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Increasing Compliance of Bar Code Medication Administration in the Emergency Room

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Submitted in partial fulfillment of the Requirements for the degree of

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2016

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Dedication

This work is dedicated to my husband, Retired Lt. Colonel James A. Wisor, Jr., who was sent to Afghanistan for thirteen months in 2008. His example of bravery and love of his profession and country gave me inspiration to follow my passion of learning and higher education. His encouragement, strength, and fortitude carried me through this process and I will be forever grateful.

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Abstract

Purpose: To ensure quality healthcare, it is necessary to provide safe medication administration. The specific goal is the reduction of medication errors in the hospital setting with concentration in the emergency room (ER). Bar-code medication administration (BCMA) has proven to be effective on the in-patient units in the hospitals researched and visited as part of this project, but the issue still remains that the emergency rooms exhibit a decreased compliance rate. The purpose of this Doctor of Nursing Practice (DNP) project, is to reverse the situation in a local community hospital that has a 50 bed emergency room, promoting increased compliance to affect improved medication safety measures. This was done by educating the nursing staff in the emergency room regarding the addition of an application related to verbal orders which increases with high acuity levels. The application will automatically profile the verbal order so that the nurse can use the BCMA and therefore increase compliance.

Significance of the Project: “Thirty-four percent of all medication errors in hospitals occur in the administrative phase of the medication process and less than 2 percent of these errors are intercepted before execution” (Voshall, Piscotty, Lawrence, & Targosz, 2013, p. 530). In addition to causing possible harm or even death to a patient when an adverse event occurs, it is also a devastating economic factor. This is a nurse-driven change and to make it a success the nursing staff must perceive that the goals are realistic and that this will improve their practice. To insure a positive outcome it is essential to establish systems standards which are compatible with nursing needs and expectations, and which facilitate development of Information Technology (IT) systems which are supportive of nursing practice (Zadvinskis, Chipps, & Yen, 2013).

Methods: Four goals were established for this project that was named: The Medication Quality Initiative. The first was to improve the compliance of BCMA utilization in the ER since they were averaging 70.9% BCMA usage following implementation, and had recently declined to 41.1 percent (RWJUH, 2015). Through careful research of the daily ER patient logs and the weekly data utilization sheets for BCMA, it had been determined that verbal medication orders increase in relationship to the increased patient activity and acuity levels, decreasing compliance. Because of this occurrence medications cannot be profiled in a timely manner and the nurses use work-arounds. The second goal was to meet with the team that consisted of the Chief Nursing Officer (CNO), ER Medical Director, ER Nursing Director, IT, Executive Informatics Nurse, IT Pharmacist, Nursing Educator, and the project preceptor. It was unanimously approved to turn on the application called CARE ADMIN in the Medication Administration Record (MAR) portion of the Patient's Electronic Health Records (EHR) System so that verbal orders can be immediately profiled. Figure E3, in Appendix E, shows the "Create Order and Document" button which is only available to ER Users of this system to allow the automatic profiling process to take place.

For the third goal, this author conducted an in-service program for 52 ER nurses so that they had a proper understanding of this new application, as well as the importance of BCMA compliance. In addition, they were given a pre-survey to determine their overall perceptions and use of this technology. The fourth goal was instituting the project, which was on-going for eight weeks. During that period, the data utilization sheets were reviewed weekly to determine project success and sustainability. At the conclusion of the eight weeks, the staff completed a post-survey to determine their perceptions after having used the new verbal order process. This post survey looked at both pre and post education perceptions.

Project Outcome: The overall response was positive. The five levels of nursing practice “From Novice to Expert” related to the core of the emergency room staffing matrix. This was an advantageous time for this project because the mentors were teaching medication administration via the BCMA to new graduates as well as incorporating how to use the verbal order application. The overall consensus was that it does improve nursing practice since it does rapidly profile the medications, thereby improving patient care. Additionally, it has been subsequently, observed that many of the physicians have become more time sensitive in transcribing their medication orders in the computer.

Clinical Significance: As a result of this project, it was noted that the percentage of BCMA use has increased. The Director of the Emergency Room will continue to have the nurses utilize the application. The sustainability of this project enhances medication administration in the emergency room. This procedure has become an integral part of the ER orientation to new staff members given by the nurse educator and nurse preceptors.

Increasing Compliance of Bar Code Medication Administration in the Emergency Room

Section I - Background

As stated in the Report Brief of the Institute of Medicine's (IOM) 1999 report "To Err is Human", it was recognized that:

the medication process provides an example where implementing better systems will yield better human performance. Medication errors now occur frequently in hospitals, yet many hospitals are not making use of known systems for improving safety, such as automated medication order entry systems, nor are they actively exploring new safety systems. (Kohn, Corrigan, & Donaldson, 1999, p. 4)

This report indicated that at that time, it was estimated that between 44,000 and 98,000 of the patients receiving medications in hospitals die from preventable medication errors.

In the intervening years, most hospitals have taken steps to adopt procedures and systems to ensure safe medication administration. However, 12 years after the IOM report, it was reported that "there are 400,000 preventable drug-related injuries per year" (Hunter, 2011) a 400% increase from the 1999 estimates. Two years later it was shown that "thirty-four percent of all medication errors in hospitals occur in the administration phase of the medication process and less than two percent of these errors are intercepted before execution" (Voshall et al., 2013, p. 530).

Hunter (2011) attributes Wideman (2010) with defining a medication error as an "unintended act or as an act that does not achieve its intended outcome" (as cited in Hunter, 2011, sect: Background). In addition to causing possible harm and even death to a patient when an adverse event occurs, it is also a devastating economic factor.

From 2008-2012 the Department of Health and Human Services' Office of Inspector

General (OIG) conducted 10 studies regarding adverse events in hospitals. They found that “27 percent of hospitalized Medicare beneficiaries experienced adverse and temporary harm events, nearly half of the events were preventable, and care associated with events cost the Medicare program an estimated \$4.4 billion a year” (DHHS - OIG, 2014, p. 1). Research has shown that the cost of electronic pharmacy management and drug repackaging is \$35,000-\$54,600 over a five year period. The savings is \$1,800-\$2,600 per harmful error prevented (Sakowski & Ketchel, 2013).

Hunter (2011) cited Wideman (2010) as explaining “the delivery of a single dose of medication is the end result of a complicated process involving 10-15 steps, each of which offers opportunity for error” (as cited in Hunter, 2011, section Background). In an attempt to overcome the complexity of the medication administration process, while improving quality patient care and safety, the Veterans Administration (VA) pioneered the concept of Bar-Code Medication Administration (BCMA).

The concept of BCMA originated in 1992, with a VA nurse who noted the use of barcoding by a car rental agency and wondered if medications could also be barcoded. During the period 1999-2000, the Department of Veteran Affairs promoted the BCMA system in 161 of its facilities (Coyle & Hermann, 2005, p. 32). The first system was “implemented in the acute care and long-term care sections of a 118-bed VA hospital beginning in February 2000... the software was designed to improve medication administration accuracy and to generate online patient medication records” (Wideman, Whittler, & Anderson, 2005, p. 437).

BCMA is based on the 5-rights of medication administration and consists of a barcode reader (scanner), a portable computer with a wireless connection, a server, and software. The medication received from the pharmacy has bar codes on the packaging. The nurse scans the

patient's wristband which is also barcoded, while determining it is the right patient and scans the medication to determine the right drug and right dose. The technology is intended to assist the nurse in administering medications by providing an additional series of checks. The system cannot and is not intended to replace the nurse's expertise, professional judgement or critical thinking skills.

Dolansky and Moore relate that:

In 2005, nursing leaders responded to the IOM call to improve the quality of healthcare by forming the Quality and Safety Education for Nurses (QSEN) initiative funded by the Robert Wood Johnson Foundation. The QSEN initiative consisted of the development of quality and safety competencies that serve as a resource for nursing faculty to integrate contemporary quality and safety content into nursing education ... QSEN is a national movement that guides nurses to redesign the 'what and how' they deliver nursing care so that can ensure high quality, safe care. (2013, paragraph 2)

The QSEN's mission, which originally started as improving undergraduate nursing education programs, has now expanded to all nursing practice. To insure improved quality and safety of patients, certain issues have been identified. The correct Knowledge, Skills and Attitudes (KSA), are necessary for improved patient outcomes. These three attributes play an integral part in developing critical thinking which allows the nurse to progress from novice to expert, while simultaneously adopting and integrating new methods, procedures and systems into their nursing practice.

During this project, it became apparent that while a nurses' KSA was critical to the success of BCMA implementation and adoption throughout the hospital, it was extremely important for the implementation of that same system in the emergency room (ER), due to the

radically different workflow and emergency nature of care in that area.

There have been several studies done to determine the effectiveness of the BCMA and one concerned a prospective, observational, time-motioned study. The purpose of this study was to observe two approaches to medication administration in an Intensive Care Unit, Paper Based Medication Administration (PBMA) and BCMA. The results revealed that the BCMA approach was more efficient than the PBMA process, resulting in a decrease in time to administer medications and an increase in the amount of time the nurses could spend on direct patient care (Dwibedi et al., 2011).

The six aims to improve quality: safety, effectiveness, patient-centered, timeliness, efficiency, and efficacy should be the basis for promoting a safe environment for patients. “The development of policies and procedures delineating workflow to prevent medication errors is not a new phenomenon. Technologies supporting barcode medication administration (BCMA) has been developed as a system to help prevent these errors and create an additional level of safety for patients” (Voshall et al., 2013, p. 530).

The five criteria identified in the article by Lukas et al., Transformational Change in Healthcare Systems, determine the readiness in an organization which can predict the success of an improvement project. These five elements include: the impetus to transform; a leadership commitment to quality; improvement initiatives which actively engage staff in meaningful problem solving activities; a commitment to achieve consistency of organizational goals with resource allocation and actions at all levels of the organization; and a commitment to integrate the outcomes, in order to bridge traditional intra-organizational boundaries among individual components (Lukas et al., 2007, p. 309).

The driving force to change processes in healthcare organizations started with the

Institute of Medicine's 1999 report "To Err is Human." It stated that medical mistakes claim the lives of between 44,000 and 98,000 Americans each year. Statistics concerning medication errors were documented separately and showed that they accounted for at least one death each day and approximately 1.3 million injuries each year. During the period 1998 and 2005, serious injuries reported to the Food and Drug Administration (FDA) of hospital drug errors have increased from 35,000 per year to 90,000 (Hunter, 2011).

In 2011, the local community hospital initiated planning for implementation of a BCMA System. The hospital had implemented an Electronic Health Records (EHR) System several years earlier. An interdisciplinary team was created which included representatives from the major departments which would be involved in the implementation; specifically Information Systems, Nursing, Pharmacy and Admissions. They met weekly, as needed, to promote this system and determine its viability.

When their sessions were completed in 2012 they determined that the psychiatric department would be their pilot study. Their thought processes was to start small and determine its success or failure. As the pilot study succeeded, it was introduced gradually on each unit with the emergency room the last one to go live. It took approximately a year to complete.

Every week a daily compliance report was issued to the directors of each unit and administration to review the percentages of use. They could determine how each nurse and unit was succeeding or failing to utilize the system. If the percentage of compliance is low then the directors determine the cause and should develop solutions to correct it.

Administration realizes the importance of nursing perceptions on the utilization of BCMA. Nursing is the driver of this system and the hospital's investment will only be successful with effective utilization. It is vital to encourage system developers to perform a

thorough review of their system design, to insure that it incorporates nurses' considerations with respect to system usability and functionality, and its impact on nursing practice.

This author has been using this system and it is usually effective in avoiding errors. However, the ER presents its own peculiar challenges. One such challenge is that during periods of high patient acuity, there is an increased use of verbal orders by the physicians. Evaluation of the issue of verbal orders was chosen because it represents a departure from the normal medication administration process, creating its own challenges for nurses trying to work within the system. To be able to rectify this problem, the Information Technology (IT) Executive Nurse and the IT Pharmacist gave the approval to turn on an application for profiling verbal orders called CARE ADMIN. This application was already built into the Cerner system but had not been utilized. It had been kept as an unutilized feature so that verbal orders would not become a regular practice for the physicians. However, in order to determine if this would improve BCMA compliance during high patient acuity levels, this feature was allowed to be utilized for the emergency room only. Appendix E shows the format in using this application for verbal orders. The author has provided the steps in these screen shots that allows the nurse to scan the medication which automatically profiles the medication, thereby administering it in a timely fashion for improved patient care.

Prior to using the profiling feature, when a verbal order was given the nurse would usually bypass using the BCMA so that there was no time delay in caring for the patient. Another option was to transcribe the verbal order on a medication sheet and fax it to the pharmacy waiting for them to profile it to be able to access the BCMA. The third option was finding and or calling the physician and reminding them to transcribe the order. This became time consuming and it forced nurses to use a work around. As mentioned previously there is a

relationship between verbal orders and periods of high acuity levels, during which the physicians tend to give an increased number of verbal orders to avoid delay in the patients receiving their medications.

Unfortunately this practice results in decreased compliance in utilization of the BCMA. It has become obvious that this verbal order issue coupled with differences in the workflow of the ER necessitate alternative methods to utilize the BCMA in this environment.

The hospital presently has a goal of 85% compliance. In the in-patient units for 2014 they have had an 87.7% compliance rate and outpatient was 70.9%. To the organizations' credit, they are one of the few New Jersey hospitals that have instituted this technology in the emergency room. The organization is working to meet the criteria for transformational change and has continued to improve in most aspects to provide an optimal outcome in patient quality and safety. Unfortunately in 2015 the compliance rate in the emergency room dropped to 41.1% (RWJUH, 2015).

Purpose of the Project

To ensure quality healthcare, it is necessary to provide safe medication administration. The specific goal is the reduction of medication errors in the hospital setting with concentration in the emergency room. BCMA has proven to be effective on the in-patient units in the community hospital, as well as those that have been researched and visited during this project. However, the issue still remains that emergency rooms exhibit a decreased compliance rate in utilizing BCMA.

The purpose of this Doctorate in Nursing Practice (DNP) project, was to improve the compliance rate for use of the BCMA in our emergency room. To accomplish this, an unutilized feature of the BCMA, called CARE ADMIN was activated for ER personnel to use. This

application automatically profiles verbal orders so that the ER nurses can use the BCMA during high patient acuity times. The existing nursing staff has undergone in-service training in the use of this profiling feature to allow them to utilize the BCMA more effectively, thereby increasing their compliance.

Description of the Project

In the summer of 2013, approval was received to conduct an analysis of the Hospital's use of BCMA by department from the Chief Nursing Officer. From the scholarly literature, it was obvious that the prevalence of medication errors affecting patient safety in the United States was a significant impediment to achieving high quality of care. Using BCMA weekly utilization data, an analysis showed that the ER was not using this technology to its fullest capacity.

Since the author used this technology as a staff nurse in the emergency room, it was recognized that there were several issues specific to emergency rooms which lower ER compliance rates. An ER is generally considered to be organized chaos, with patients with high acuity levels, often requiring immediate medication administration to address their medical conditions. Additionally, verbal orders are prevalent, and since they are not profiled in a timely manner, the nurses use work-arounds to prevent delay in medication administration, thereby bypassing BCMA and decreasing compliance. As a result, it became obvious that if the verbal order problem could be resolved, there was a likelihood that the ER compliance rate could be improved.

Discussions with Pharmacy and IT revealed that a feature called CARE ADMIN, which had the capability to automatically profile verbal orders, was already built into the BCMA system. During implementation of the BCMA system, this feature had been deactivated because it was thought that its activation could lead staff physicians to overuse verbal orders. Permission

was granted to turn this feature on for use in the emergency room during an eight week period to determine if it could help improve ER compliance. In August 2015, the ER was only utilizing BCMA for 41.1% of the medications being administered.

The nursing staff received an information paper describing the project (Appendix A) and a pre-survey (Appendix B) that was developed, to determine their current perception of using the bar coding system.

Over the next four weeks in August/September, a total of 52 ER nurses were trained to use the new feature. The timing of this training was advantageous, since there were a number of new graduates that were being mentored in the ER and they were able to begin using this application feature early in their orientation process. Having the opportunity to train small groups was also beneficial because this led to an easier exchange of ideas and opinions on this technology. These exchanges revealed that while verbal orders are not the only issue causing low ER compliance, it was certainly a large contributor to the problem.

The project lasted for eight weeks. As an ER staff nurse during this period, the value and impact of this change on the patient was fully understood. Being in the ER there was opportunity to review the application profiling feature with staff members and to answer any questions which arose. The utilization data sheets were reviewed every two weeks and also when the project ended. A post-survey was given to the staff to determine if they saw a benefit in using this application.

Significance of the Project

“Thirty-four percent of all medication errors in hospitals occur in the administrative phase of the medication process and less than two percent of these errors are intercepted before execution” (Voshall et al., 2013, p. 530). In addition to causing possible harm or death to a

patient when an adverse medication event occurs, they also can produce extremely damaging legal and financial consequences for the hospital and its staff.

As a nurse-driven change its' success depends on the nursing staff perceiving that the goals are realistic and that this will improve their practice. To insure a positive outcome it is essential to establish systems standards which are compatible with nursing needs and expectations, and which facilitate development of Information Technology (IT) systems which are supportive of nursing practice (Zadvinskis et al., 2013).

Section II - Literature Review

The strategies used to identify the articles which would be utilized during this project were based on the article's relevance to the use of bar-coded medication administration in the emergency room and the currency of the information. The databases utilized were: PubMed, Cinahl, and Google Scholar. Keywords used: (1) Bar-Code Medication Administration, (2) medication errors, (3) safety, (4) technology.

Selection criteria for this literature review resulted in nineteen articles for comparative study. After reading through these articles, six of them were judged to be applicable to this project, and were selected. These articles were ranked relative to the issues of the clinical question of nursing perceptions and its relationship to BCMA compliance.

These articles were then grouped into two categories which were specific to the ER. The first category related to the clinical question of nursing perceptions and the second category included articles focusing on the issues of the medication errors and the BCMA technology itself.

The article, Nurses Attitudes toward the use of Bar-Coding Medication Administration System written by Marini, Hasman, Huijer, and DiMassi (2010), discussed the importance of

identifying users' attitudes toward the BCMA system and their perception of its usefulness, early in the implementation process.

Attitude has long been used as a determinant for users' intention to use or adopt an information technology system. The attitude adopted by nurses regarding the BCMA system was in part determined by their perception of its usefulness and in part by the system's ease of use.

Marini et al. (2010) acknowledged that Rogers' diffusion of innovation (DoI) theory (Rogers, 1995) provided a viable description of how technological innovation is communicated by individuals in a social system. That theory identifies the five stages which users of new technological innovations pass through prior to adoption of the innovation as: Knowledge (exposure), Persuasion (favorable attitude), Decision (user commitment), Implementation (guidance) and Confirmation (reinforcement of use).

Rogers' theory says that as they pass through these stages, users rate the innovation based on five attributes: the innovation's relative advantage (is it better or worse than what it replaces); its compatibility (with past experiences, needs and existing values); its complexity; its trialability (ability to use or experiment with the innovation on a limited basis); and the observability and visibility of its results.

The instrument utilized for this study was a 33 question survey, which focused on measuring the nurses BCMA system utilization as well as their attitudes about utilizing this system to aid in safe medication administration. This survey also collected sociodemographic data such as the nurse's sex, age, nursing education level, BCMA system skill level and years of nursing practice.

According to the study "Nurses consider the BCMA system to have a positive impact on

nursing practice if it supports medication administration decision making, speeds up the flow of work, and enhances productivity” (Marini et al., 2010, p. 122).

The next article, Nurses’ Perception of a Bar-Coded Medication Administration System performed a comparison study on “the perceived impact of the BCMA system on the nurses’ ability to give medications, perceptions of medication errors, and nurses’ satisfaction” (Gooder, 2011, p. 703).

The conceptual framework of this study also utilized the DoI theory, and the researcher’s goal of evaluating the success of the BCMA implementation was based on the nurses views of the system’s relative advantage, compatibility, complexity and observability.

The study was conducted in a 280 bed acute care Hospital in the western United States. The pilot study took place on a 28 bed medical unit recruited as the experimental group. A 28 bed cardiovascular step-down unit served as the control group. The BCMA was NOT implemented on the control unit.

The survey instrument used was a questionnaire consisting of eight questions, seven of which were rated using a Likert-type scale from 1 (Strongly Disagree) to 5 (Strongly Agree). The survey sought to measure the nursing perceptions regarding the ease of use of the medication process. There was a 42% completion rate of the questionnaires; 33 returned on the experimental floor and 26 on the control unit. The author indicated that the low survey completion rate resulted in a sample size which was too small to determine statistical reliability of the results.

The results of this study indicated that nurses had a decrease in overall satisfaction with the medication process following implementation of the BCMA. Since this decline in satisfaction was isolated to the experimental group only, it was concluded that they are a direct

result of the BCMA implementation.

In large part the nurses dissatisfaction resulted from their inability to see medications due and previously given, on the handheld device used by the system. It was suggested that this shortcoming had more to do with the actual system's design than the size of the device used.

The significance of these results is that they differ greatly from those reported by other researchers, who found increased nurse satisfaction with the medication administration process following the implementation of BCMA systems. The researcher pointed out that while nurses were part of the implementation team in this study, this may not be adequate, and that inclusion of nurses in the initial design and development of these systems could hold the key to insuring the system better met the nurse's needs upon implementation.

Gooder concludes that "before any decisions are made regarding the overall effectiveness of BCMA, hospitals first need to determine whether the benefits are negated by nurses' resistance to the change and how that resistance can be minimized" (Gooder, 2011, p. 703).

Zadvinkis et al. in their 2013 article entitled Exploring nurses confirmed expectations regarding health IT: A phenomenological study, described a study conducted using semi-structured interviews along with observation of nurses using the system, to explore the impact of electronic health records (EHR) and bar code medication administration (BCMA) systems which had been implemented four months previously. The interviewees were nurses in an academic center with a minimum of two years' experience and knowledge of EHR and BCMA.

A phenomenological approach seeks to understand a phenomena from the perspective of those who experience it. Understanding is reached through the use of personal interviews. The goal of this study was to understand, from a nursing perception, the subjects' experience related to these newly implemented technologies, with the objective of understanding the impact they

had on the nurse's perceptions of these technologies.

The study examined the nurses' perceptions in five areas: interaction with the computer, nursing performance regarding task accomplishment, unit-specific teamwork, interdisciplinary teamwork and quality of care.

The outcome of this study was the recognition of the importance of a user-friendly system design, the use of ethnographic methods to understand the context in which the systems features will be used, and the need for post implementation IT review. It also showed that, to obtain positive outcomes when implementing Health Care IT systems, standards must be established which are consistent with nursing expectations and directed at developing an environment which is supportive of nursing practice.

The differential in these studies were the instruments used as well as the use of both quantitative and qualitative research showing a description of the tools used in the studies. It also illustrates that the articles published in 2010, 2011, and 2013, began to show progression of not only the importance of the technology, but how the perceptions of the nurses play a vital role in its success.

The three studies show similarities in understanding the need to assist with "...nurses' multitasking and caring for multiple patients in a complex, fast-paced health care environment" (Zadvinskis et al., 2013, p. 96). They are recognizing that "nurses' levels of expectations may serve as a basis for prioritizing health IT practice solutions, to 'proactively' anticipate system interactions, rather than repair them post-implementation" (Zadvinskis et al., 2013, p. 96). One study described the acceptance process as a "...progression to competence: potential users learn to operate the system, and therefore are able to adapt its features to the requirements of their work" (Marini et al., 2010, p. 120).

In relation to attitudes and perceptions of nurses, the next group of articles relate to the challenges of implementation of BCMA in the emergency room as well as its benefits. Nancy Glover (2013) in her article Challenges implementing bar-coded medication administration in the emergency room to medical surgical units, describes the use of system utilization reports to understand the challenges faced in different units, with a focus on the difference between BCMA use in the ER and on Medical Surgical Units.

The study's findings indicated that a number of factors negatively impacted utilization of the BCMA in the emergency room. A major factor was the incidence of "stat" and "now" medication orders in the ER (72.6% of all orders administered) and the small number of those types of orders on the medical-surgical units (only 2.8% of all orders administered). The result was the lopsided use of verbal orders in the ER, which conflicted with the medication administration process which called for the order to be in the system before being administered.

The verbal order issue and other unique aspects of emergency room nursing workflow as well as the additional steps required to chart when using bar-coded medication administration created some significant obstacles to adoption of the technology in the ER. Glover (2013) concluded that bar-coded medication administration in its current form, is probably more suitable for use on medical-surgical floors than in the emergency room, and that new approaches must be developed for bar-coded medication administration to be successful in the emergency room environment.

Bonkowski, et al., in their 2013 study Effect of barcode-assisted medication administration on emergency department medication errors discussed an analysis of medication errors prior to and after instituting BCMA in emergency departments. This study took place at a large medical center and was conducted by their Department of Pharmacy.

The study was an observational study conducted in the ED. The methodology used was to measure the rate of medication administration errors before and after implementing an integrated electronic medical record system with BCMA capability. Errors were classified as wrong drug, wrong dose, wrong route of administration, or a medication administration with no physician order (verbal orders). The error type, severity of error, and medications associated with errors were also quantified.

During the study 1,978 medication administrations were observed (996 pre-BCMA and 982 post BCMA). The medication administration error rate was 6.3% prior to BCMA implementation, declining to 1.2% post BCMA. This represented a relative error rate reduction of 80.7% and was directly attributed to the introduction of the new technology. Wrong dose errors, which had represented 66.7% of all medication errors observed, decreased by 90.4% in the same period.

The conclusion of the study suggested that implementing BCMA in the ED was associated with significant reductions in the medication error rate and specifically wrong dose errors, but also points out that BCMA is not routinely used in the emergency departments. They concluded that the “EDs may benefit from BCMA, because ED medication administration is complex and error-prone” (Bonkowski et al., 2013, p. 801).

On March 7, 2014, at the Emergency Nurses Association Leadership Conference in Phoenix Arizona, Brown (2014) presented a poster session on Implementation of Bar Code Medication Administration in the Emergency Department Setting. She indicated in her abstract that serious medication errors occur in hospitals resulting in significant patient morbidity and mortality. These errors frequently involve administration of incorrect drugs and incorrect doses. Bar-code medication administration technology significantly reduces medication administration

errors by improving compliance with checking the “five rights” of medication administration.

Although BCMA is frequently used in the inpatient setting, it had not been as widely adopted in the emergency department (ED) setting.

The purpose of this project was to implement BCMA technology in the ED in conjunction with the implementation of computerized physician order entry (CPOE) to reduce medication errors and improve patient safety. The design included an interdisciplinary team who would be instrumental for implementing this system.

The project took place in a Level III emergency/trauma department with an annual volume of 65,000 patients. The participants/subjects included the emergency department nursing staff utilizing BCMA technology on patients admitted to the ED who received medication as part of their care.

In preparation for the advent of this system the interdisciplinary team formulated the implementation plan. This plan included: Development of new workflow to support BCMA; Identification of type and placement of new equipment/technology, (scanners and computers); Attachment of bar codes by Pharmacy to all medications; Training of nursing staff-2 hours of didactic training in medication scanning; Hands-on support from super-users for 4 weeks following implementation; Established expectations for staff use of bar code scanning with increased compliance expected monthly; and Posting of individual nurse compliance to encourage a sense of competitiveness among nursing staff.

The expectation of compliance was set at 75% since codes and procedural sedation were eliminated from the results. The results/outcomes showed that approximately 90% of the nursing staff uses BCMA 80% of the time when administering medications. The wrong medication was scanned by nursing 100 times a month. This number, however, unfortunately is deceptive as it

includes when a medication concentration is scanned that does not match the physician order. This is related to a system issue and the team is working on building medication lists in the computerized documentation system. However, there is still value in having the BCMA identify a “wrong medication” as it requires the nursing staff to double check that they have the correct medication. Approximately 10 times per month the data revealed that a medication was scanned for one patient when it was actually ordered for another patient. In this instance use of BCMA has demonstrated a clear reduction in medication errors.

Brown (2014) in the abstract for a poster presentation at the ENA Leadership Conference in Phoenix, Arizona states that the:

BCMA system can be implemented successfully in the emergency department setting. Factors important to the success of the implementation include: leadership support, interdisciplinary team involvement including nursing staff that will use BCMA technology, adequate equipment/technology at the point of service, and adequate training and rollout support. (paragraph 5)

Theoretical Framework

The project’s theoretical framework was based on Patricia Benner’s nursing theory “From Novice to Expert.” The five levels of nursing practice: novice, advanced beginner, competent, proficient, and expert relates to the core of the emergency room’s staffing matrix. To maintain a viable project, the experienced nurses who will be mentoring, must perceive that this will advance their nursing practice and that they are the drivers of this technology through example.

Experience is not the mere passage of time or longevity; it is the refinement of preconceived notions and theory by encountering many actual practical situations that

add nuances or shades of differences to theory. Recognition, reward, and retention of the experienced nurse in positions of direct clinical practice are the first steps in improving the quality of patient care. (Benner, 2012, p. 407)

Section III – Project Methodology

As mentioned previously, the author's journey to establish this project began in 2013. A nurses' ultimate goal is providing optimal care through safe practices. The statistics are overwhelming on the amount of errors related to medication administration that occur on a daily basis. This not only can cause devastating harm to a patient but also financial hardship in today's healthcare's economic struggles.

Since the hospital was acquired by a larger medical institution in June, 2014, there was a new Chief Nursing Officer (CNO). Meetings took place with the CNO and the ER Nursing Director present the proposed project. Provisional approval was granted and it was suggested that a meeting of the original team who implemented the BCMA in 2011 take place. The purpose was to present the basic outline of the project, including its purpose, benefits, and proposed budget.

The original team that remained, consisted of the IT Executive Nurse and the IT Pharmacist. After presenting the proposal, final approval was granted and it was entitled "The Medication Quality Initiative." It was approved to activate the CARE ADMIN feature of the BCMA application for immediate profiling of verbal orders. There was an opportunity to meet with the new ER Medical Director to inform him of the project, which was then presented at their physician meeting. The final meeting took place with the Chief of Pharmacy. At this time a tour of the area was done which allowed for greater understanding the process by which they repackaged and bar code medications prior to releasing them to the various units.

In the interim, the Nursing Informatics Educator, from the Center for Professional Development, agree to become the project preceptor. She also was the person who generated the data utilization sheets for each unit so she was well versed in the issues that plagued the emergency room.

There was no necessity for approval from the Institutional Review Board (IRB) since there was no involvement of patients in the education and training of the nursing staff. Implementation of this project occurred over a five phase process. During Phase I, a literature search took place which was followed by site visits to hospitals in three states: Massachusetts, New York, and New Jersey. Since this technology was relatively new, a better understanding of its implications and impact on patient safety was needed. The information assembled during this phase was used to develop the proposal and project objectives.

During Phase II, provisional approval was granted by Nursing Administration along with securing a preceptor.

Phase III was the development of the Medication Quality Initiative with the IT Executive Nurse and the IT Pharmacist, gaining approval to initiate turning on the application to profile verbal orders when the project officially started.

Phase IV was an informational meeting with the ER nursing staff and giving them the pre-survey. The education and training of the staff followed and the project began.

Phase V was the follow-up with a post survey and reviewing the data utilization sheets every two weeks during the eight week trial along with checking the data three weeks after completion of the project to determine success and sustainability.

Phase I

With the completion of the article review, the initial phase of this project started with site

visits at medical centers in Massachusetts, New York, and New Jersey who had already instituted BCMA, paying close attention to the emergency room. The objective was to gather the data needed to present this project to Nursing Administration at our local community hospital.

Findings showed that these institutions were also struggling to get BCMA utilization increased in their ER. Discussions with the nursing educators, pharmacists and nursing staff in these hospitals revealed that the same issue of verbal orders was causing their ER nursing staff to utilize work-arounds. Because of this and the differences in ER work flow there were two hospitals that had delayed instituting the BCMA in their emergency rooms.

One exception was a large specialty hospital in which they established computers at the bedside in every ER patient room including isolation areas so that the physician could transcribe the medication immediately. They also had a pharmacy in their ER which reduced the time for medication arrival to the patient, if it was not available in their Pyxis medication machine. While providing a solution to the utilization situation, this approach would represent a very costly solution.

Phase II

After meeting with the other institutions it was felt that enough information was there to present to our Nursing Administration. The Initial meeting with our CNO and the ER Nursing Director was to inform them of the proposed project. It was felt that non-compliance was a significant safety issue and provisional approval was given. It was believed that any level of improvement would be important to achieve. The discussion continued concerning the issues with adverse events that not only cause harm to the patient but a financial burden to the institution in light of the new Medicare regulations.

During this Phase, a project preceptor was secured, the Nurse Informatics Educator from

the Center for Professional Development. This was advantageous since we had a working relationship, and she was instrumental in the education and training of all hospital nursing staff from 2011-2012 when BCMA was implemented. Additionally she was the point person who generated the data utilization sheets on a weekly basis to each unit.

Phase III

The next step was to meet with the members of the original BCMA Implementation Team who had survived the hospital's recent merger; only the Executive IT Nurse and IT Pharmacist were still employed. The purpose of the project was presented to them. Approval was given to begin the project which was called "The Medication Quality Initiative." At this time they agreed to turn on the profiling application (CARE ADMIN) so that verbal orders were immediately profiled. Since this application was already a part of the computer system there was no additional cost. Our discussion revolved around the recognition that this is a nurse driven technology and that their perceptions were vital to its success. Since verbal orders caused work-arounds to the staff, our hope was that this application feature would be an incentive "to adapt its features to the requirements of their work" as stated in Marini et al. (2010, p. 120).

Phase IV

This phase focused on the introduction of this new profiling capability to the staff. This was accomplished in a series of meetings which took place over several weeks so that nurses on all three shifts were accommodated. During this time the nurse educator was kept informed of the process.

As a member of the ER staff a relationship had been established. Prior use of the BCMA without the profiling feature activated allowed this author to relate to the staff's negative and positive perceptions. Ideas were exchanged and an in depth discussion on patient safety and

outcomes occurred.

Nurses, in general, have difficulty with change and it was advantageous knowing how they think. Since the ER is fast paced and organized chaos, they need to feel that this change would enhance their practice and not delay care. By demonstrating the ease of this application and recognizing that their time spent in reminding the physician to transcribe the medication would be reduced, they expressed a more positive outlook.

Prior to starting the project the staff was shown the pre-project compliance rate and it was requested that a pre-survey be completed, which incorporated their present use and perceptions (Appendix B). When the educational in-service was completed for fifty-two nurses, the project started and ran over an eight week period. During this time a review of the application occurred and any questions that arose were answered. Having the opportunity to also use this application, it was also beneficial to the author's individual nursing practice.

Phase V

In this final phase the data utilization sheets were reviewed every two weeks to determine the compliance rate. After a meeting with the Nursing Director at the end of the project to share the results, it was decided to continue with the application because of the increase in compliance rate.

Fortunately there were new graduates orienting throughout this time period and their mentors addressed the use of the application with them. Since this is now a part of the system, it will be incorporated into the orientation process.

The staff received a post-survey (Appendix C) in which questions were posed to determine if, as a result of the project, their perceptions of the BCMA had changed. Appendix D, which contains both pre and post-survey comments, shows a more positive trend in the

nurses’ comments regarding use of BCMA in the ER, following the implementation of the CARE ADMIN application. This project began the week of September 20, 2015 and ended the week of November 8, 2015.

Section IV - Project Outcomes

The overall response to the use of the Verbal Order application was positive at all levels of the nursing staff, from Novices to Experts. Table 1 contains a summary of Medication Administration in the ER during the period August 3 thru November 29, 2015. The study began the week of September 20th and continued until November 8, 2015.

Table 1			
Summary of Emergency Room Medications Administered during the period 8/3/2015 thru 11/29/2015			
Week	Number of Medications Administered	Number of Medications Administered thru BCMA	Percentage of Medications Administered thru BCMA
08/03/15	3410	1402	41.1%
10/04/15	2951	1483	50.3%
10/18/15	2463	1247	50.6%
11/01/15	2662	1279	48.0%
11/29/15	2864	1322	46.2%

It can be seen from Figure 1 that the staff’s compliance in using the BCMA was at 41.1% prior to the study. During the study that compliance level increased to a high of 50.6%, a 23% increase from the August utilization. By the conclusion of the study the compliance stood at 48%, which represented a 19% increase from the August levels.

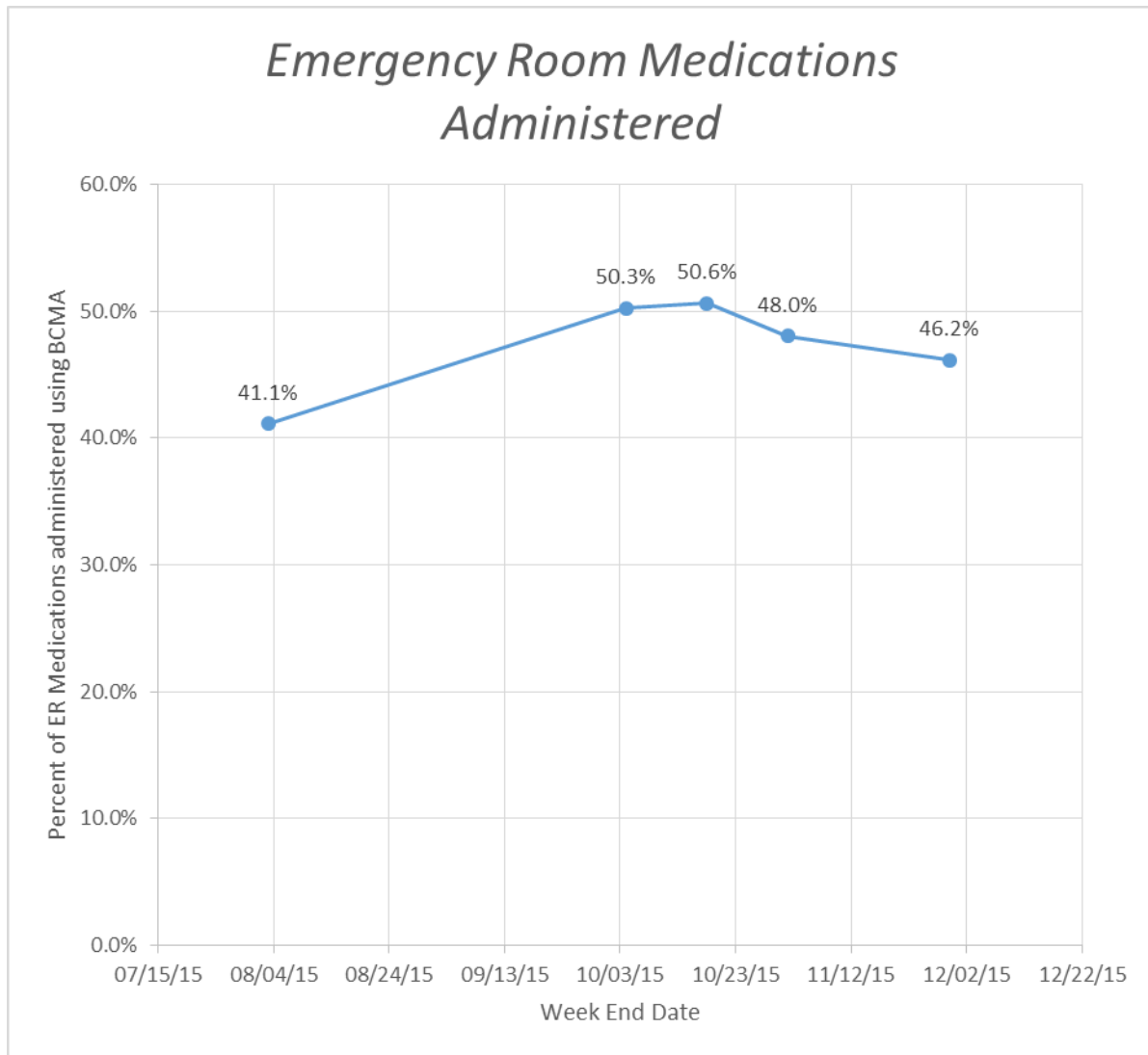


Figure 1. ER Medications Administered Using the BCMA System, August 2015 through November 2015. Utilization of the BCMA System increased in the ER from 41% to 48% by the conclusion of the study.

To determine the long term impact on staff compliance, data from 3 weeks following the conclusion of the project was examined. It showed that 3 weeks after the project, compliance had declined to 46.2% which, while it still was a 12% increase from the August levels, it represented a 48% decrease in the gains made at the highest level October 18th.

It should be mentioned that a major concern and the reason the feature wasn't implemented originally, was the fear that it might encourage the physicians to increase their use

of verbal orders, which was contrary to the intended purpose of the BCMA System. Fortunately, based on what was observed, many of the physicians have become more time sensitive to transcribe their medications.

The author was very pleased with the positive reaction of the majority of the staff. With this application, when a verbal order is given, the nurse has to press the application, scan the patient bracelet and the medication and put in the physicians name. This not only improves patient care but it improves the efficiency of the nurse both in safety and timeliness.

Since the percentage of use by the staff increased, the Director of our Emergency Room has made the decision to continue to keep this application. Use of the profiling application is now part of the orientation and mentoring program in the ER. Given its integration into the daily workflow of the ER and its general acceptance by the nursing staff, use of the profiling application shows sustainability.

Section V - Summary, Conclusion, Recommendations

According to Marini and Hasman, p. 439:

The significant drop in medication error rate achieved with the use of BCMA in various facilities presents a blueprint for its positive impact on patient safety. The observation measure to evaluate BCMA use showed an increased rate of error detection because of the systems' ability to capture and record intercepted administration errors. (2009)

This reduction in medication errors prevents adverse reactions and risk of harm to patients therefore improving their quality of care. The observational, time-study mentioned in this paper increased the time spent on direct patient care and a decrease in medication activities. This in turn creates a more desired result or effect, which is the objective of reducing medication errors and improving patient outcomes (Wisor, 2015).

Since there was a positive reaction with the ease of using this application from the nursing staff along with improving their workflow, the Director of the Emergency Room made the decision to keep the application. The author would recommend that the weekly data utilization sheets are followed closely by the Nursing Director.

Each individual's compliance records should be shared with the staff at the monthly staff meetings and the director should use that forum to encourage staff members to maintain and improve their compliance rate using the BCMA to its fullest extent. The author would also recommend that compliance levels should be addressed during nurses annual evaluation since the data utilization sheets list every nurse and their Individual compliance records could become a part of their personnel record as a part of the evaluation. Since compliance is an integral part of each nurses job, it would make sense to tie achievement of a target level of compliance to the salary increase they would receive as a result of their review.

Sustainability of Project

Since this project initiated the use of the verbal order application and the results indicate a positive trend, it will remain as part of the emergency room's bar coding system. The current staff has been trained on its utilization and future employees including new graduates will learn about it during their orientation to the BCMA.

But as with all new innovations, without reinforcement and emphasis from management, the user's behavior is likely to revert to pre-innovation behavior. To prevent this, the ER must take a number of steps to integrate the use of the verbal order application into the unit's operating process to heighten the staff's awareness of how important compliance is to the patients and nursing practice at this hospital.

Part of this will involve carefully choosing ER preceptors who utilize and promote this

system feature, so that they can truthfully encourage their preceptees as well as the other staff members by their example. Additionally it's essential that ER management closely monitor the compliance statistics and use knowledge of how individuals are succeeding or failing to meet established standards, to provide additional encouragement and emphasis to those individuals.

And finally, since this innovation and BCMA itself represents a critical component in the overall system of Nursing Care in the ER, it must become part of the nurses' annual evaluations. Only by providing the nursing staff with the proper mix of encouragement, positive reinforcement and incentives can the hospital hope to insure the long term viability of this innovation and the BCMA system itself.

This technology is a work in progress and it is still in its infancy, having only been introduced within the past 15 years. Since the technology is constantly evolving, there is little doubt that before long a new and improved BCMA System will be available, which will address ALL the issues which impact its utilization.

Until that Utopian System is available, a small change to the existing system has been made, with the result being, greater system utilization, reduced work for the ER nurses and physicians alike, and improved levels of care for our patients.

References

- Benner, P. (2012). From Novice to Expert. *The American Journal of Nursing*, 82(3).
<http://www.jstor.org>.
- Bonkowski, J., Carnes, C., Melucci, J., Mirtallo, J., Prier, B., Reichert, E., ... Weber, R. (2013). Effect of barcode-assisted medication administration on emergency department medication errors. *Journal of the Academy of Emergency Medicine*, 20(8), 801-806.
- Brown, J. (2014, March). *Implementation of Bar Code Medication Administration in the Emergency Department Setting*. Poster session presented at the meeting of Emergency Nurses Association Leadership Conference, Phoenix Convention Center, Phoenix, Arizona. Abstract retrieved on April 3, 2016 from: <http://www.nursinglibrary.org/vhl/handle/10755/324151>
- Coyle, G.A., & Hermann, M. (2005). Evaluation of the Department of Veterans Affairs. *Nursing Administration Quarterly*, 29(1), 32-38.
- Department of Health and Human Services – OIG. (February 2014). *Adverse events in skilled nursing facilities: national incidence among medicare beneficiaries* (DDHS Publication No. OEI-06-11-00370). Washington, DC: U.S. Government Printing Office.
<http://oig.hhs.gov/oei/reports/oei-06-11-00370.pdf>
- Dolansky, M.A., & Moore, S.M. (September 30, 2013). Quality and Safety Education for Nurses (QSEN): The Key is Systems Thinking. *OJIN: The Online Journal of Issues in Nursing*, 18(3), Manuscript 1.
- Dwibedi, N., Sansgiry, S.S., Frost, C.P., Dasgupta, A., Jacob, S.M., Tipton, J.A., & Shippy, A.A. (2011). Effect of bar-code-assisted medication administration on nurses in an intensive care unit: a time-motion study. *American Journal of Health Systems Pharmacy*, 68(11),

1026-1031. www.ncbi.nlm.nih.gov/pubmed

Glover, N. (2013). Challenges implementing bar-coded medication administration in the emergency room in comparison to medical surgical units. *Journal of Computer Informatics Nursing, 31*(3), 133-41. www.ncbi.nlm.nih.gov

Gooder, V.J. (2011). Nurses' Perceptions of a (BCMA) Bar-coded Medication Administration System: A Case-Controlled Study. *Online Journal of Nursing Informatics, 15*(2). <http://ojni.org>.

Hunter, K. M. (2011). Implementation of an Electronic Medication Administration Record and Bedside Verification System. *Online Journal of Nursing Informatics, 15*(2). www.ojni.org

Joshi, M.S., Ransom, E.R., Nash, D.B., & Ransom, S.B. (2014). *The Healthcare Quality Book: Vision, Strategy, and Tools* (3rd ed.). Chicago, IL: Health Administration Press / Washington, DC: Association of University Programs in Health Administration.

Kohn, L.T., Corrigan, J.M. & Donaldson, M.S. (Eds.), (1999). *To err is human: building a safer health system* [Report Brief]. Washington, D.C.: Institute of Medicine. Retrieved from: http://www.qu.edu.qa/pharmacy/development/documents/14ay/To_Err_is_Human_1999_report_brief.pdf

Lukas, C.V., Holmes, S.K., Cohen, A.B., Restuccia, J., Cramer, I. E., Shwartz, M., & Chams, M.P. (2007). Transformational Change in Healthcare Systems: an organizational model. *Journal of Health Care Management Rev., 32*(4), 309-320. www.ncbi.nlm.nih.gov

Marini, S.D., & Hasman, A. (2009). Impact of BCMA on medication errors and patient safety: a summary. *Journal of Student Health Technology Informatics, 146*, 439-444. www.ncbi.nlm.nih.gov

Marini, S.D., Hasman, A., Huijjer, H.A., & DiMassi, H. (2010). Nurses' Attitudes toward the use

- of Bar-Coding Medication Administration. *Journal of Computer Informatic Nursing*, 28(2), 112-123. www.ncbi.nlm.nih.gov
- Robert Wood Johnson University Hospital, Somerset (2015). BCMA Utilization Statistics of the Emergency Room.
- Rogers, E.M. (1995). *Diffusion of innovations* (4th Ed.). New York, NY: The Free Press.
- Sakowski, J.A., & Ketchel, A. (2013). The cost of implementing inpatient bar code medication administration. *The American Journal of Managed Care*, 19(2), 38-45. www.ncbi.nlm.nih.gov
- Voshall, B., Piscotty, R., Lawrence, J., & Targosz, M. (2013). Barcode Medication Administration Work-Arounds: A Systematic Review and Implications for Nurse Executives. *The Journal of Nursing Administration*, 43(10), 530-535.
- Wideman, M., Whittler, M., & Anderson, M. (2005). Barcode Medication Administration: Lessons Learned from an Intensive Care Unit Implementation. In K. Hendriksen, J. B. Battles, E. S. Marks, et al., (Eds.), *Advances in patient safety: from research to implementation* (Volume 3: Implementation issues). Rockville, MD: Agency for Healthcare Research and Quality (US).
- Wisor, C. (2015). *Reduction of Medication Errors with New Technology*. Quality and Information Systems Course Paper, Seton Hall University.
- Zadvinskis, I.M., Chipps, E., & Yen, P. (2013). Exploring nurses' confirmed expectations regarding health IT: A phenomenological study. *International Journal of Medical Informatics*, 83(2), 89-98.

APPENDIX A

Pre-Study Information Paper

The following memorandum was distributed to the Nursing Staff as an introduction to the Scholarly Project prior to the distribution of the Pre-Study Questionnaire.

Dear RN Staff:

As part of my Scholarly Project for the DNP, I have developed a short survey for you to do to determine our status with the BAR-CODE MEDICATION ADMINISTRATION. This project revolves around increasing compliance in the emergency room. I have followed the weekly data sheets for five weeks and our percentage of usage is low.

We all understand the difficulty in sustaining this when our main concern is to treat the patients in a timely fashion. I realize that there can be many reasons for this low compliance but I am concentrating on increasing the speed of profiling verbal orders. To accomplish this Nursing Administration and the IT Department have allowed us to turn on an application that will profile verbal orders in a more timely and proficient fashion.

After I receive the results of the survey I will review the application with the RN staff so that the project can begin the week of September 20, 2015. Once the education and orientation is completed you can begin utilizing it until the end of the first week of November. I will continue to monitor the weekly data sheets to see if this assists you in your practice and if it has sustainability. I will meet with all of you to do a post survey follow-up and again when the results are tallied.

I want to thank you in advance for your cooperation. The surveys will be in your mailbox and you can return them to my mailbox.

APPENDIX B

Pre-Study Questionnaire

BAR-CODE MEDICATION ADMINISTRATION PROJECT**EMERGENCY ROOM STAFF PRE-STUDY SURVEY**

Choose one answer for each question Name: _____(optional)

1) Utilizing BCMA improves my practice and efficiency

- a) Strongly Agree
- b) Agree
- c) Neither Agree or Disagree
- d) Disagree

2) Utilizing BCMA helps in reducing medication errors

- a. Strongly Agree
- b. Agree
- c. Neither Agree or Disagree
- d. Disagree

3) Medications scan what percentage of time

- a) Less than 50%
- b) Between 51-75%
- c) Between 76-90%
- d) Greater than 90%

4) How often does medication fail to scan

- a) Always
- b) Frequently
- c) Occasionally
- d) Never

5) If Verbal Orders were profiled immediately I would be more likely to use BCMA

- a) Strongly Agree
- b) Agree
- c) Neither Agree or Disagree
- d) Disagree

6) If the medication fails to scan I notify pharmacy of the issue

- a) Strongly Agree
- b) Agree
- c) Neither Agree or Disagree
- d) Disagree

7) If the medication does not scan initially, how likely is it that you stop using BCMA for the rest of the shift

- a) Very Likely
- b) Likely
- c) Somewhat Likely
- d) Not Likely

APPENDIX C

Post-Study Questionnaire

BAR-CODE MEDICATION ADMINISTRATION PROJECT**EMERGENCY ROOM STAFF POST-STUDY SURVEY**

Choose one answer for each question Name: _____(optional)

1) Utilizing the Verbal order application on BCMA improved my practice and efficiency

- a. Strongly Agree
- b. Agree
- c. Neither Agree or Disagree
- d. Disagree

2) Utilizing BCMA helps in reducing medication errors

- a) Strongly Agree
- b) Agree
- c) Neither Agree or Disagree
- d) Disagree

3) Using BCMA, Medications scan what percentage of time

- a) Less than 50%
- b) Between 51-75%
- c) Between 76-90%
- d) Greater than 90%

4) How often does medication fail to scan

- a) Always
- b) Frequently
- c) Occasionally
- d) Never

5) Since Verbal Orders are now profiled immediately I am more likely to use BCMA

- a) Strongly Agree
- b) Agree
- c) Neither Agree or Disagree
- d) Disagree

6) If the medication fails to scan I notify pharmacy of the issue

- a) Strongly Agree
- b) Agree
- c) Neither Agree or Disagree
- d) Disagree

7) If the medication does not scan initially, how likely is it that you stop using BCMA for the rest of the shift

- a) Very Likely
- b) Likely
- c) Somewhat Likely
- d) Not Likely

8) I participated in the pre-survey questionnaire

- a) Yes
- b) No

Comments:

APPENDIX D

Pre / Post Study Questionnaire Comments

The following are comments provided on the Pre-Study Questionnaire by 9 of the 20 participants in that survey:

- Highly inefficient, prone to error, rovers never work to scan or not enough rovers, many ER orders are not put in in a timely manner (not something that will be fixed in an ER environment).
- Takes longer to scan patient and medications. Very time consuming to use in the Emergency Department.
- Too time consuming in the ER. It creates frustration when medications don't scan.
- I don't think barcoding is appropriate in the Emergency Department:
 - Delays Medications (all stat)
 - Inappropriate meds may be given because barcode works, but patients' status in the ER is constantly changing!!
 - Stops nurses from looking at their patients, not their bracelets.
- Takes too much time and still need to check 5 rights
- Have found that many medications do not scan because what we (ER) have in the Pyxis does not match the orders. The medication is right, but we may have different doses. Still have to utilize work-arounds, not always efficient, nothing is 100% - but a good thing overall - does help to catch some errors.
- Bigger blockage to using BCMA. Not always available, working and charged rover (often evening and night shift comes on to find dead or almost dead rover). No good

place to keep the rover, where it is near a chair and phone, so we can chart; they end up being in the way in the nurse's station.

- I think it's important for nurses not to rely on the barcoding too much. Must be sure to double check medication and dosage visually, not just with the computer.
- Scanning is time consuming. Often you must scan the same medication three times before it is recognized. Also do not have time to constantly call pharmacy. Often pharmacy has no resolution to the problem. Also scanner on computers are not working.

The following are comments provided in the Post-Study Questionnaire by 5 of the 15 participants in that survey:

- I love using the new verbal order app. I've used it a few times and it works great!
- I can't believe how using this system takes the stress away. It profiles so rapidly.
- I have always believed in the bar coding as a safety feature, but this change has really improved it.
- It's so nice to be able to give the patient their medication quickly and it's nice not to have to chase the doctors to write the order.
- I've used the new feature several times successfully and I believe it has definitely increased my scanning compliance.

APPENDIX E

BCMA Medication Profiling Feature Screen Shots

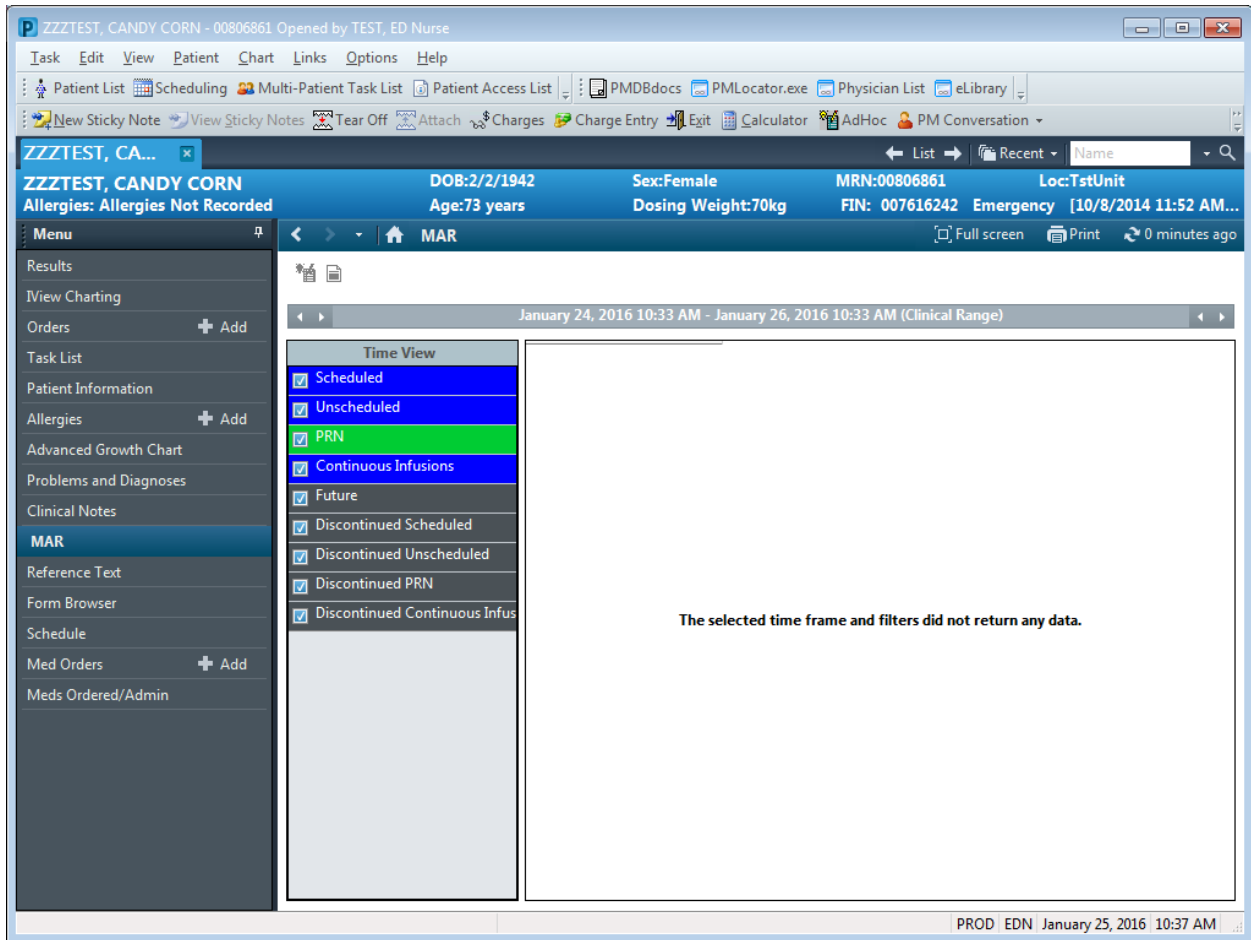


Figure E1. BCMA system Medication Administration Record (MAR) screen. This example shows a patient with no medication orders entered.

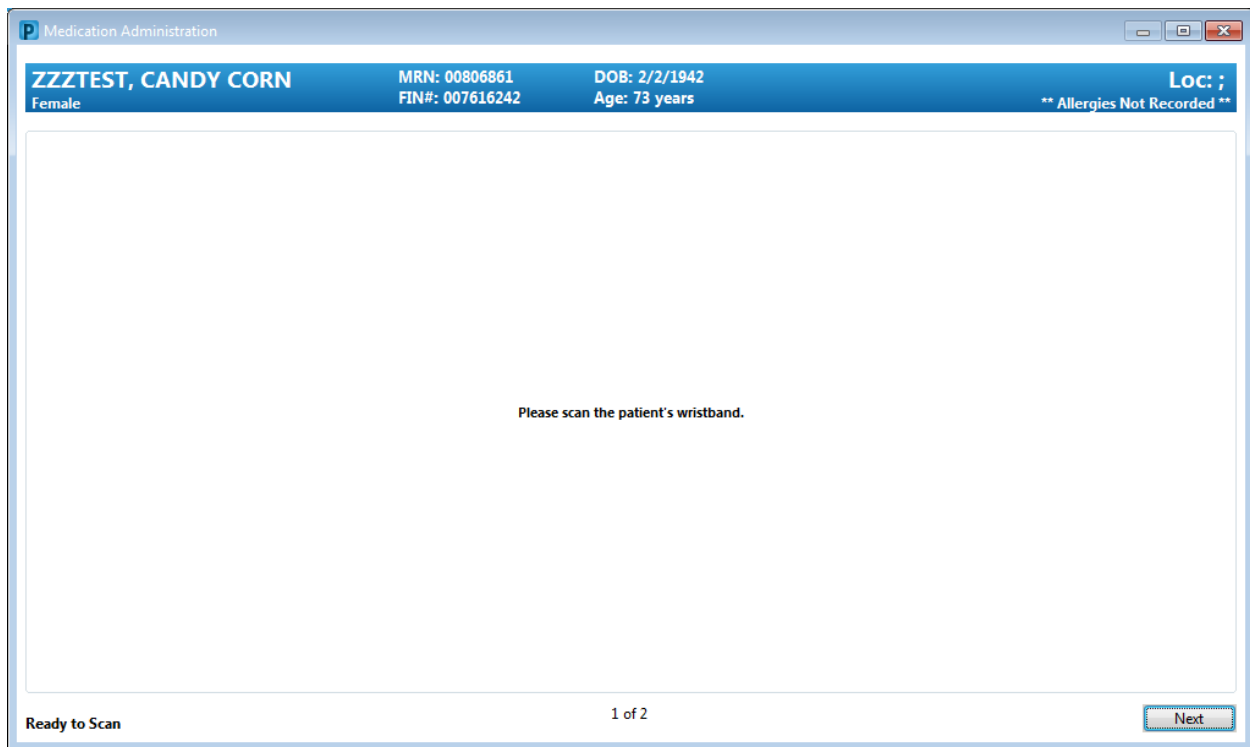


Figure E2. BCMA system wristband scan prompt. After launching the Medication Administration Wizard the patient will be identified by scanning the bar-coded wristband.

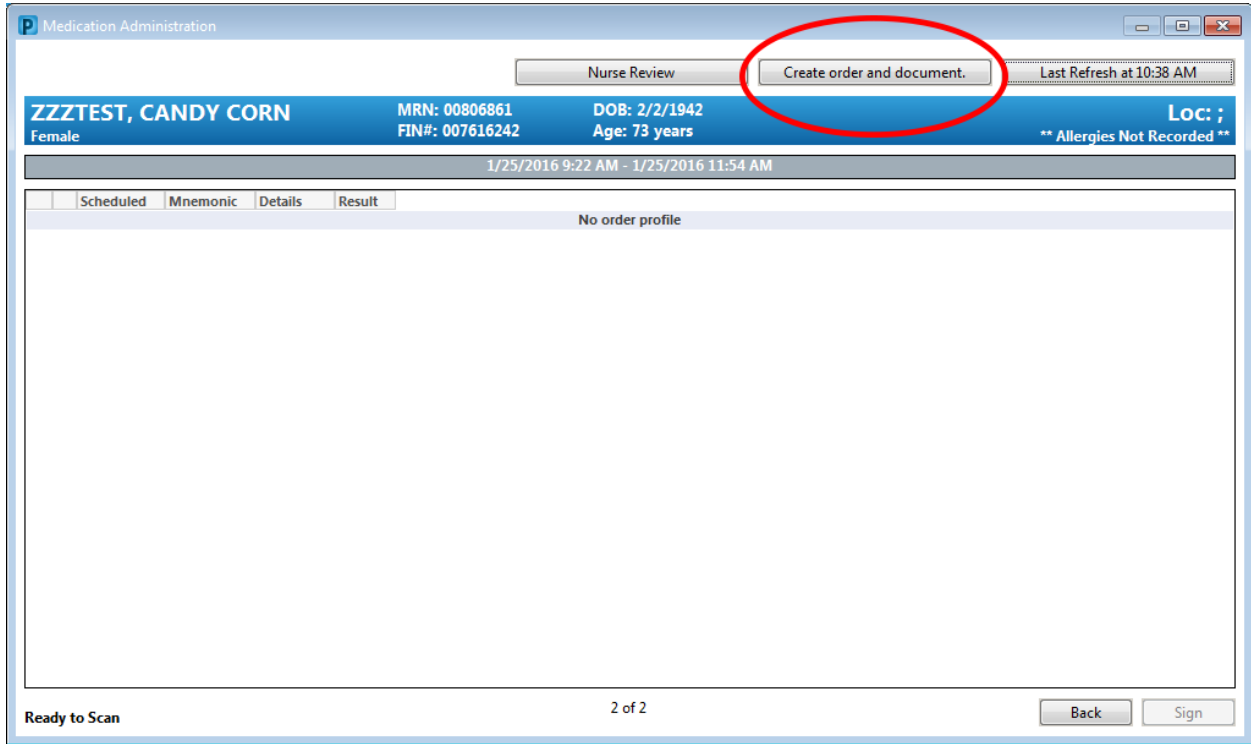


Figure E3. BCMA system medication profiling screen, step 1. Using the “Create order and document” button (circled in red) at the top, the nurse is able to scan a product and create an order in single step.

Create order and document. ZZZTEST, CANDY CORN - 007616242

Document and place One-Time Order for: furoSEMide 40 MG/4 ML VIAL

Performed date / time: 01/25/2016 1040

*Ordering Provider: [Yellow Highlighted]

Communication Type: Verbal - Read back

Performed by: TEST, ED Nurse

Dose: 40 mg

Volume: 4 mL

*Route: [Yellow Highlighted]

Form: Soln

Site: [Greyed Out]

Infuse Over: 0

1/25/2016 0900	1/25/2016 1000	1/25/2016 1100	1/25/2016 1200	1/25/2016 1300	1/25/2016 1400
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comment... Return to Search Cancel Sign

Figure E4. BCMA system medication profiling screen, step 2. Administration window appears requiring the name of the Ordering Provider. The communication type defaults to Verbal - Read Back. Route of Administration must be entered. Depending on the route selected additional site information might be required

Create order and document. ZZZTEST, CANDY CORN - 007616242

Document and place One-Time Order for: furoSEMide 40 MG/4 ML VIAL

Performed date / time: 01/25/2016 1040

*Ordering Provider: TEST, ED Physician

Communication Type: Verbal - Read back

Performed by: TEST, ED Nurse

Dose: 40 mg

Volume: 4 mL

*Route: IV Push

Form: Soln

*Site: Right Hand

Infuse Over:

1/25/2016 0900	1/25/2016 1000	1/25/2016 1100	1/25/2016 1200	1/25/2016 1300	1/25/2016 1400
	4				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comment... Return to Search Cancel Sign

Figure E5. BCMA system medication profiling screen, step 3. View of screen upon completion of data entry into the form.

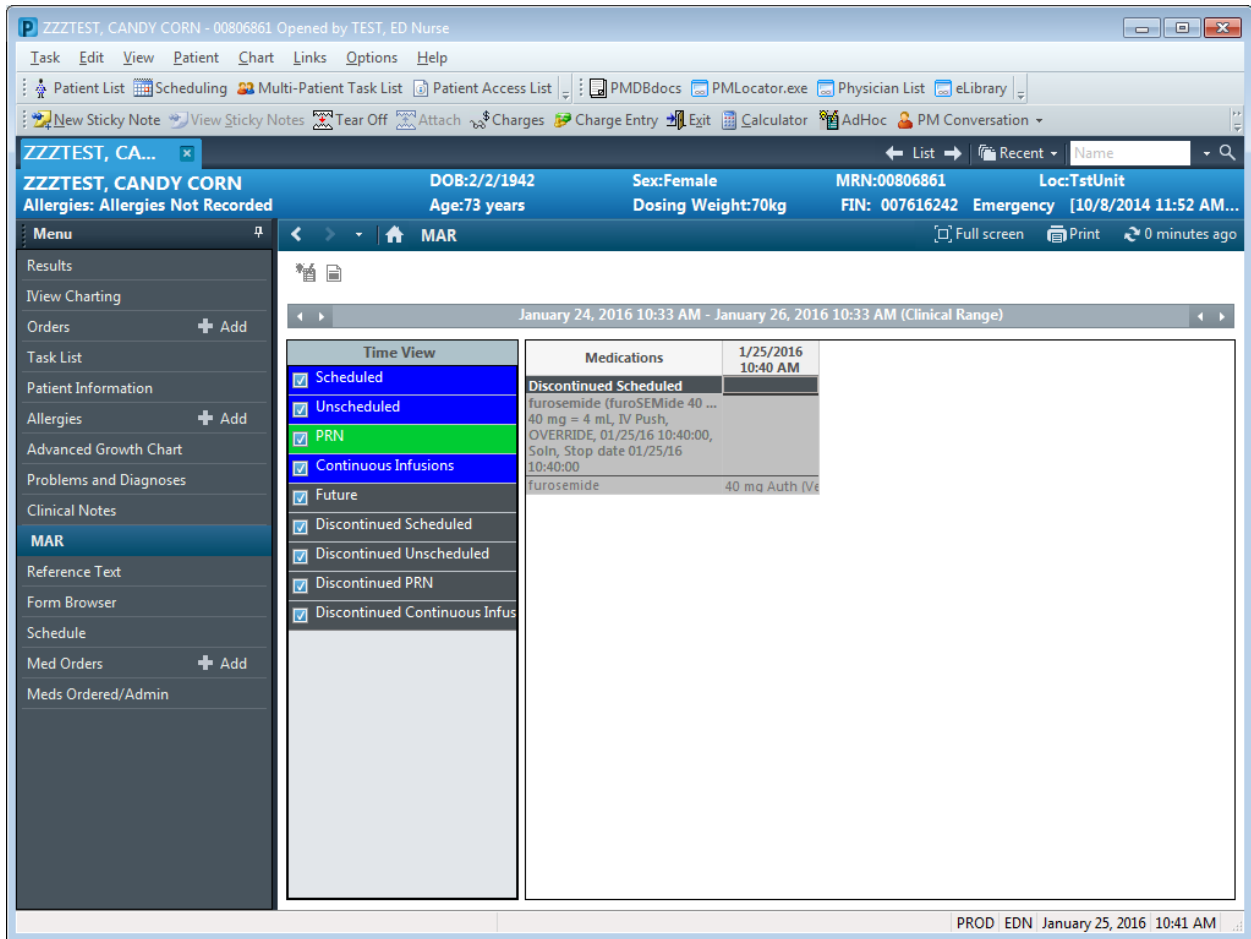


Figure E6. System medication profiling screen, step 4. Completed order appears on the MAR