BAR CODE MEDICATION ADMINISTRATION-CLINIC ORDERS (BCMA-CO) 
INCREASE NURSES’ SATISFACTION WITH THE MEDICATION ADMINISTRATION 
SYSTEM—A QUALITY IMPROVEMENT PROJECT 

by 

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A DNP Project Presented in Partial Fulfillment 
Of the Requirements for the Degree of 
Doctor of Nursing Practice 

For submission to the Journal of Informatics Nursing 

Capella University 

May 2017
BCMA-CO INCREASE NURSES’ SATISFACTION

Abstract

Nurses’ satisfaction was compared before and after implementation of Bar Code Medication Administration- Clinic Orders (BCMA-CO) in a Veterans Affairs (VA) urgent care clinic. Results were significant, revealing increased satisfaction with medication administration system after the implementation of BCMA-CO.

Keywords: medication administration, BCMA-CO, urgent care, Veterans Affairs, nurse satisfaction.
Bar Code Medication Administration-Clinic Orders (BCMA-CO) Increase Nurses’ Satisfaction with Medication Administration Systems—A Quality Improvement Project

It is the key responsibility of practicing nurses to ensure the safety of their patients during medication administration. Nurses are often the last individuals involved in the medication delivery process. The importance of safe medication administration cannot be overemphasized; the administration of medication is a complex activity, and the delivery of medication is a highly error-prone procedure. Adherence to safe medication practices is essential to ensuring the accurate administration of medication (Donaldson, Aydin, Fridman, & Foley, 2014; Kim & Bates, 2013). Despite the strong focus on safe medication administration practices, medication administration-related errors continue to occur because of (a) low adherence to medication administration guidelines, (b) a lack of standardization in medication administration processes, (c) deviation from the “rights” of medication administration (i.e., right patient, right drug, right dose, right time, right route, and right documentation), (d) the presence of interruptions and distractions during medication administration processes, and (e) the absence of reliable systems that detect errors and prompt nurses to complete double-checks (Ching, Long, Williams, & Blackmore, 2013; Donaldson et al., 2014; Gunningberg, Poder, Donaldson, & Swenne, 2014; Young, Brehmer, Adkins, Clarkowski, & Wagner, 2015).
The Bar Code Medication Administration (BCMA) system has been implemented by hospitals as an intervention to improve medication administration safety, improve documentation, increase the efficiency in administering medications, and reduce medication errors (Samaranaye et al., 2014; Seibert, Maddox, Flynn, & Williams, 2014). Gordon (2014) argued that the integration of BCMA systems into nurses’ workflows could help increase nurses’ adherence to safe medication administration practices, improve medication administration accuracy, promote a culture of safety, and increase nurses’ levels of satisfaction with medication administration systems.

**Problem Description**

At the urgent care clinic of the selected facility, poorly defined medication administration systems, and a lack of infrastructure designed to optimize the medication processes were threatening patients’ safety and needed to be addressed. The processes of using printed medication order sheets to administer medications and recording these administrations on separate notes in the patient chart are not subject to patient safety checks. The hospital outpatient areas, including the urgent care clinic, do not use bar code technology for medication administration. Also, unlike its inpatient units, the hospital’s outpatient clinics have no standardized medication management oversight to ensure safer medication administration practices, including pharmacy order verifications and provider order entries.

The safety of patients during the medication administration process is paramount in any patient setting, particularly, in any area in which patients present with complex medical conditions and high-risk medications are frequently administered (e.g., emergency departments (EDs) or urgent care clinics). Medication errors occur more frequently in highly complex environments where administration errors are common (Vazin, Zamani, & Hatam, 2014;
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Zeraatchi, Talebian, Nejati, & Dashti-Khavidaki, 2013). However, nurses are expected to ensure safe medication processes regardless of the health care setting. The use of bar code technology to optimize and increase the safe administration of medications in such environments is urgently needed, but the prevalence of BCMA systems remains limited in outpatient or clinic settings (Bonkowski et al., 2014). The nurses have voiced safety concerns about the current medication administration processes at the urgent care clinic.

Available Knowledge

A literature review was conducted to answer the following clinical question: In urgent care settings, how does the use of a Bar Code Medication Administration – Clinic Orders (BCMA-CO) system (compared to the no-BCMA-CO system) affect nurses’ levels of satisfaction with the medication administration system over an eight-week period? The PubMed, Science Direct, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Elton B. Stephens Company (EBSCO) databases were searched for potentially relevant articles. Searches were conducted for articles published from 2012 to 2016 and used the following keywords: “medication safety,” “medication administration accuracy,” “nurses and medication administration safety,” “bar code medication administration,” “BCMA,” “bar code medication administration and medication administration safety,” “bar code medication administration and medication errors,” “bar code medication administration and outpatient,” “bar code medication administration and emergency/urgent care clinic,” “nurse satisfaction and medication administration system,” “nurse satisfaction and bar code medication administration,” and “BCMA and nurse satisfaction.” The searches yielded 1,035 results total. After all the titles of the articles were screened, all potentially relevant full-text articles were selected for inclusion in the project. Next, each article’s abstract was reviewed and critically appraised. Inclusion criteria
were then applied to each article to determine eligibility for inclusion. The references sections of
the eligible articles were also reviewed to locate other relevant studies. After each article was
carefully appraised, 20 studies that appeared relevant to the clinical question were selected. Of
the 20 studies selected, 13 investigated BCMA, and seven explored nurses’ levels of satisfaction
with their hospital’s medication administration systems and processes.

An additional search was conducted for articles published from 2000 to 2016 on surveys
and instruments used to measure nurses’ levels of satisfaction with medication administration
systems. Two published instruments, the Medication Administration System- Nurses Assessment
of Satisfaction (MAS-NAS) scale (Hurley et al., 2006) and the Technology Acceptance Model
(TAM) survey (Holden & Karsh, 2010) were identified. Of the two instruments, the MAS-NAS
scale (Hurley et al., 2006) was deemed the most appropriate for this project. The MAS-NAS
scale was developed to assess nurses’ medication administration expectations, identify potential
problems with medication administration, and compare pre- and post-implementations of bar
code technology. A further search was conducted to locate studies that had used the MAS-NAS
scale (Hurley et al., 2006). Only three such studies were found to have been published in the last
five years. To help identify more studies on the subject, the publication date range for the search
was adjusted to 2005 to present, and three additional studies were found.

The correct administration of medication is vital to patient safety. Medication errors
commonly occur because of mistakes made in administration doses or techniques, deviation from
safe medication administration practices, and suboptimal medication administration systems.
Such errors affect medication accuracy rates and outcomes (Donaldson et al., 2014; Gunningberg
et al., 2014). Two studies showed strong correlations between medication administration
processes and the safety of medication administration (Donaldson et al., 2014; Gunningberg et
al., 2014). Gunningberg et al. (2014) examined the frequency of deviations in safe medication practices among surgical unit nurses. They directly observed 17 nurses in 306 drug administration encounters, observing their adherence to the fundamental “rights” (i.e., right patient, right drug, right dose, right form, right route, and right time) of medication administration. They found that the nurses adhered poorly to some safe medication administration practices, such as verifying patients’ identities and labeling medications. Of the 306 medication administration encounters, 54 medication errors were observed, of which the most common was administering the drug at the wrong time and the second most common was omitting to administer the drug at all.

Similarly, Donaldson et al. (2014) directly observed nurses administering medication to assess medication administration accuracy. They observed a number of deviations from safe medication administration practices, including failures to check patients’ identities and a failure to explain the medication to patients. Wrong dose errors accounted for 45% of the medication errors (Donaldson et al., 2014). A later study by Donaldson, Aydin, Fridman, 2014) showed that nurses’ frequently failed to adhere to safe medication practices (e.g., by delaying completion of medication administration documentation or failing to check patient identifiers) because of staffing factors, high levels of patient turnover, and the presence of distractions when delivering medications.

The use of BCMA systems to improve medication administration accuracy at the point of care has been examined in the literature (Bonkowski et al., 2014; Seibert et al., 2014). Bar code-enabled point of care technology includes patient identity verifications, the electronic checking of medication orders, and, most importantly, the requirement that nurses perform double-checks before administering medication. BCMA enables nurses to manage the medication
administration “rights,” and it thereby helps prevent wrong patient, wrong dose, wrong drug, wrong form, wrong route, and wrong time errors. Under BCMA systems, each medication must be scanned; thus, this enables BCMA systems to alert nurses of any mismatches or discrepancies in medication orders. Further, BCMA systems ensure that all medication administrations are completely and accurately documented (Hassink, Essenberg, Roukema, & van den Bemt, 2013).

Recent studies have investigated the effectiveness of BCMA in improving patient safety and its impact on medication administration processes (Bonkowski et al., 2014; Bowers et al., 2015; Hardmeier, Tsourounis, Moore, Abbott, & Guglielmo, 2014; Seibert et al., 2014). In these studies, researchers directly observed medication administration processes before and after the implementation of BCMA technology and found that post-BCMA medication accuracy rates exceeded pre-BCMA medication accuracy rates. Additionally, positive outcomes were associated with BCMA implementations, including reductions in medication errors. Nurses’ compliance with safe medication administration practices were also improved post-BCMA, because BCMA processes require nurses to engage in safety checks. Accordingly, the number of safe practice violations decreased following the implementation of BCMA. The efficiency of nurses’ medication administration workflow also increased; for example, the timeliness of medication administrations improved under BCMA systems (Bonkowski et al., 2014; Bowers et al., 2015; Hardmeier et al., 2014; Seibert et al., 2014). The nurses also reported an increased sense of satisfaction with BCMA systems and noted their usefulness, ease of use, and helpfulness for reinforcing safe medication practices (Tseng et al., 2012). Collectively, this evidence speaks to the advantages of integrating BCMA into nurses’ medication administration systems.

It has been argued that the rigid medication administration steps involved in BCMA do not provide the flexibility needed to manage the medical emergencies that occur in urgent care
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clinics or EDs. However, a recent study by Bonkowski et al. (2013) provided for the evidence of the effectiveness of BCMA in EDs by showing that BCMA reduced ED medication errors. Notably, wrong dose errors decreased significantly following the implementation of a BCMA system. Thus, BCMA can produce promising results in EDs. These findings indicated that BCMA systems should also be deployed in outpatient settings and showed the potential advantages of using BCMA systems in urgent care clinic.

Many health care organizations have adopted and meaningfully used BCMA to address quality and safety issues in medication administration processes; however, it is equally important to understand nurses’ perceptions of medication administration systems (Holden, Brown, Scanlon, & Karsh, 2012). Research has shown that nurses’ views of BCMA systems are tied to the successful implementation, use, and management of these systems (Moreland, Gallagher, Bena, Morrison, & Albert, 2012). Accordingly, studies on nurses’ levels of satisfaction with medication administration systems vary in their conclusions. Fowler, Sohler, and Zarillo (2009) and Moreland et al. (2012) used surveys to examine differences in nurses’ levels of satisfaction with the point of care bar code technology before and after the implementation of a BCMA system. The results of these studies showed a statistically significant improvement in nurses’ levels of satisfaction following the implementation of BCMA. Moreover, these studies revealed that nurses were most satisfied with the quality and safety features of BCMA systems, including the alerts, prompts, double checks, and ease of accessing medication information.

However, these studies also showed that nurses were dissatisfied with the extra steps that needed to be undertaken to ensure the accurate verification of medication administration using BCMA systems. The nurses believed that the additional time required to complete the process took time away from patient care or timely medication administration (Fowler et al., 2009;
Moreland et al., 2012). This finding speaks to the need to consider, changes to nurses’ workflows when integrating BCMA systems to ensure that positive perceptions are fostered and that nurses’ confidence in the advantages of BCMA systems is developed. Previous research has shown that if nurses perceive BCMA systems as ineffective or inefficient, negative outcomes may result. For example, if nurses are dissatisfied with medication administration systems, they may engage in “workarounds” that could compromise patients’ safety (Halbesleben, Rathert, & Williams, 2013; Smuellers, Onderwater, van Zwieten, & Vermeulen, 2014).

Additionally, as Holden et al. (2012) noted, the success of BCMA systems largely depends on the quality of technology, and nurses’ trust in and satisfaction with medication administration systems. So, nurses must be directly involved in BCMA implementations, workflow assessments, and designs so that these systems can be maximally beneficial.

Theoretical Framework
The theoretical framework that guided this project was Kotter’s Change Management Theory. This theory employs a strategic approach to achieving change and comprises the elements of planning, organizing, managing, and coordinating change (Kotter, 2012). Because of the highly complex nature of this health information technology project which sought to implement BCMA-CO, avoid failure, and maximize the efficiency of resources, Kotter’s Change Management Theory and its linear approach in particular was deemed as the most appropriate framework for this project (Kotter, 2012). This theory provided the frame of reference for all the stages of the project from initiation, implementation, and maintenance.

Kotter’s Change Management Theory suggests that improvements must be effectively managed to ensure the smooth implementation of a project and sustain lasting change, and it involves three phases: (a) creating a climate for change, (b) engaging stakeholders, and (c) sustaining the change (Kotter, 2012). Furthermore, as Kotter (2012) noted, Change Management Theory should not only help the team execute the strategies, but also help manage the individuals affected by the change. Using Kotter’s Change Management Theory as the framework for this project proved advantageous, because it enabled the creation of a model that ensured collective embrace of the quality improvement initiative. To ensure the project’s success, Kotter’s change management methodologies (Kotter, 2012) were conscientiously applied in its undertaking.

**Specific Aims**

This project sought to examine nurses’ levels of satisfaction with a currently used medication administration system before and after BCMA-CO implementation. The goals of the project were to: (a) improve medication safety by implementing BCMA-CO in an urgent care clinic, and (b) increase nurses’ levels of satisfaction with their medication administration system by integrating BCMA-CO into medication processes. Safe and quality medication management
is critical in outpatient settings, so the implementation of BCMA-CO in an urgent care clinic is a vital step toward the improvement of outpatient medication administration safety.

Methods

Intervention

The vision that drove this quality improvement initiative was the desire to improve the medication administration system in an urgent care clinic to ensure patient safety and quality care. The project adopted a Plan-Do-Study-Act (PDSA) cycle (Taylor et al., 2014) to guide the implementation of the initiative, ensure that the intervention was optimally planned and executed, and illustrate the effects of the implementation while allowing for learning to occur at each stage (Portella, Pronovost, Woodcock, Caster, & Dixon-Woods, 2015; Taylor et al., 2014).

Plan. The planning phase involved the establishment of an interdisciplinary team that would support the project. The key stakeholders set the standards for the quality improvement initiative. Regular bi-weekly meetings were held to ensure that the team was provided with ongoing information and implementation support. The Doctor of Nursing Practice (DNP) student served as the project manager and had the overall responsibility of initiating, planning, monitoring, and evaluating the project.

Do. A pre-intervention survey was conducted one month before the implementation of BCMA-CO. The second phase included the “go live” event (i.e., the integration of BCMA-CO into urgent care nurses’ medication administration processes). All the components of the intervention plan were implemented during this phase. The implementation included the installation of BCMA-CO software (first in test mode, then in a live environment). The interdisciplinary group that was established in the “Plan” phase created clinic quick orders and order menus, configured clinic locations, and provided training. BCMA super-users were trained
and made available to staff all shifts. The BCMA super-users provided extra support, thus mitigated implementation-related challenges and increased the level of nurses’ acceptance of the new software system (Yuan, Bradley, & Nembhard, 2015). The post-intervention survey was administered one month after project implementation.

**Study.** A comparative analysis of the pre- and post-intervention responses was conducted. Pre- and post-implementation data were essential to understanding the impact of BCMA-CO on nurses’ levels of satisfaction with the medication administration system. Evaluation outcomes were shared with the stakeholders and hospital nurse leaders, and the positive outcomes provided concrete evidence for the value being brought by the intervention to nurses, in the form of increased utility and improved delivery of quality and safe patient care.

**Act.** The “Act” stage closed the project intervention cycle. In this stage, the interdisciplinary team (established for the PDSA intervention) identified potential problems related to the project’s implementation and made improvements as necessary (Taylor et al., 2014). The team will continue to monitor, support, and evaluate changes to ensure that the implementation of the BCMA-CO software has resulted in a safe medication administration system, and that nurses are satisfied with the bar code technology.

**Study of the Intervention**

To improve the safety of medication administration, increase nurses’ levels of satisfaction with the medication administration system, and implement change successfully, a quality improvement methodology that uses pre- and post-testings’ was selected for the project design (Toulany, McQuillan, Thull-Freedman, & Margolis, 2012). A pre-test/post-test design was considered ideal for this quality improvement project because it allows for evaluation of how well the quality improvement intervention achieves its objectives. According to Holly (2014), the
quality improvement initiative allows insights to be gained on the systems and processes that need to be improved and evaluation to be conducted on the impact of the improvement/initiative. Results from the pre- and post-tests were determined using surveys that assessed nurses’ levels of satisfaction with the medication administration systems.

**Setting.** The project took place at a 396-bed Veterans Affairs (VA) hospital located in Pennsylvania. The hospital offers primary care, mental health care, geriatrics and extended care, women’s healthcare, and social work services for inpatients and outpatients. The hospital organization is accredited by the Joint Commission. It is ranked in the top 20 percent for quality and efficiency among all VA hospitals in the country. It also exceeded the VA national benchmark for primary care and mental health access in 2015.

The urgent care clinic of the hospital was selected for the implementation of BCMA-CO. It had a large population of outpatients and treated 5,634 patients in 2015. The urgent care clinic was chosen among the outpatient clinics for this project because patients admitted to the urgent care clinic are more likely to receive medication as part of their care.
Participants. To help determine the nurses’ levels of satisfaction with the medication administration system, a sample was drawn from all staff registered nurses (RNs) and licensed practical nurses (LPNs) in the hospital urgent care clinic and the outpatient clinics. Nurses from outpatient clinics were included because they can be assigned to work in the urgent care clinic. Those who could participate in this project included RNs, LPNs, and managerial RNs who worked full-time, part-time, or float and who administered medication in the urgent care clinic. Excluded were: (a) RNs, LPNs, and managerial RNs who did not work full-time, part-time, or float in the urgent care clinic; and (b) RNs and LPNs, who have not administered medication in the urgent care clinic.

Participants were recruited by being notified of the opportunity to participate in the project during staff meetings in which the project’s aim and procedures were presented along with the requirements for participation. The confidentiality of the data was also addressed. Twenty-six nurses were invited to participate.

Measures

Data on the nurses’ levels of satisfaction was collected using the MAS-NAS scale developed by Hurley et al. (2006). The MAS-NAS scale and permission to use the scale were obtained from Dr. Ann Hurley. The MAS-NAS tool was selected because of its established validity and reliability. The tool is the survey most commonly used to measure nurses’ levels of satisfaction with medication administration systems (Fowler et al., 2009; Halbesleben et al., 2013; Moreland et al., 2012). The MAS-NAS scale has demonstrated reliability with a Cronbach alpha value of .86 (Hurley et al., 2006). In Halbesleben et al.’s. (2013) study on the role of nurses’ levels of satisfaction with medication administration systems, the MAS-NAS scale demonstrated a Cronbach value of .95 for Sample 1 and a Cronbach value of .91 for Sample 2.
The MAS-NAS survey questionnaire has three sections. The first section was used to collect demographic information related to the type of nurse (RN or LPN), and each nurse’s level of education, years of experience in the nursing profession, and work history. The second section of the survey included 18 medication administration accuracy-related questions on efficacy, safety, and access. Question number 11 was changed from “The current medication administration system makes it easy to check that I am following the ‘5 rights’ when I administer medications” to “The current medication administration system makes it easy to check that I am following the ‘6 rights’ when I administer medications”. This change was made because the medical center’s policy refers to “six rights” of medication administration rather than “five rights.” Permission to modify the question was obtained from Dr. Ann Hurley. Data on the nurses’ levels of satisfaction with the medication administration systems were collected at two points. One set of data was collected four weeks before BCMA-CO was implemented and served as the pre-test data. The second set was collected four weeks after BCMA-CO had been implemented and served as the post-test data.

Participants were asked to assign a number value from one to six to 18 Likert-type questions and responses (where one represented strongly agree, two represented moderately agree, three represented slightly agree, four represented slightly disagree, five represented moderately disagree, and six represented strongly disagree). Participants could also select “not applicable” for any statements that did not apply to them. The last section of the survey comprised two open-ended questions about participants’ experiences with the current medication administration system, and the nurses’ ability to administer medication safely and professionally.

The MAS-NAS scale (Hurley et al., 2006) was distributed pre- and post-BCMA-CO implementation as an online survey via the web-based service Survey Monkey. The link to the
online survey was distributed using the hospital’s secure e-mail server. The survey link was emailed to all potential participants and was active for two weeks to provide participants sufficient time to complete the questionnaire. A reminder e-mail was sent at the mid-point of the two-week pre- and post-survey period. The Doctor of Nursing Practice (DNP) student visited the urgent care and the outpatient clinics twice each week during the survey period at the end of shifts to encourage RNs and LPNs working at the clinics to participate.

The first page of both the pre- and post-test survey was an informed consent page that explained the purpose of the project, participants’ rights, and what the participants were being asked to do. Specifically, the informed consent page stated that participation was voluntary and that participants had the right to withdraw from the project at any time and, for any reason. The informed consent page also indicated that participants’ responses would remain confidential. After reading the informed consent page, participants responded to an item that indicated that they agreed to participate and were directed to the next part of the survey, which contained the MAS-NAS survey.

Participants’ identities remained unknown to the DNP student, because no identifying information was collected. So that pre- and post-test responses could be tracked and confidentiality preserved, participants were asked to create a six-digit confidential identifier called an “ID” number. This number was unknown to the DNP student and was not included in any personnel files. The number was made of the year in which a participant was born followed by the last two digits of his/her telephone number.

Analysis
Participants’ responses were summarized using descriptive statistics such as means (M) and standard deviations (SD). To determine whether the BCMA-CO intervention improved
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nurses’ satisfaction, a dependent samples t-test was conducted. The samples compared were nurses’ pre- and post-test responses. Data from the electronic survey were imported and analyzed using the Statistical Program for the Social Sciences (SPSS) (IBM Corp., 2013).

**Ethical Considerations**

Before the commencement of the project, the DNP student sought the approval of Capella University’s Institutional Review Board (IRB). Approval from the facility’s IRB was also obtained for this project. The project was deemed a quality improvement project and therefore was not subject to IRB oversight. Participants were informed of their right to refuse to participate in the project at any time and were informed that survey data would be treated confidentially.

**Results**

There were 25 responses to the survey before BCMA-CO implementation (pre-implementation) and 26 responses to the survey after BCMA-CO implementation (post-implementation). After removing blank survey responses (in some surveys, participants did not complete the demographic and MAS-NAS questions), survey responses that had duplicate ID numbers, and the surveys of participants who did not complete both the pre- and post-implementation surveys, 19 completed surveys that could be included in the analysis remained. The pre- and post-implementation MAS-NAS scores were then checked for outliers using standardized values. Tabachnick and Fidell (2012) suggested that scores with standardized values greater than 3.29 or less than -3.29 should be considered outliers and removed from the data. However, no outliers were identified in this project. Thus, the final sample used in the analysis comprised data from 19 participants.

Descriptive statistics for the final sample are outlined in Tables 1 and 2. A large majority of the participants were RNs (n = 16, 84.2%). Concerning the highest level of education attained
by participants, 21.1% \((n = 4)\) held nursing diplomas, 31.6% \((n = 6)\) associate degrees, 26.3% \((n = 5)\) bachelor’s degrees, and 21.1% \((n = 4)\) master’s degrees. At the beginning of the project, most of the participants stated that they had worked in an inpatient unit in which BCMA had been implemented \((n = 12, 63.2\%)\). Finally, the participants had been employed for an average of 11.03 years as nurses at the VA hospital \((SD = 8.87)\) and had worked for an average of 3.66 years in the hospital’s urgent care clinic \((SD = 3.83)\).

Table 1. Descriptive Statistics for Categorical Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Nurse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPN</td>
<td>3</td>
<td>15.8</td>
</tr>
<tr>
<td>RN</td>
<td>16</td>
<td>84.2</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diploma</td>
<td>4</td>
<td>21.1</td>
</tr>
<tr>
<td>Associate Degree</td>
<td>6</td>
<td>31.6</td>
</tr>
<tr>
<td>Bachelor’s Degree</td>
<td>5</td>
<td>26.3</td>
</tr>
<tr>
<td>Master’s Degree</td>
<td>4</td>
<td>21.1</td>
</tr>
<tr>
<td>Worked on unit where BCMA was implemented</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>12</td>
<td>63.2</td>
</tr>
<tr>
<td>No</td>
<td>7</td>
<td>36.8</td>
</tr>
</tbody>
</table>

*Note.* Percentages may not add to 100.0 due to rounding error.
Table 3. Comparison of Mean Scores from Survey Before and After BCMA-CO Implementation

<table>
<thead>
<tr>
<th>Question</th>
<th>Pre-BCMA-CO Implementation</th>
<th>Post-BCMA-CO Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Know both the intended actions and side effects of medications</td>
<td>3.83</td>
<td>1.74</td>
</tr>
<tr>
<td>2. Drug alert feature (drug/drug or drug/food interaction) of the current medication administration system helpful</td>
<td>4.00</td>
<td>2.12</td>
</tr>
<tr>
<td>3. Ease of checking active medication orders before administering medications.</td>
<td>4.00</td>
<td>1.63</td>
</tr>
<tr>
<td>4. Pharmacist verification</td>
<td>3.93</td>
<td>1.58</td>
</tr>
<tr>
<td>5. Promotes 2-way communication between clinicians (MD, PA, NP, Pharmacist, RN) about medication orders</td>
<td>5.37</td>
<td>1.74</td>
</tr>
</tbody>
</table>

Table 3. Continued
Comparison of Mean Scores from Survey Before and After BCMA-CO Implementation
<table>
<thead>
<tr>
<th>Question</th>
<th>Pre-BCMA-CO Implementation</th>
<th>Post-BCMA-CO Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Access to provider’s order</td>
<td>3.32</td>
<td>1.65</td>
</tr>
<tr>
<td>7. Easy to get drug information</td>
<td>3.88</td>
<td>1.79</td>
</tr>
<tr>
<td>8. Provider and pharmacist communicated and agreed on the order</td>
<td>4.13</td>
<td>2.56</td>
</tr>
<tr>
<td>9. Know where all the medications are stored or if they need to be procured from pharmacy</td>
<td>2.78</td>
<td>1.63</td>
</tr>
<tr>
<td>10. Efficient at medication administration</td>
<td>4.35</td>
<td>1.87</td>
</tr>
<tr>
<td>11. Easy to check and follow the “6 rights” of medications administration</td>
<td>4.22</td>
<td>1.68</td>
</tr>
<tr>
<td>12. Adequate turnaround time for “stat” orders</td>
<td>4.08</td>
<td>2.58</td>
</tr>
<tr>
<td>13. Effective in reducing and preventing medication errors</td>
<td>4.06</td>
<td>2.17</td>
</tr>
<tr>
<td>14. User friendly to nurses</td>
<td>3.93</td>
<td>1.95</td>
</tr>
<tr>
<td>15. Equipment readily available</td>
<td>3.33</td>
<td>1.79</td>
</tr>
<tr>
<td>16. Provide the information on what to do if patients have any bad reactions from a medication.</td>
<td>4.31</td>
<td>1.95</td>
</tr>
<tr>
<td>17. Keep stashes of medications</td>
<td>1.78</td>
<td>1.07</td>
</tr>
<tr>
<td>18. Message that acknowledges and accepts a known drug/drug interaction to give medication safely.</td>
<td>4.75</td>
<td>2.33</td>
</tr>
</tbody>
</table>

Note. Lower MAS-NAS scores indicate higher nurse satisfaction

A dependent samples t-test was conducted to determine whether the BMCA-CO intervention improved nurses’ levels of satisfaction. The dependent samples t-test is an appropriate statistical analysis to use when the goal of the research is to determine whether there is a difference between two related or repeated-measure samples relative to a continuous dependent variable. In this analysis, the dependent variable was satisfaction. The samples being
compared were nurses’ pre- and post-implementation responses. The results of the \( t \)-test were significant (\( t(18) = 4.57, p < .001 \)), indicating that nurses’ satisfaction scores changed significantly from pre- to post-implementation. Specifically, nurses’ satisfaction scores were significantly lower post-implementation (\( M = 1.88, SD = 0.87 \)) than pre-implementation (\( M = 3.69, SD = 1.38 \)). Because lower scores on the MAS-NAS corresponded with higher satisfaction, these results indicated that nurses’ levels of satisfaction improved after the BCMA-CO intervention. Before the implementation of the BCMA-CO system, the mean scores on the MAS-NAS ranged from 1.78 to 4.35. One month after the BCMA-CO conversion, the mean scores on the MAS-NAS ranged from 1.07 to 2.58. A significant improvement in nurses’ levels of satisfaction was noted across all the MAS-NAS items. Table 4 sets out the descriptive statistics for participants’ composite satisfaction scores.

Table 4. Descriptive Statistics for Composite Scores

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfaction pre-BCMA-CO</td>
<td>3.69</td>
<td>1.38</td>
</tr>
<tr>
<td>implementation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfaction post-BCMA-CO</td>
<td>1.88</td>
<td>0.87</td>
</tr>
<tr>
<td>implementation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Lower MAS-NAS score indicates higher nurse satisfaction.

A reliability analysis using Cronbach’s alpha was conducted on the MAS-NAS (Hurley et al., 2006) items both pre- and post-implementation. George and Mallery (2010) have stated that Cronbach alpha values of .7 or higher indicate acceptable reliability. Table 5 sets out the Cronbach alpha reliability coefficients. The inter-item reliability for satisfaction exceeded .7 for both pre- and post-implementation, indicating that the reliability of the items was acceptable at both time points.
Before the main analysis was conducted, the assumption of normality was tested using a Kolmogorov-Smirnov (KS) test for both the pre- and post-implementation satisfaction scores. The results of the KS test were significant for the post-implementation scores ($p = .001$), but were not significant for the pre-implementation scores ($p = .177$). This indicated that the distribution of post-implementation satisfaction scores differed significantly from a normal distribution. Thus, the assumption of normality was not met. Consequently, a non-parametric alternative to the dependent samples $t$-test (i.e., the Wilcoxon signed ranks test) was conducted in addition to the planned dependent samples $t$-test. The results of the Wilcoxon signed ranks test were significant ($Z = -3.20, p = .001$), indicating that nurses’ satisfaction scores changed significantly from pre- to post-implementation, and confirming the results of the dependent samples $t$-test.

**Discussion**

This quality improvement project compared nurses’ levels of satisfaction with a medication administration system before and after the implementation of a BCMA-CO system. Before the BCMA-CO conversion, participants were satisfied with the process of medication procurement and knew where to find the required medications (e.g. in the unit or at the
pharmacy) ($M = 2.78, SD = 1.67$). The urgent care clinic uses an automated dispensing cabinet (ADC) that stores most medications and facilitates quick access to medications.

Participants displayed the lowest levels of satisfaction in response to Question 18: “When I see a message that acknowledges and accepts a known drug/drug interaction, I believe it is appropriate to give the medication” ($M = 4.75, SD = 1.42$). One possible reason for participants’ low levels of satisfaction in response to this item is that warning messages noting known drug/drug interactions and override interventions did not exist before the implementation of the BCMA-CO. Moreover, under the previous outpatient pharmacy process, medications could be administered to patients before the pharmacy had performed the necessary safety checks on medication orders. Accordingly, this approach affected medication safety.

Participants displayed the second lowest levels of satisfaction in response to the question that focused on the efficiency of the medication administration system. It stated: “The current medication administration system helps me to be efficient at medication administration” ($M = 4.35, SD = 1.94$). Before the introduction of BCMA-CO, the outpatient medication administration process used a manual documentation process that increased documentation time.

The open-ended survey question that asked participants about their experiences with the medication administration system uncovered the reasons underlying participants’ disappointments with the current medication administration system. Participants’ responses included: “The current system is not safe and inefficient,” “The current medication administration is unable to support medication safety,” and “The need to print medication orders is not efficient at all.” Previous studies have shown that negative side effects and unfavorable experiences hinder medication administration tasks and consequently affect nurses’ levels of satisfaction with medication administration systems (Halbesleben et al., 2013). However, the
participants in this project made some encouraging comments in anticipation of the BCMA-CO implementation, when they observed that the use of this technology could improve their work processes and medication safety. The implementation of the new medication administration system was a necessary step for ensuring patient safety and improving the quality of care and nurses’ workflow processes.

One month after the BCMA-CO implementation, the four questions that yielded the highest satisfaction scores were Questions 3, 4, 9, and 17. As reflected in their responses to item 3 (“The current medication administration system makes it easy to check active medication orders before administering medications”), participants were satisfied with how easy it became to check orders post-intervention ($M = 1.63$, $SD = 0.90$) compared to pre-intervention ($M = 4.00$, $SD = 1.71$). BCMA-CO software and barcode scanners were installed at workstations in every patient’s room, enabling information on active medications to be displayed, and allowing nurses to perform BCMA at patients’ bedsides. Additionally, computers on wheels were deployed to provide nurses immediate access to medication information and medication history, anytime and anywhere in the urgent care clinic. The results of previous studies have shown that the ease of access to medication data positively affects nurses’ levels of satisfaction with medication administration systems (Leung et al., 2015; Morrison & Albert, 2012).

There was also a marked increase in participants’ levels of satisfaction in response to Question 4: “The current medication administration system provides me with information to know that a medication order has been checked by a pharmacist before I administer the medications.” Indeed, from pre-intervention ($M = 3.93$, $SD = 1.77$) to post-intervention ($M = 1.58$, $SD = 0.77$), participants’ mean score for this item increased by 2.35. For medication orders to appear in the BCMA-CO, pharmacist and nurse order verifications are required (both of which...
are critical to patient safety) (Hassink et al., 2013). Similar studies have shown that nurses’ are most satisfied when they are assured that medication orders have been verified and double-checked (Fowler et al., 2009; Tseng et al., 2012).

Participants in this project expressed similar levels of satisfaction with the medication procurement process before BCMA-CO implementation and one month after BCMA-CO implementation (\(M = 1.63, SD = 1.12\)). The urgent care clinic medication storage unit not only stores large quantities of medications, but also integrates medications with patients’ profiles. Allowing nurses to select a patient’s name and medication order helped streamline the process of medication procurement. Further, participants’ responses to Question 17: (“I have to keep stashes of medications to be sure I have medications I need when I need them” ), which were reverse-scored, revealed that it was not common practice for nurses to keep a medication “stash” (\(M = 1.07, SD = 0.27\)). This finding is important because deviation from safe medication practices can result in medication errors (Donaldson et al., 2014).

Conversely, following the implementation of BCMA-CO, the turnaround time for highest priority orders or “stat” medications became an issue (\(M = 2.58, SD = 1.74\)). This occurred because the hospital’s use of a virtual pharmacist to finish medication orders during night tours and on the weekends delayed verifications of “stat” medication orders. BCMA-CO requires that a pharmacist review and verify each medication order before the drug can be made available in the system. Because of the delay, nurses were forced to telephone the pharmacy to have “stat” orders verified. Similarly, Bonkowski et al. (2014) found that a challenge arises for “stat” orders under BCMA systems because of the unique issues that EDs or urgent care clinics face in managing emergency medications. Bonkowski further noted that the use of BCMA demands a workflow that is congruent with the medication administration workflow for “stat” orders. Thus,
The turnaround time for “stat” medication orders needs to be addressed to prevent clinic workflow interruptions and the adoption of workaround strategies that will negate the benefits of BCMA-CO.

The use of BCMA-CO provides nurses the knowledge that each medication order has undergone pharmacy safety checks (i.e. dosage checks, allergy checks, drug/drug interactions checks, and duplicate drug order checks) and that a pharmacist has reviewed each medication and verified that each order is accurate. However, the findings of this project indicated that participants were concerned with the ways in which providers and pharmacists communicated when order clarifications were needed ($M = 2.56$, $SD = 1.32$). Moreland et al. (2012) reported that communication remains critical for ensuring medication safety and optimal medication administration delivery. In an informal discussion, nurses indicated that they believed that the gaps in communication were partly attributable to the use of off-site pharmacy support. In some instances, virtual pharmacists placed unclear medication orders on hold but failed to make follow-up clarification calls. These breaks in communication led to interruptions in care and affected nurses’ workflows. An efficient, clear communication procedure to be used by providers and pharmacists is required to maximize timely medication administration, ensure patient safety, and increase staff satisfaction (Leung et al., 2015). The methods of medication order processing and verification for BCMA-CO that are used during the nights and on weekends are currently being evaluated to address this issue. According to Voshall and Piscotti (2013), problems related to workflow interruption can cause nurses to circumvent system safety measures and override systems (e.g., by administering medications before receiving pharmacist verification). Rack, Dudjack, and Wolf (2012), and Voshall and Piscotti, (2013), suggested that eliminating system
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inefficiencies should be a high priority to help nurses completely embrace the technology and develop confidence in and satisfaction with medication administration systems.

Summary

Lower scores on the MAS-NAS corresponded with higher satisfaction, indicating that nurses’ levels of satisfaction with the medication administration system improved after the BCMA-CO implementation. The implementation of the BCMA-CO system has improved the medication administration systems because it meets the needs of nurses by providing safe and quality patient care in the urgent care clinic. The results of this project confirmed that nurses’ were, overall, more satisfied with the BCMA-CO system than with the previous medication administration system. This finding is key because if nurses hold favorable perceptions of BCMA-CO, they will have greater confidence in the usefulness and suitability of the technology when using it in urgent care and outpatient settings. Moreover, this quality improvement project has important implications for nursing practices. Barcode technology can be used to create a culture of safety and a reassuring work environment for nurses. The integration of BCMA-CO into urgent care was an effective solution that improved the quality of medication administration and increased nurses’ levels of satisfaction with a medication administration system. Areas for BCMA-CO process improvement included turnaround time for “stat” orders and communication processes concerning medication orders.

Limitations

Nevertheless, this project had some limitations. One of the most obvious is that the short time frame between pre- and post-testing may not accurately reflect the experiences of nurses using BCMA-CO. More time is needed before the new medication administration system is completely embedded into nurses’ work processes and the BCMA-CO system stabilizes (Novak,
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Holden, Anders, Hong, & Karsh, 2013). Despite the short time frame, the nurses’ strong positive perceptions of BCMA-CO can be attributed to the effective project management. Adequate training, the early identification of issues, progress monitoring, audits, 24/7 unit rounds to solicit feedback and provide support, presence of BCMA-CO super-users, and a team approach ensured the smooth implementation of this project.

Another limitation of the project was the small number of participants; only 19 RNs and LPNs completed the surveys. This limits the project’s ability to conclude that BCMA-CO improved nurses’ levels of satisfaction with the system. Moreover, the satisfaction results cannot be generalized beyond an urgent care clinic setting. However, this project is an early attempt to implement BCMA-CO and examine nurses’ levels of satisfaction with a BCMA-CO system in an outpatient setting at the VA. The project outcomes were rich in detail, and the project led to improvement in nurses’ levels of satisfaction with medication administration processes.

**Conclusions**

The implementation of BCMA-CO was shown to be associated with increases in nurses’ levels of satisfaction with a medication administration system. It is critical that nurses be satisfied with medication administration systems, because medication administration delivery substantially affects nurses’ work processes and quality of care. The outcomes of this quality improvement project showed that the complex processes of medication administration in an urgent care clinic could be improved and made safer by converting to BCMA-CO. The findings of this project provide insight into nurses’ experiences of BCMA-CO implementation and can be used to inform nurse leaders who are contemplating of implementing BCMA-CO in outpatient clinics. However, BCMA-CO processes must be continuously examined to identify any issues
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that nurses may perceive as challenging or problematic. Nurses’ feedback on potential problems should be explored and addressed promptly to mitigate unintended consequences.

The use of Kotter’s Change Management Theory (Kotter, 2012) and the PDSA approach was beneficial because these methods ensured that the implementation was optimally planned and executed, and that it contributed to the project’s success. Furthermore, this important endeavor was made possible through the application of DNP essentials. Specifically, organizational and systems knowledge, leadership skills, interprofessional collaboration, methods for evidence-based practice, and knowledge of the uses of information technology (AACN, 2006) served as the foundational guidelines for the development of the scholarly project. Finally, this quality improvement project was meaningful, because the implementation of BCMA-CO is a significant undertaking that directly correlates with improved patient safety, quality of care, and nurses’ satisfaction levels.
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Appendix

33
STATEMENT OF ORIGINAL WORK

Academic Honesty Policy

Capella University’s Academic Honesty Policy (3.01.01) holds learners accountable for the integrity of work they submit, which includes but is not limited to discussion postings, assignments, comprehensive exams, and the dissertation or capstone project.

Established in the Policy are the expectations for original work, rationale for the policy, definition of terms that pertain to academic honesty and original work, and disciplinary consequences of academic dishonesty. Also stated in the Policy is the expectation that learners will follow APA rules for citing another person’s ideas or works.

The following standards for original work and definition of plagiarism are discussed in the Policy:

Learners are expected to be the sole authors of their work and to acknowledge the authorship of others’ work through proper citation and reference. Use of another person’s ideas, including another learner’s, without proper reference or citation constitutes plagiarism and academic dishonesty and is prohibited conduct. (p. 1)

Plagiarism is one example of academic dishonesty. Plagiarism is presenting someone else’s ideas or work as your own. Plagiarism also includes copying verbatim or rephrasing ideas without properly acknowledging the source by author, date, and publication medium. (p. 2)

Capella University’s Research Misconduct Policy (3.03.06) holds learners accountable for research integrity. What constitutes research misconduct is discussed in the Policy:

Research misconduct includes but is not limited to falsification, fabrication, plagiarism, misappropriation, or other practices that seriously deviate from those that are commonly accepted within the academic community for proposing, conducting, or reviewing research, or in reporting research results. (p. 1)

Learners failing to abide by these policies are subject to consequences, including but not limited to dismissal or revocation of the degree.

Statement of Original Work and Signature

I have read, understood, and abided by Capella University’s Academic Honesty Policy (3.01.01) and Research Misconduct Policy (3.03.06), including the Policy Statements, Rationale, and Definitions.
I attest that this dissertation or capstone project is my own work. Where I have used the ideas or words of others, I have paraphrased, summarized, or used direct quotes following the guidelines set forth in the APA Publication Manual.

Learner name and date
Maria Jinky R. Valdez 4/30/17

Mentor name and school
Jocelyn D’Antonio, Ph.D., Capella University