# STRATEGIES FOR IMPLEMENTING BARCODE ADMINISTRATION SYSTEMS

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*Abstract:* **The number of medication errors associated with preventable deaths in healthcare facilities remains at a high rate for healthcare leaders. Practices of medication delivery remain similar to those 10 years ago. Hospitals that have implemented barcoding medication administration systems have reported a decrease in medication errors ranging from 60% to as high as 93%. Despite this utility of barcoding, only 50% of U.S. hospitals have implemented barcode medication administration. This comparative case study explored the strategies hospital leaders used to implement barcode medication administration systems, utilizing the sociotechnical theory for a conceptual framework. Face-to-face, semi structured interviews were used to identify experiences from a purposive sample of 20 hospital leaders from Minnesota and Iowa. The research question guiding this study addressed strategies hospital leaders used to implement barcode medication systems to reduce preventable medical errors. After analyzing the interview transcripts using inductive analyses, 4 themes emerged. These themes include the strategic organizational communication, technology and end user support, hands-on training, and application of audit reports. Hospital leaders might benefit from the study findings when developing strategies to implement barcode medication systems. The implication for positive social change includes the potential of decreasing patient medication errors and reducing loss of life caused by medication errors with hospital leaders accelerating the adoption of barcode medication systems in hospitals. Other health care providers may explore how the findings might help reduce medication errors in their facilities.**

*Keywords:* **Barcode, Medication, Safety, Implementation, Qualitative, Sociotechnical Theory.**

## 1. INTRODUCTION

People die needlessly each year because of preventable medical harm (Tzeng, Yin, & Schneider, 2013). The U.S. Food and Drug Administration, (FDA) Adverse Event Reporting System (FAERS) in 2011 noted 573,111 serious preventable incidents of harm occurred in patients with 98,518 resulting in death. Of the 573,111 patient deaths reported to FAERS in 2011, 38 percent of the deaths were a result of medication errors (Classen et al., 2011). Weston and Roberts (2013) opined that the majority of barcoding reported a decrease in medication errors ranging from 60% to as high as 93%. Conversely, only 50% of U. S. hospitals have implemented barcode medication administration (Pedersen, Schneider, & Scheckelhoff, 2012). In harmony with the electronic medical record, barcode technology design enables the safety of patients by identifying the right patient, right medication, right dose, right time, and right route with each medication delivery (Seibert, Maddox, Flynn & Williams, 2014). Barcode medication administration delivery systems emphasize an innovative process in reducing medication errors.

In April 2004, the Department of Health and Human Services implemented the barcode rule FDA strategy that uses state-of-the-art technology to improve patient safety. When used with bar code scanners and computerized patient information systems, bar code technology can prevent many medication errors, including administering the wrong drug or dose, or administering a drug to a patient with a known allergy (FDA, 2011). While the bar code rule was effective in supporting

bar code identification on each medication, the FDA only recommended the use barcode scanner in the delivery of medication to the patient.

In 2011, medication errors harmed 1.5 million people (Hsiao & Hing, 2012). Classen et al. (2011) reported 49% of all hospital admissions encounter a preventable error that results in injury, known as an adverse drug event (ADE). Of the 49% ADE, 19% were medication errors (Classen et al., 2011). The risk of dying from an ADE is one in 200 or as many as 187,000 deaths in hospitals each year (Boodman, Villarreal, & Jones, 2011). While not all ADEs result in harm, those that do are costly. Van Den Bos (2011) reported the annual cost of measurable medical errors at $17.1 billion. In 2012, Brunetti and Dong-Churl (2012) noted the approximate cost of ADE's to the nation was between 76.6-136 billion annually on the morbidity and mortality cost of errors. In addition, medication errors cost an extra 3.5 billion in medical costs (Hsiao & Hing, 2012).

Medication errors are the second most frequent cause of injury for all types of medical errors (FDA, 2011). An estimation of more than 40 % of adverse events that occur in a hospital setting occurs from medication errors (Cortelyou-Ward, Swain, & Yeung, 2012). Medication administration is the very process of improving a patient's health by providing correct medication; however, this is the exact practice that puts patients' safety at risk (IOM, 1999). With a continuing drive to implement healthcare technology to improve patient safety, issues related to proper maintenance, access and ease-of-use in their design and implementation transpire (Keer, Williams, Cooke, & Ashcroft, 2013). While EHR and computerized order entry may capture errors committed during medication prescribing, BCMA may be more effective in intercepting errors committed during medication administration (Brunetti & Dong-Churl, 2012). Barcode medication administration is a revolutionary way of using technology to administer medication and, at the same time, preventing medication errors (Cleary-Holdforth & Leufer, 2013). Barcoding is one of many advances in technology that hospitals are implementing to minimize medication errors.

## 2.   METHODS

The purpose of this qualitative case study was to explore the strategies hospital leaders used to implement barcode medication administration systems. Twenty hospital leaders from two hospitals in Minnesota and Iowa participated in interviews to discuss their strategies. Triangulation supported the responses from the participants' interview with policy and procedures on barcode administration process obtained from each hospital. Prior to interviews, an expert validation with five panel experts to ensure the reliability (method) and validity (results) of the questions occurred. Five colleagues in the healthcare field reviewed the interview questions to help establish content validity. The selections of the five participants were three individuals from separate healthcare acute care settings and two University healthcare professors.

## 3.   DATA COLLECTION

Data collection occurred utilizing a face-to-face interview process in addition to the policy and procedures on barcode administration process from each hospital. The utilization of member checking gave participants the opportunity to correct errors and challenge interpretations, by agreeing or disagreeing with the interpretation, allowing for changes if necessary to achieve accuracy and completeness of the data collected.

The data information was loaded into NVivo software to evaluate the potential of identifiable themes and common notations. The coding of patterned themes illustrated the stories express by the participants. Analysis of policy and procedure information for the two hospitals occurred at the completion of the interview process.  Examination of each hospitals policy and procedure for similar themes and processes documented in an excel spreadsheet.

## 4.   RESULTS

Four themes emerged from the data analysis. The themes involved: (a) strategic communication, (b) technology and end user support, (c) training the end users, and (d) audits reports including documentation on the percent of scanning completed per nurse, the reasons why an override occurred and identification of late or early dispensing errors. Table 1 illustrates the themes in relationship to the Participants responses. Hospital leadership participants are referenced as Participant A through T during the data analysis.

**TABLE 1 Categories of Themes in the Study per Participant**

| Theme | Participant Response |
|---|---|
| • Strategic communication | • A, B, D, E, F, G, H, I, J, K, L, M, N, P, Q, R, S, T |
| • Technology and end user support | • B, C, D, E, F, H, I, J, K, M, N, O, P, Q, R, T |
| • Training | • A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, T |
| • Audits | • A, D, E, F, H, I, J, K, M, N, Q, S |

Table 2 illustrates the findings collected during the review of the policy and procedure documents collected. Analysis for each hospital policy and procedure included the relationship of the content similarities and uniqueness. Data analysis from the policy and procedures (P&P) appear in each noted theme. The triangulation of identified patterns across sources noted the theme of strategic communication with the differences in the number of steps in each P&P. Hospital IA communicated 31 steps compared to Hospital MN at 17 as identified in Table 2. Technology, end user support, and training correlated to the P&P analysis of the five rights and scanning procedures. Audits identified in Hospital IA P&P related to the interview audit discovery, however P&P documentation of audits in Hospital MN documentation remained absent.

**TABLE 2 Relationship of Policy and Procedures per Hospital**

| Hospital | Number of Steps in P&P | 5 Rights | Scanning Wristband/ Medication | Reporting/ Audits |
|---|---|---|---|---|
| Hospital MN | 17 | Yes | Yes | No |
| Hospital IA | 31 | Yes | Yes | Yes |

**Theme 1: Strategic Communication**

Communication was a key component to the success of the BCMA project. Participants B, D, G, and K spoke of the importance of communicating with all disciplines prior to the start of the project, during and post. Many participants referred to the post communication as the most important. The feedback from the end users allowed for making necessary changes to the coding or workflow immediately post implementation. Participants F, R and T identified patients as needing communication about the project and providing them with education on how BCMA helps in patient safety. Participant M stated the best communication was a sheet of paper with all the tips and tricks of how to use the new product attached to the back of every computer in the patients' room. Strategic communication in written form supported analysis of the policy and procedures of barcode medication from each hospital. Four pages of the document represented one hospital's policy and procedure, while the other hospital had two pages. A consistency within the two hospitals in communicating the five rights of medication pass and a verification of orders transpired. Analysis of detailed information communicating the level of home medication distribution and the credentials of hospital employees who were eligible to pass medications occurred in one hospital's policy and procedure documents. While documentation within the policy and procedures remained unique, the essence of patient safety in medication administration was forefront.

**Theme 2: Technology and End User Support**

Theme 2 focused on the technology and end user support. One of the most significant challenges nurse leaders will face in the coming is to find the balance between the benefits of using the technology, while not diminishing the human element. Participants R and T commented how technology cannot interfere with the human side of caring for patients. Policy and procedure documentation in both hospitals supported the scanning of patient identification band and each medication.

The technology support was programing the scanners and troubleshooting the equipment if it did not work. Participants explained end user support as extra individuals on the units to add support during the first week of implementation. The extra staff helped with the slowness in the learning curve by providing duties normally performed by the staff. Participant A and L noted chocolate treats delivered to the floor by administration were helpful in the learning curve period because

chocolate represents support and acknowledgment of a job well done. Super users, were described by the majority of those interviewed as a person who had extra training and helped each staff member on the unit with questions and support during the implementation.

**Theme 3: Training**

Participant D commented that no person goes to work to hurt others. When used properly, the majority of the interviews stated BCMA decreases errors significantly. With proper training, BCMA can save lives. Mandatory classroom training for staff occurred, in addition to on the unit hands on training, and one hospital provided practice kits. Participant B described the practice kits as an individual training strategy that allowed staff to take a kit up to the unit with systematic instructions and examples to practice orders and scanning to feel more comfortable with the process. Training too soon was an obstacle reported by Participant C. Training needed to occur within a month period so staff could retain all the material presented in a timely manner stated Participant C. Participant A, C, and J supported follow-up training once the project started. Follow-up training was most important in avoiding workarounds. One example of a workaround was failure to scan the patients' wristband. While both hospitals' policy and procedure requires scanning the wristband, this was not consistent with evidence from the interviewee Participants A, H and I. While the notations of workarounds occur in practice, the hospital policy and procedures outline systematic procedures on acceptable medication delivery.

Both hospitals report utilizing BCMA in the emergency room. No unit identification of BCMA occurs in the policy and procedures. Training complications multiplied for the emergency room when nurses learned to enter orders in the computer system to speed the medication delivery process. In addition, one hospital utilized tele-pharmacy in the hospital pharmacy. Tele-pharmacy is an off-site pharmacy used during the night shift. The normal turnaround time for medication review with a tele-pharmacy prior to delivery of a medication is 10 minutes, which in the emergency room can be a long wait, hence the ability to enter orders and proceed with the five rights in a manual sense.

**Theme 4: Audits**

Theme 4 concentrated on the audits and reports for both hospitals. Hospitals communicated the audit and compliance reports are from the BCMA electronic tracking system. The audit reports include documentation on the percent of scanning completed per nurse, the reasons why an override occurred and identification of late or early dispensing errors. The policy and procedure documents did not specify audit reports; however, additional documentation is required for tracking reasons for the omission of delivery and medication errors.

Participant B communicated their hospital was striving for 95 % compliance on all medications scanned. Correct and consistent procedures for medication delivery decrease the potential for medical errors, thus a decrease in medical error cost. Participant F confronted a nurse who was not scanning the medications based on the audit, and the nurse's response was "I was not going to scan until you made me do it." Participant N supported communicating the compliance report to all staff. Participant E posted the compliance report on the unit with the nurses' names and percentages of compliance achieved. Participant E commented that this process provided competition within the unit in supporting each other in how to fix any workflow that was not supporting the process.

## 5.    RECOMMENDATIONS FOR ACTION

The findings identified organization communication as an important phase in implementation success. Communicating the benefits and attributes of increasing patient safety, decreasing medication errors and improving the quality of care for all patients provided the framework for the start of the project. Recommendations for multidisciplinary work teams with a number of hands on user on the team transpired. The findings support the importance of addressing communication throughout the process and continuing throughout the evaluation phase. Communication is apparent in the verbal form of support, the written form on tips and tricks to address challenges and through positive measures such as delivering candy to the floors in support of the major change.

Technology and end user support recommendations include a complete discovery of all barcodes and scanning compliance of the barcodes. The recommendation would be to identify medications with two barcodes up front and provide the education necessary during training. If medications do not scan, the recommendation is to have a protocol in place to call pharmacy rather than trying to work around the problem.

End user support is instrumental at the time of implementation. The use of super users on each unit is highly recommended. Call centers to field questions and concerns and additional staff on the units to assist in the daily duties of the unit during the first week are essential in an implementation success.

Recommended is hand on training as an effective training tool, in addition to classroom training and post training follow up. Post training recommendation is to avoid possible workarounds in the future.

The final recommendation is for the successful application of audit reports. Audit reports identify the potential challenges occurring on the units. Recommendation of posting audit reports supported immediate change in behavior. Communicating the results via one-to-one conference, staff meetings and hospital wide reporting occurred.

Limitations included a small sample size, a hospital in Minnesota and one in Iowa. Future studies may take into consideration hospitals in other regions of the U.S. A limitation was the possibility that study participation may not honestly express their views and perceptions due to of concerns of confidentiality. Future studies may consider off-site interviewing in place of onsite interviewing achieving a greater level of confidentiality. The length of time of the interviews may have limited attendees because of busy work schedules or unavailability. Scheduling in the future may be more advantages at the beginning or end of a workday.

Further studies might strengthen opportunities to address the compliance of BCMA based on the audit reports. Additionally, further studies are necessary on how effective BCMA systems are in significantly reducing deaths due to medication errors.

## 6. CONCLUSION

The most significant contribution of this study was the focus on patient medication safety designed to decrease medication errors and save lives with the application of barcode medication systems. The four themes that emerged from my data analysis were: (a) strategic communication, (b) technology and end user support, (c) training the end user, and (d) audits reports including documentation on the percent of scanning completed per nurse, the reasons why an override occurred and identification of late or early dispensing errors. Strategic communication identified themes supporting verbal and written communication as essential components of successful implementation. The collaboration of technology and the end user support enhanced the dedication of the sociotechnical theory. Hands-on and timely training in conjunction with increasing compliance with audit reporting reinforced the findings. Participants' interview results and policy and procedure documentation channeled the themes. Several of the participants in this study reinforced best practice strategies for the success of barcode implementation. Supported throughout the study findings, sociotechnical theory demonstrates the collaboration of technology and human factors remained supported. The themes that emerged from the study may be factors that are critical for hospital leaders in the strategies necessary for barcode medication implementation.

Sharing successful methods to accelerate the implementation of BCMA may reduce medication errors afflictions of cost and potential disabilities encountered by patients and their families affected by the medication error. Nursing needs to lead the way in the design and implementation of practice and policies that improve outcomes and reduce medication error. This study makes an important contribution to research on the importance of optimizing the common strategies used by hospitals to implement barcode medication systems to ensure safety and increase the quality of patient care.

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