., 2009) by a interprofessional team that continually tracks issues, determines the process for handling concerns, and monitors error reports during BCMA implementation (Bargren & Lu, 2009).

For example, when administering supplemental IV potassium or insulin, two high-risk medications, there may not be a good solution for the precise timing needed to match the medication profile system and the BCMA administration process. An interprofessional team must be poised to address such concerns immediately.

Nursing leaders recognized the development, implementation, and evaluation of technology such as BCMA can be challenging in fast-paced health care environments (Henneman, 2009). Thus, during BCMA implementation it is necessary to have strong leadership and a sound plan for implementation that includes all stakeholders, particularly practicing nurses (Bargren & Lu, 2009; Early et al., 2011). In this article, a comprehensive BCMA implementation process that included rapid response to ongoing feedback obtained from bedside nurses as well as engaged nursing leaders is described.

As Mayo Clinic began an intensive investigation and planning process prior to implementing BCMA in recognition of the safety and workflow issues surrounding medication administration, nurse leaders recognized the impact of BCMA technology on

bedside nurses. While BCMA provides the technological safety net to enhance patient safety, it also introduces new hardware and software into nursing practice and changes workflows and unit cultures. Careful change management was critical for successful adoption of the new system. Additionally, nurse leaders recognized medication administration requires critical thinking and ongoing nursing judgment (Eisenhauer, Hurley, & Dolan, 2007); therefore, BCMA must support and enhance nurses’ ways of thinking. To that end, feedback from bedside nurses was used before, during, and after BCMA implementation to inform adjustments to both the BCMA system and its implementation. The implementation process was conducted by numerous support teams and included multiple avenues for ongoing communication and opportunities for nurses to provide immediate feedback related to BCMA issues that needed to be addressed to ensure successful implementation. Nurse leaders from across the organization were very involved in all stages of the project, enhancing communication, adoption, and evaluation of the processes.

METHODS

Planning BCMA Implementation

Institutional leaders brought together an interprofessional team to plan and implement BCMA at Mayo Clinic (from here forward referred to as the “interdisciplinary oversight group” or “IOG”). The members of the IOG included nursing, pharmacy, information technology (IT), facilities, and system engineers. In addition to a nurse administrator who co-lead the project with an IT leader, nursing leaders from across the department of nursing who participated in the IOG included a nurse manager, clinical nurse specialist (CNS), nursing education specialist (NES), informatics nurse specialist (INS), quality specialist, nurse researcher, and bedside

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nurses. Select members of the IOG (nurse administrator, pharmacy, project manager, IT representatives, INS, and CNS) were involved at every point along the implementation timeline and provided unit-level support for each unit. Individuals in senior leadership roles were identified as champions of the project and were kept apprised of challenges and successes.

The IOG performed an intense vetting process with key stakeholders prior to purchase and implementation of BCMA. On-site visits to institutions using BCMA were conducted to obtain preliminary information about the functionality and use of BCMA, including observations and interviews with nurses using the system to obtain their perspectives. The IOG also conducted a Failure Mode Effect Analysis describing the risks associated with the implementation of a BCMA system. The primary risks identified included transportation of medications from the medication preparation area to the bedside, medication order review, and patient identification. Each of these risks was addressed during the planning process.

Simulation sessions were conducted as part of the planning process during which bedside nurses trialed various BCMA equipment options and use of the BCMA software. During the first simulation session, scenarios were developed to test three different hardware configurations. These included a fixed system in an intensive care unit (ICU) room, and two different portable systems: one with a tethered barcode scanner and one with a wireless scanner in a general patient unit. Nurses were asked to complete a survey about the use of the hardware and to participate in a post-simulation feedback session. The second simulation session was intended to determine how the nurses interacted with the software in various clinical scenarios.

The scenarios replicated included a night shift, a day shift in a semi-private room, and a day shift in an isolation room. Although the simulations were as realistic as possible, additional pilot testing was done on one of the nursing units to further trial the various hardware options and software prior to implementing BCMA throughout the institution.

BCMA Technology

BCMA refers to a technology designed to prevent medication errors and to improve the quality and safety of medication administration (Cummings, Bush, Smith, & Matuszewski, 2005). BCMA includes an electronic administration record that interfaces with pharmacy systems. BCMA hardware consists of a barcode reader/scanner connected to a portable or desktop computer by a wired or a wireless connection. At the point of medication administration, the nurse scans a barcode printed on the medication, looks at the computer screen for warnings, and subsequently scans the barcode printed on the patient's armband and again looks at the computer screen for any warnings.

The BCMA system verifies the "5 rights" (right medication given at the right dose, at the right time, and by the right route for the right patient) (Elganzouri et al., 2009). Identification of the right patient is the primary risk in the medication administration process at the point of care (Bates et al., 1995). Regulatory standards require two patient identifiers, such as the patient name and birthdate, be used to identify a patient when administering medications. The BCMA system provides an objective match of the identifiers and provides an error alert if there is a mismatch. The manual process used by nurses in the past was a subjective process where human factors may interfere such that the nurse might not be aware an error had occurred.

BCMA software from two

commercial vendors was evaluated by the IOG. In addition to the features described previously, the BCMA software included a barcode medication charting module that provided the necessary interface with the electronic health record (EHR) at the point of care. The IOG determined the selected BCMA software would interface with the current EHR, which supported retention of medication documentation within the original EHR. Other vendors would have required medication administration documentation separate from the existing EHR.

BCMA Implementation

The IOG that developed the implementation plan also guided the implementation process. Weekly IOG meetings included ongoing dialogue about refining implementation plans, and problem-solving issues associated with implementation. The team operationalized a detailed plan for a rolling implementation of the BCMA system across the institution beginning with pilot units, which were selected because they comprised a busy surgical practice including an ICU, progressive care unit, and general care unit. The nurse manager, who also served on the IOG, ensured a strong nursing leadership champion for the initial rollout. These pilot areas also provided real-time analysis of the tethered, untethered, and computer on wheels models. The pilot unit implementation was followed by the addition of 55 additional patient care units over a period of 15 months, affecting over 3,050 nurses and 1,300 patient beds. Additional resources brought forward by the IOG to support the BCMA implementation are listed in Table 1 and described below.

Unit-based response team. A unit-based response team (which included a subset of the IOG) was identified prior to the "go-live" and assisted in planning their specific unit implementation. Nursing

Table 1.
BCMA Implementation Resources

Group	Purpose	Members	Meeting Frequency
Interdisciplinary Oversight Group (IOG)	To plan and implement the BCMA across all hospital units.	<ul style="list-style-type: none"> • Nurse Administrator • Nurse Manager • Clinical Nurse Specialist (CNS) • Informatics Nurse Specialist (INS) • Nursing Education Specialist • Quality Specialist • Clinical Nurse Researcher • Bedside Nurses • Pharmacy Administrator • Pharmacists (2-3) • Information Technology (3) • Systems Engineering • Facilities and Support Services 	Weekly during BCMA planning and implementation
Unit-Based Response Team	To obtain and immediately address high-priority problems during BCMA implementation.	<ul style="list-style-type: none"> • Nurse Administrator • Nurse Manager • CNS and INS • Pharmacist • Information Technology • Systems Engineering 	Daily during the first 5 days of BCMA implementation on a particular unit and weekly for 4 weeks after implementation
BCMA Nursing Cross-Unit Workgroup	To address newly identified or ongoing nursing practice issues after BCMA implementation across nursing specialty areas.	<ul style="list-style-type: none"> • CNS and INS • Specialty nursing practice representatives (e.g., ICU, surgical areas, psych) • Information Technology • Pharmacist 	Monthly during BCMA implementation and continued for 2 years after implementation
BCMA Website	To provide an electronic forum to provided ongoing communication with nurses and access for providing continuous feedback.	<ul style="list-style-type: none"> • INS 	During implementation and remains a continuous resource for BCMA updates
Nurse Satisfaction Surveys	To measure nurse satisfaction before, during, and after BCMA implementation.	<ul style="list-style-type: none"> • Nurse Researcher 	Prior to BCMA implementation, 4 weeks, 4 months, and 1 year after implementation
Human Factors Review	To observe and interview nurses about the medication administration process and to identify issues from a systems perspective.	<ul style="list-style-type: none"> • Usability Expert • Nurse Administrator 	Prior to BCMA implementation, 4 months, and 1 year after implementation
BCMA System Reports	Alert: to provide an on-screen alert that medication about to be given does not match pharmacy records. Utilization: to provide data about use of BCMA system.	<ul style="list-style-type: none"> • CNS and INS • IT • Pharmacist • Bedside nurse 	Weekly during implementation

leadership was actively engaged at each unit and assisted in the staff nurse education process to promote change management and adoption of the new technology and processes. The unit-based response team and IOG met daily on each unit and made rounds on the night

shifts during the unit's first week of implementation to address nurses' concerns as they developed. Although pre-implementation planning sessions had been conducted on each specific unit, unidentified practice issues surfaced during implementation. The practice issues

were usually related to the specialty population and their nuances of care (pediatrics, oncology, etc.). Solutions for some problems could be identified readily and resolved quickly; however, other issues such as medication packaging and use of insulin pens required problem-solv-

ing with multiple stakeholders. The INS, CNS, and NES were also physically present on the nursing units during the day and on call during off-hours to address problems as they developed and provide ongoing one-on-one problem-solving, staff support, and education.

BCMA nursing workgroup. A workgroup comprising IOG members who participated on each of the unit-based response teams and bedside nurses from across multiple units (general care, specialty care, and intensive care units) was developed to problem-solve medication administration issues discovered after “go-live” and were shared across many nursing units. Bedside nurses who were using the newly installed BCMA system met monthly with the workgroup to provide detailed descriptions of issues they were encountering. The workgroup jointly developed solutions and posted meeting minutes on the BCMA website to update nursing staff. When the work team identified global medication practice issues impacting nurses across the institution, the work team referred these issues to the IOG for resolution. Active nursing leadership engagement was critical to the problem-solving process as well as elevating institutional issues to senior leadership.

BCMA website. A dedicated BCMA intranet website was developed to facilitate implementation. The website provided information updates about BCMA rollout schedule, dates for BCMA classes, updated policies, quick tips, workflows, and responses to issues as they were identified. The INS monitored the website closely during implementation and provided nearly real-time responses to nurses’ questions and concerns posted via an online feedback form. Also, a “frequently asked questions” section was kept up to date on the website.

Nurse satisfaction surveys. Electronic surveys of nurse satisfaction with the new BCMA

system were conducted by a nurse researcher to broaden opportunities for obtaining feedback from bedside nurses. The Medication Administration System: Nurses Assessment of Satisfaction (MAS-NAS) scale (Hurley et al., 2006) was used to measure nurse satisfaction before, during, and after BCMA implementation. The MAS-NAS is divided into subscales for access (6 items), safety (7 items), efficacy (5 items), and includes one item for overall satisfaction. The Cronbach Alphas for each subscale were access (0.71), safety (0.76), and efficacy (0.77). Use of a validated instrument was valued by the interprofessional BCMA team as a way to obtain objective, targeted feedback throughout the implementation process.

Human factors review. An experienced usability expert conducted a human factors system review by observing medication administration before, during, and after adoption of BCMA. The human factors reports highlighted the importance of the environmental aspects of the medication administration process, recognizing BCMA is only a part of the medication administration workflow. The expert’s suggestions for improving medication administration safety (graphic user interface, terminology, lighting, etc.) were brought forward to the IOG and eventually to the nursing practice committee for action/resolution.

BCMA system reports. The BCMA software provided two types of reports: system alerts and utilization reports. BCMA system alerts provide a warning on the computer screen alerting the nurse the medication about to be given does not match existing pharmacy records. The BCMA software provided alert data for immediate use by the nurse and for later review by nurse managers. Utilization data were obtained and monitored early in the implementation process. Utiliza-

tion reports provided nurse managers with information about nurses’ continued use of the old medication documentation process (which was no longer supported for use) and those that used the BCMA bypass scan function (eliminating the patient safety net). The nursing leadership team followed up with individual nurses as to the importance of using BCMA. Active coaching by the nurse manager was critical to moving the unit culture forward in adopting new workflows and processes. Additional utilization reports provide information on the frequency of warning screens nurses encounter during the medication administration process. Skilled report writers developed and provided utilization data that were useful for nursing and organizational leaders.

RESULTS

Feedback to Implementation Teams

Ongoing feedback provided by bedside nurses to members of the interprofessional implementation team and via the website indicated aspects of the BCMA system were problematic and needed to be addressed. BCMA system hardware issues primarily included concerns about scanners and barcodes. Although nurses had preferred tethered scanners during the preliminary testing in the simulation center, wireless scanners were not eliminated completely from the implementation plan. It quickly became apparent during implementation that most nurses actually preferred wireless scanners, and this was likely due to improved functionality resulting from upgrades in wireless technology since the early testing was conducted in the simulation center. Wireless scanners were incorporated quickly as the standard hardware in the BCMA system.

BCMA barcodes were also problematic initially. For example, sometimes the barcodes became damaged or moisture accu-

mulated so the scanner was unable to recognize them. Additionally, traditional barcodes were too large to be used with newborn and pediatric armbands. Several types of barcodes were tested until 2D datamatrix barcodes (commonly referred to as the “Aztec” barcode) were selected as most durable and effective and small enough for newborn and pediatric armbands.

Overall BCMA software delays, referred to as *latency*, were identified early in the implementation process, especially as nurses attempted to move from screen to screen. Latency was improved through software upgrades, and nurse satisfaction increased significantly. In addition, links were created within the BCMA system software to connect the nurse with institutional resources such as intravenous (IV) medication administration guidelines. In addition, the need for a shortcut or quick navigation back to the medication administration record to assess when a medication was last administered was identified.

Workflow complexities were underestimated initially and required re-evaluation during implementation. Despite pre-implementation efforts to identify medication administration workflows clearly, additional nursing practice issues were identified during implementation. For example, workflows around documentation of wasted controlled medications were identified when the process became more visible with BCMA. A new workflow needed to be developed that allowed for wasting the medication at the automated dispensing cabinet and pharmacy changed its practice to send the exact medication dose whenever possible to minimize wasting. Similarly, variability in unit-specific practice patterns such as documentation of IV flushes, medication preparation practices, and hand hygiene expectations became more transparent with BCMA. Practice policies such as charting and clearing patient-con-

trolled anesthesia syringes were either reaffirmed or revised by clinical practice committees and then applied consistently across all units.

BCMA System Alerts

During implementation, the IOG recognized the amount of alert data provided by the BCMA software was voluminous and required extensive work to develop reports that were usable by nurses and nurse managers. The INS and IT representative streamlined the alert reports to include basic alerts for wrong patient or wrong medication, including incorrect dose. These reports alerted bedside nurses and nursing leaders to potential errors intercepted by the BCMA system.

The Nursing Work Group noted aspects of the BCMA software that were intended to support the nurses’ workflows were problematic and required further investigation and problem solving. For example, work team members noted BCMA alerts were often misunderstood by bedside nurses. This issue was discussed with a human factors specialist who recommended alert terminology that was IT centric be changed to language that was more meaningful and instructive to bedside nurses. For example, after scanning a medication the nurse received a prompt on the bottom of the screen noting the medication had been entered into the scanned medication *queue*. A number of nurses were unfamiliar with this term or that this was the proper spelling of the term. The prompt was changed to state the scanned medication was added to the *list* of scanned medications.

Nurse Satisfaction Surveys

Initial survey responses indicated somewhat lower than expected levels of nurse satisfaction with the new BCMA system (see Table 2). Nurses identified overall system slowness as a problem that increased the time spent in med-

ication administration. Inflexibility of the system to accommodate patients’ schedules, such as time off the unit, was also problematic. These findings prompted the implementation team to redouble efforts to improve the overall performance of the BCMA system through software upgrades. Bedside nurses reported statistically significantly ($p<0.05$) improved system access, safety, and efficacy, as well as improved overall satisfaction following two major BCMA software upgrades.

Human Factors Review

Issues that impacted medication administration were identified by direct observation of the medication administration process. A portion of identified problems were related directly to BCMA, while others related to the environment in which medication administration took place. The availability of computers and their location within the work area were ongoing concerns. Nursing leaders felt strongly bedside computers were necessary for optimal patient safety. However, placing a bedside computer in a convenient location in each patient room was at times very challenging, especially in smaller patient rooms; most patient rooms were eventually reconfigured from double to single occupant rooms. The use of mobile computer workstations, however, was required for some clinical areas based on spatial restrictions or the needs of the patient population. Additional environmental issues were identified and addressed by the IOG including providing additional task lighting at bedside computers, designating a specific space at the bedside for preparation of medications, providing defined storage locations, and charging stations for the computers on wheels.

BCMA System Utilization Reports

BCMA system utilization reports were key indicators of successful integration of BCMA into

Table 2.
Survey Results Before and After Software Upgrades

Subscales Upgrade #1	<i>n</i>	Mean	<i>SD</i>	<i>p</i>
Access				0.011*
Pre Upgrade #1 (Group 1)	331	4.40	0.91	
Post Upgrade #1 (Group 2)	183	4.58	0.73	
Safety				0.000*
Pre Upgrade #1 (Group 1)	331	4.03	0.92	
Post Upgrade #1 (Group 2)	183	4.36	0.76	
Efficacy				0.000*
Pre Upgrade #1 (Group 1)	331	3.99	1.08	
Post Upgrade #1 (Group 2)	183	4.40	0.85	
Satisfaction				0.000*
Pre Upgrade #1 (Group 1)	330	6.40	2.33	
Post Upgrade #1 (Group 2)	183	7.36	1.72	
Subscales Upgrade #2	<i>n</i>	Mean	<i>SD</i>	<i>p</i>
Access				0.012*
Pre Upgrade #2 (Group 3)	72	4.50	0.73	
Post Upgrade #2 (Group 4)	65	4.80	0.64	
Safety				0.045*
Pre Upgrade #2 (Group 3)	72	4.35	0.71	
Post Upgrade #2 (Group 4)	65	4.60	0.76	
Efficacy				0.029*
Pre Upgrade #2 (Group 3)	72	4.44	0.90	
Post Upgrade #2 (Group 4)	65	4.76	0.81	
Satisfaction				0.039*
Pre Upgrade #2 (Group 3)	72	7.47	1.74	
Post Upgrade #2 (Group 4)	65	8.06	1.55	

daily nursing practice. BCMA utilization reports were generated for each individual nurse, each nursing unit, and for each specialty nursing division. Unit-specific data regarding BCMA utilization reports were provided to each nurse manager with comparisons across the department of nursing. Nurse managers monitored these reports on a monthly basis and discussed concerns with individual staff nurses. Initially, low BCMA utilization was related to fear of technology by some nurses and concern about the timeliness of medication administration. The BCMA process initially slowed the administration process and

reinforced the recognition BCMA is not expected to save time but improve safety. Eventually medication administration should take about the same length of time as a manual system. When low BCMA administration was identified for a particular unit, compliance and educational interventions were initiated immediately by unit leadership.

Just Culture, a system to support organizational improvement (Frankel, Leonard, & Denham, 2006), was a key strategy to reinforce nurses' understanding of the importance of BCMA use for patient safety. Sessions were held with each nursing unit to review

(a) the critical link of BCMA with patient safety, (b) the BCMA process, and (c) BCMA system utilization data as well as availability of specific RN performance data (which was shared privately with individual nurses). This review assisted nurse managers and nursing staff to understand their unit-specific practice improvement opportunities. Nursing leadership teams were instrumental in monitoring and coaching bedside nursing staff. Nurses reviewed and responded to utilization data and coaching resulting in BCMA utilization average of over 95%. A small percent of medications require emergent administration that may not allow for profiling as quickly as needed or system limitations for scanning a late medication, or use of the patient's own medications.

Recommendations

BCMA is critical technology that impacts patient safety. Many medication administration processes are affected by BCMA implementation resulting in a need for timely, accurate feedback on many levels. Data availability from multiple sources is critical to identify and address system, practice, and compliance issues proactively. Early and ongoing opportunities to obtain information about nurses' concerns about medication administration processes, including BCMA, are critical for successful implementation of a system that contributes to patient safety.

Recommendations based on this organization's experience are made for BCMA planning, implementation practices, nursing practice/workflows, environmental factors, and adoption strategies (see Table 3). Nurse leaders must recognize BCMA involves changes in nursing workflows and unit cultures requiring education and coaching throughout the change process. The IOG, the cross-unit workgroup, and the unit-based response teams used ongoing nursing feedback to address the

Table 3.
Recommendations

Issue	Recommendations
BCMA Planning	<ul style="list-style-type: none"> • Conduct site visits of institutions using BCMA to observe concrete examples of BCMA functionality and to develop realistic expectations. <ul style="list-style-type: none"> – Include the interprofessional team in the visits. – Create a clear vision of the scope of the implementation. • Ensure institutional leadership support to adjudicate issues that have institution-wide impact. <ul style="list-style-type: none"> – Provide ongoing status reports of issues and barriers. • Ensure an interprofessional team commitment. <ul style="list-style-type: none"> – Move BCMA from a nursing issue to a systems issue and improve communication and problem solving across disciplines and departments. • Include nursing leadership and a strong nursing voice during planning and system selection. • Plan for immediate and ongoing data collection to ensure timely problem identification. • Include project management to assist with timelines, detailed planning prior to implementation, and to anticipate upcoming issues to consider.
BCMA Implementation	<ul style="list-style-type: none"> • Include opportunities for ongoing nursing feedback during BCMA implementation. <ul style="list-style-type: none"> – Include all levels of nursing leadership to increase understanding of issues and to support needed system/practice changes. – Include bedside nurses in system development. – Include bedside nurses in work teams to assist with design features, implementation, error messaging, and retesting. • Provide ongoing education to bedside nurses and nursing leadership to increase competency with the system and to assist with adaption as the system evolves. • Recognize the likely need for BCMA software refinements to better meet nursing practice workflow requirements. • Develop mechanisms to ensure barcodes are legible, durable, and similar for all patients; have a mechanism to print new barcode IDs as needed. • Evaluate scanners to determine functionality for various patient population and to ensure timeliness and ease of scanning.
Nursing Practice and Workflows	<ul style="list-style-type: none"> • Anticipate practice variation across units; discuss and reaffirm clinical policies and expectations. • Develop mechanisms to increase system flexibility and to document process irregularities (e.g., patients leaving the unit, wasted medications, taking medications into isolation rooms). • Clarify workflows and reaffirm acceptable practices. • Develop clear, concise nurse-specific practice expectations that identify appropriate bypass usage.
Environment	<ul style="list-style-type: none"> • Ensure adequate computer availability and optimal placement. • Consider task lighting for difficult-to-see keyboards and administration of medications at night. • Designate space in patient rooms for medication preparation. • Recognize BCMA is highly affected by other medication processes and increases the need for standardization (e.g., medication room). • If using mobile workstations consider mobility issues such as the ergonomic impact of the cart and carpeting. • Work closely with pharmacy partners to address manufacturing barcode issues, repackaging, and stock order discrepancies.
Adoption Strategies	<ul style="list-style-type: none"> • Develop early and accurate utilization reports using sophisticated report writers. • Provide broad dissemination of utilization data to organizational and nursing leaders. • Provide unit trend data to nursing leaders and bedside nurses. • Provide education and support for “Just Culture.” • Ensure a supportive environment for safety and continuous improvement.

numerous BCMA system issues. Nursing leadership engagement was critical to support nurses' adoption of new workflows and technology. Data availability on nurse adoption of technology, use of system overrides, and error rates were important for supporting staff nurse behavior change.

Conclusion

BCMA implementation represents a change in a complex process requiring significant modifications in the work of nurses. Nurses' voices are critical for successfully implementing BCMA technology to support this change in nursing practice. Feedback from nurses who administered medications was critical to selecting and refining a BCMA system that supported their practice needs. In addition, feedback regarding implementation status was critical for keeping key stakeholders across the institution informed of the progress and initial impact of the implementation. Nursing leadership engagement throughout the process supported the successful adoption of new workflow processes and technology. \$

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