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## Medication Administration Pre and Post BCMA at the VA Medical Center

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### Abstract

The Department of Veterans Affairs (VA) is using Bar Code Medication Administration (BCMA) software to document medication administration which reduces errors while increasing safety and efficiency. This article compares the pre and post BCMA medication administration processes and outlines the benefits and safety features that BCMA offers. Furthermore, screen shots from actual medication administrations with BCMA are included to show the user's view while administering medications. BCMA enhances authentication, security, and confidentiality, issues that the old paper medication administration records (MARs) lacked.

**Keywords:** BCMA, Medication Administration, Barcode, Veterans Affairs,  
Computer Technology





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### Introduction

**B**ar Code Medication Administration (BCMA) is a point-of-care software solution that addresses the uncompromising issue of medication errors by electronically validating and documenting medications for patients. It ensures that the correct patient receives the correct medication, the correct dose, at the correct time, via the correct route, and visually alerts nursing staff when the proper parameters are not met (United States Department of Veteran Affairs, 2006a). The primary cause of error-related inpatient deaths is adverse drug events such as medication errors that result in patient harm. An estimated 7,000 deaths are associated with medication errors annually (Migdial, 2000).

While health-care costs in the United States continue to soar, hospitals including the Department of Veterans Affairs (VA) and others are reducing costs and errors while increasing safety and efficiency by using software for BCMA. For this reason, the VA was named one of seven recipients of the prestigious Innovations in American Government Award presented by the Ash Institute of the John F. Kennedy School of Government at Harvard University (United States Department of Veterans Affairs, 2006b). "This award tells the American people what millions of veterans and their families have known for years – that VA provides world class health care in a professional, compassionate and high-tech environment," said then Secretary of Veterans Affairs R. James Nicholson (The Innovations in American Government Awards, 2006).

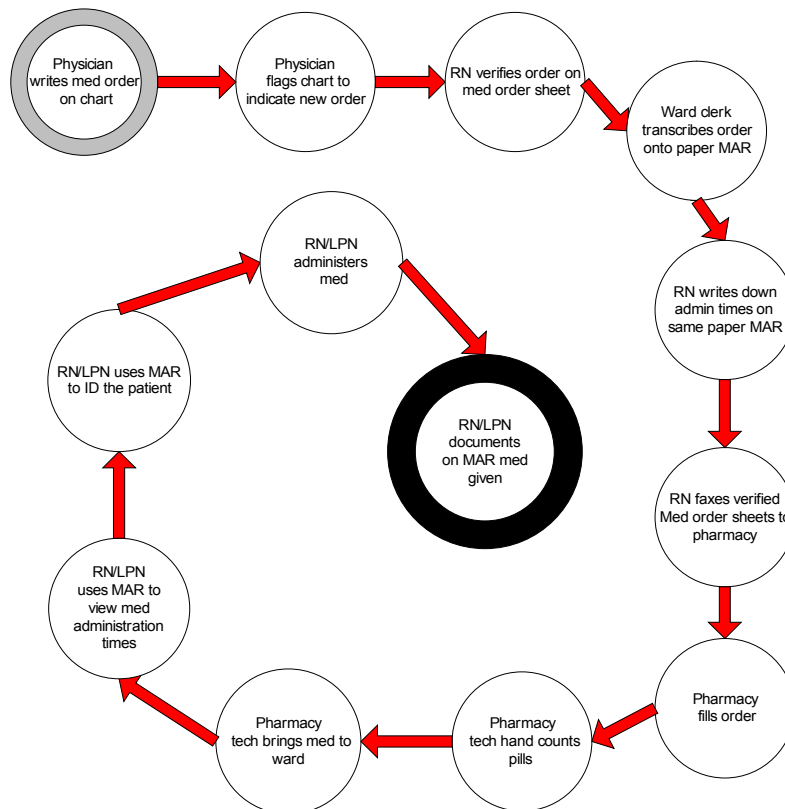
With the rapid expansion of computer technology it might be assumed that most healthcare organizations would be utilizing that technology to its fullest potential, but that has not occurred. In fact, fewer than 10% of all healthcare organizations have incorporated any type of medication safety technology into patient care activities (Saba & McCormick, 2006). In contrast, nurses at all VA hospitals have





been using BCMA since 2000. This paper will illustrate how the medication administration process in the VA changed using BCMA by describing what occurred prior to, and after, the implementation of the award-winning BCMA software.

To understand the BCMA medication administration process and fully appreciate its true value, it is important to first examine medication administration prior to BCMA implementation. Figure 1 presents a visual flowchart of the medication administration process prior to BCMA. At that time, VA hospitals were utilizing paper documentation with Medication Administration Record (MAR) sheets.



**Figure 1. Pre BCMA Medication Process**





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The medication administration process began with the physician hand-writing the medication order onto the Order Sheet in the paper chart. The physician would then flag the chart by moving a tab to show red on the hard chart cover which would indicate to nursing and clerical staff that a new order was written. The physician would return the chart back to the nurses' desk. The Registered Nurse (RN) would then verify the orders on the medication order sheet and give that order sheet to the ward clerk to be transcribed onto the paper MAR, leaving the administration time blank. The RN would then write down the administration times for each medication on the same paper MAR. Next, the RN would fax the medication order sheets to the pharmacy.

Once the Pharmacist received the faxed medication order sheets, the pharmacist verified each order and sent the medication order sheets to the pharmacy technician to be filled by hand. The pharmacy technician would then gather all the medications for the patient and deliver the medication to the ward where the patient was located so that the nurse could start administering the medications according to the times and dates on the MAR.

The next step in medication administration would be for the RN or licensed practical nurse (LPN) to gather the medications for the patient and put them in the appropriate patient drawer in the mobile medication cart. The RN/LPN would use the paper MAR along with the mobile medication cart to review the medication administration times. When administering medications, the RN/LPN again would verify the right medication, right dose, right route, right time, and right patient. The RN/LPN verified the patient by matching the name on the MAR with the name on the patient's armband. After verifying the 5 rights and the patient identification, the RN/LPN then administered the medications. Once administration was complete, the RN/LPN documented on the MAR that the medication was administered.

The post BCMA medication administration process presents a significant contrast





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to the previous process for medication administration. Figure 2 illustrates the medication administration process using BCMA and the computerized patient record system (CPRS). The revised process begins with the physician entering an electronic order into the CPRS. The process for entry of the electronic medication order includes a series of order checks built into the system. CPRS provides for order checks on all orders which can be set locally by each site.

CPRS initiates order checks during the ordering process (see Figure 2 on next page).

Table 1 shows the order checks that are available on the Phoenix local CPRS system:

Allergy-Contrast Media Interaction	Error Message
Allergy-Drug Interaction	Estimated <u>Creatinine Clearance</u>
<u>Aminoglycoside</u> Ordered	<u>Glucophage-Contrast Media</u>
<u>Biochem Abnormality</u> For Contrast Media	<u>Glucophage-Lab Results</u>
<u>Clozapine</u> Appropriateness	Lab Order Freq Restrictions
Critical Drug Interaction	Missing Lab Tests For Angiogram Procedure
CT & MRI Physical Limitations	No Allergy Assessment
Dangerous Meds For Patient with age > 64	Order Checking Not Available
Dispense Drug Not Selected	<u>Polypharmacy</u>
Duplicate Drug Class Order	Recent Barium Study
Duplicate Drug Order	Recent Oral <u>Cholecystogram</u>
Duplicate <u>Opioid</u> Medications	Renal Functions Over Age 65
Duplicate Order	Significant Drug Interaction

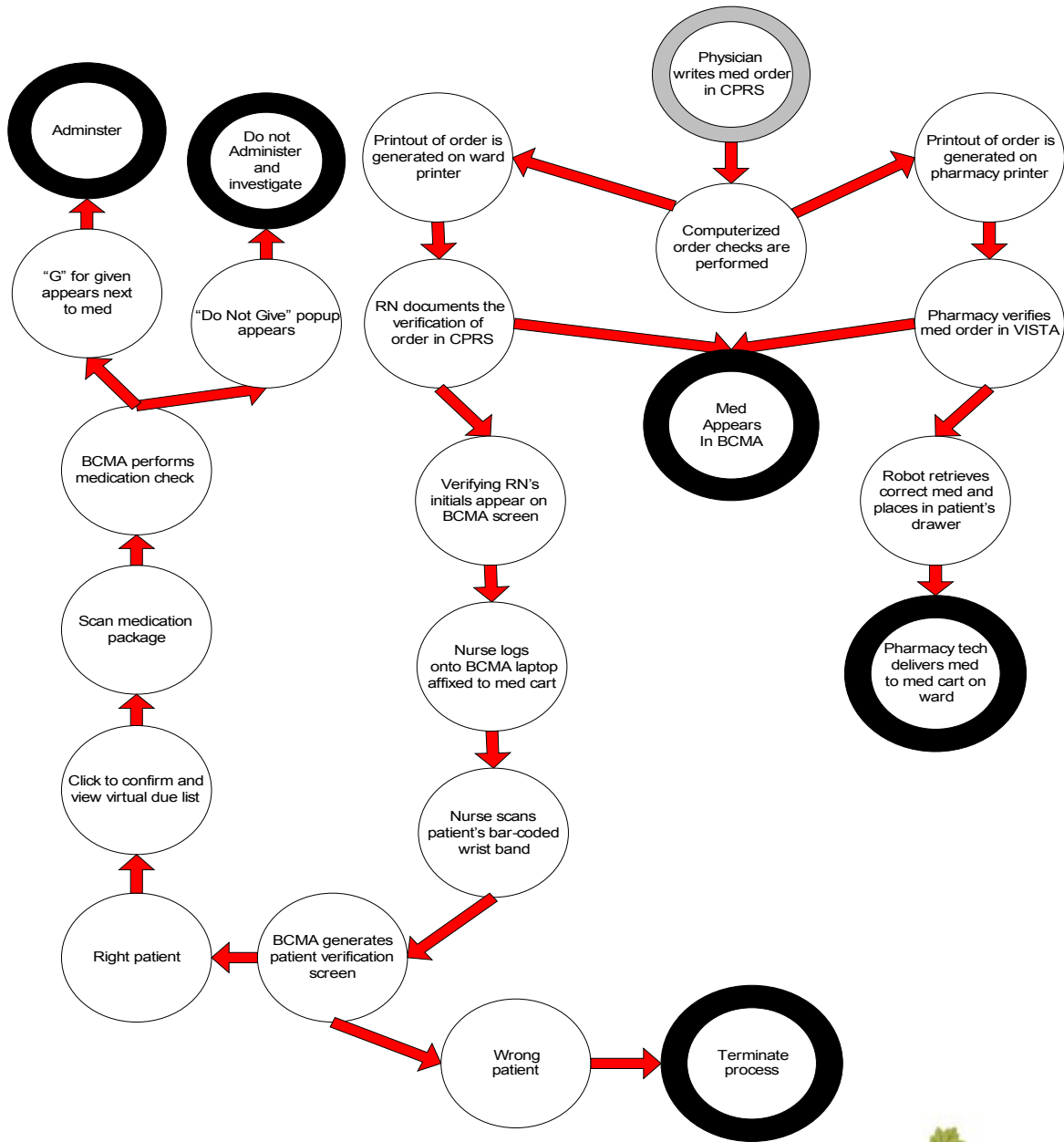
**Table 1. Order Checks Available at the Phoenix Veterans Affairs Medical**





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**Figure 2. Medication Administration Process Using BCMA**

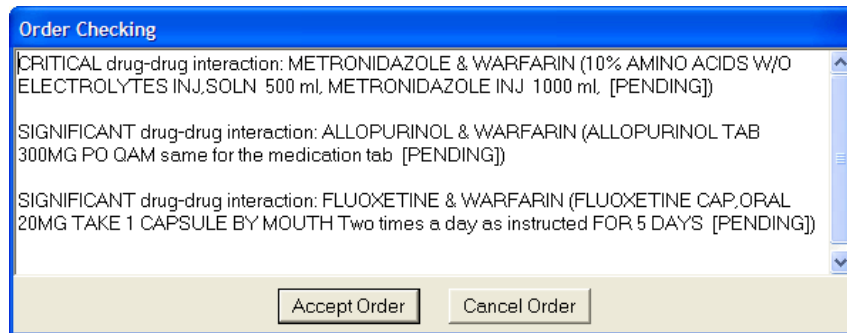




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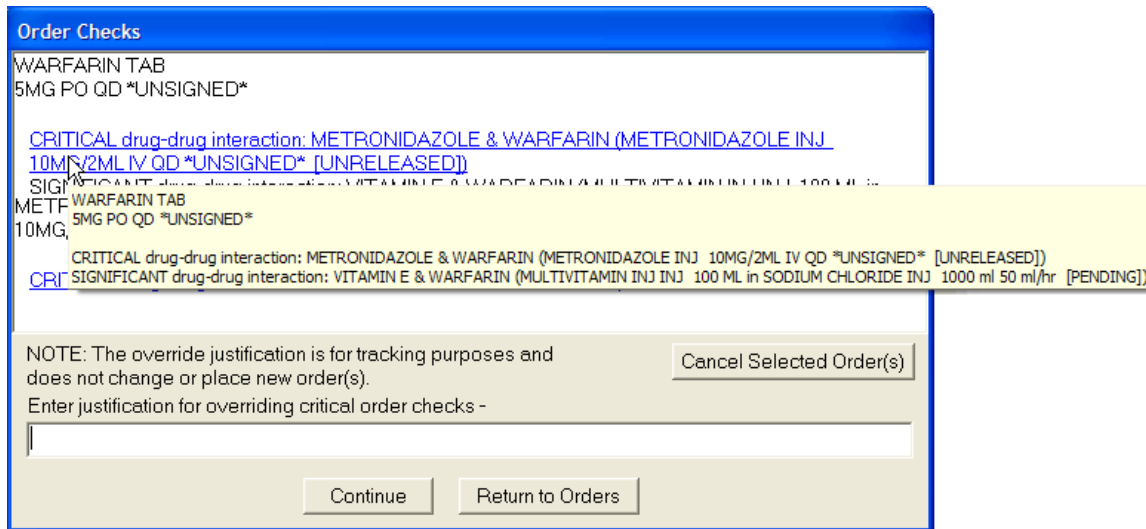
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Several parameters that each VA site controls determine how the order checks function. For medication orders, if a potential problem is found, CPRS displays the order check window shown in Figure 3.



**Figure 3. Example Order Check**

When a medication order is accepted, order checks are performed to identify potential problems. If the clinician chooses to sign the order, CPRS displays the dialog shown in Figure 4.



**Figure 4. Order Check Dialog**





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The example shown in Figure 4 would require a justification for overriding the critical interaction displayed. Another advantage of this software is that when the user hovers the cursor over the text a hover hint will appear that contains the complete text for the order. A Clinical Danger Level is set for each order check by the local site. Where the Clinical Danger Level is set determines whether or not the order check requires the clinician to enter a justification. For example, the pharmacy package determines if a drug-drug interaction is critical or significant. Each site then determines whether the provider must enter a reason for override. This is done by setting a Clinical Danger Level in CPRS for the Critical Drug Interaction and Significant Drug Interaction order checks. If the Clinical Danger Level is set to High for an order check, the clinician must enter a justification for overriding the order check. If the order check has a lower Clinical Danger Level, CPRS does not require the clinician to enter a justification.

Allergy assessments also use order checks. If the site has set the No Allergy Assessment order check Clinical Danger Level to High and the patient does not have an allergy assessment, the order will require a justification for override. If the site has set the Clinical Danger Level to Moderate, no reason for overriding the order is required. When a user enters a high clinical danger level override justification, the justification for override is sent with the orders to ancillary packages that are integrated into the CPRS system so that the information is available to their users. For example, a user of the clinical dietetics package would see the justification for an allergy order to be overridden.

The printout of the order is generated on the pharmacy printer, and the pharmacist verifies the medication order as well as the result of all the order checks. Then the pharmacy Robot retrieves the correct medication and places it in the patient's medication drawer. The pharmacy technician then places the medication drawer on the medication cart and delivers the cart to the medication room on the unit where the patient is located.





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At the time that a printout of the order is generated to the pharmacy printer, another printout is also generated to the ward printer. This happens in order to alert staff that there are new medications ordered by the physician on one of their patients. The physicians generating these orders can be anywhere in the facility where they have access to a VA computer.

The RN verifies the medication order in CPRS which then places the verifying RN's initials on that medication order on the BCMA screen. When a nurse administers medication using BCMA, the first step is to log onto a laptop which has BCMA loaded onto it. These laptops may be affixed to the top of the medication cart as illustrated in Figure 5, or can be on a stand-alone cart as depicted in Figure 6.



**Figure 5. Laptop Affixed to Medication Cart**



**Figure 6. Stand-alone Cart**

In order to access the patient's medication administration record, the nurse scans the patient's bar-coded wristband as illustrated in figure 7. The wristband includes the patient's name and social security number which are the two identifiers used by the facility for patient identification.





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**Figure 7. Scanning a Wristband**

Once the patient's bar-coded wristband is successfully scanned, BCMA generates a patient confirmation screen as illustrated in figure 8.

BCMA - Patient Confirmation	
Name: CXAHZLY,ZLYRHA J	Ward: 3B5
SSN: 101-17-9619	
DOB: 10/1/1923	Rm-Bd: 3215-1-4604
<b>Allergies:</b> no allergy assessment	
<b>ADRs:</b> No ADRs on file	
<b>Patient Flags:</b>	
Is this the correct patient?	
<input checked="" type="checkbox"/> I have confirmed this patient's identity using two acceptable forms of patient identifiers.	
<input type="button" value="Yes"/> <input type="button" value="Cancel"/>	

**Figure 8. Patient Confirmation Screen**

If the incorrect patient's information is displayed, the nurse does not check the patient identity confirmation box and the process is terminated. If the correct patient's information is displayed, the nurse checks the patient identity confirmation box and clicks yes to continue. Then the electronic medication administration record will appear on the screen (Figure 9).







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**Scenario #1.** The medication order is Aspirin 81 mg PO Q Day. The medication is dispensed by pharmacy in one package containing one Aspirin 81 mg tablet. When scanned, BCMA documents that the medication was given.

**Scenario #2.** The medication order is Tylenol 650 mg PO QID PRN. The medication is dispensed by pharmacy in two packages, each containing one Tylenol 325 mg tablet. When scanned, BCMA will display the multiple dose screen shown in figure 11.

**Multiple Dose**

Active Medication: **ACETAMINOPHEN TAB**

Special Instructions/Information:  
**For Pain or Fever**

Dosage: 650MG Units per Dose: 2

ACETAMINOPHEN 325MG TAB U/D Unable to Scan

ACETAMINOPHEN 325MG TAB U/D Unable to Scan

Enter a Comment (Optional): (150 Characters Maximum)

Scanner Status: **Ready** Enable Scanner Done Cancel

**Figure 11. Multiple Dose Screen**

This screen alerts the nurse that it takes two units per dose to administer the ordered amount of Tylenol. When both packages are scanned, BCMA documents that the medication was given.

**Scenario #3.** The medication order is Nicotinic Acid 150 mg PO BID. The medication is dispensed by pharmacy in two packages, each with one Nicotinic Acid 100 mg tablet in them. When scanned, BCMA will display the multiple/

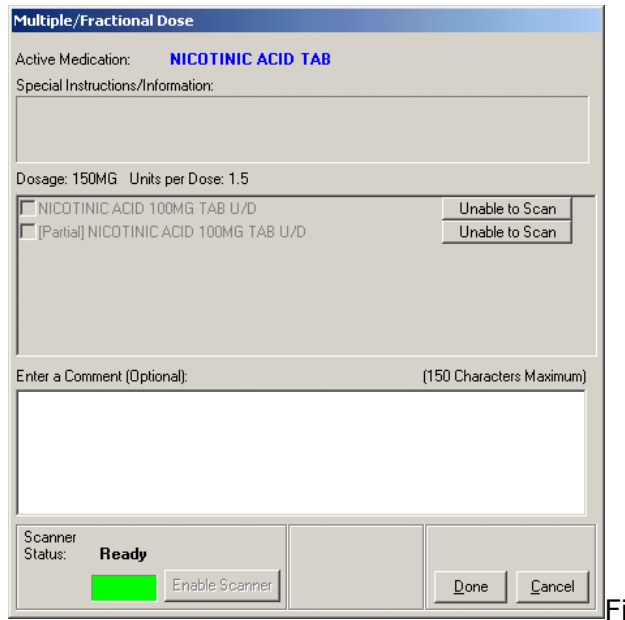




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fractional dose screen shown in figure 12.



**Figure 12. Multiple/Fractional Dose Screen**

This screen alerts the nurse that it takes one and one-half units per dose to administer the ordered amount of Nicotinic Acid. When both packages are scanned, BCMA documents that the medication was given.

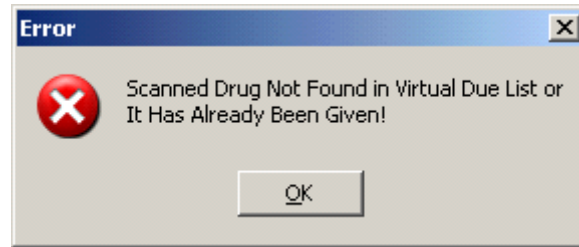
If nurse scans the wrong medication, or the right medication with the wrong dose, or a medication that has already been given, BCMA will display an error message alerting the nurse not to administer the medication. See figure 13 below.





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**Figure 13. Error Message**

When nurses use BCMA exactly as it was designed, medications errors are significantly reduced. Table 2 compares the types of reported medication errors between 1993 and 2001. In each category of error, fewer errors occurred while the BMCA system was in use (Johnson, Carlson, Tucker, & Willette, 2003). There was from 61.97% to 93.48% improvement in different error types when comparing post BCMA to pre BCMA

Error Type	1993 (%)	2001* (%)	Improvement (%)
Wrong Medication	0.00371	0.00091	75.47
Wrong Dose	0.00334	0.00127	61.97
Wrong Patient	0.00138	0.00009	93.48
Wrong Time	0.00143	0.00018	87.41
Omission	0.00917	0.00272	70.34

**Table 2. Reported Error Rate Per Total Doses Dispensed**





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In a recent research study, (Morriss et al, 2009), a comparison was done between hospital systems that use BCMA and ones that do not. It was found that the implementation of BCMA in a neonatal intensive care unit significantly reduced the relative risk in targeted, preventable adverse drug events. The percentage of omitted doses was 14% in hospitals not using BCMA versus 1% in hospitals using BCMA, as seen in table 3.

	No BCMA system (n = 39)	BCMA system (n = 20)
Omitted dose	14 (35.9)	1 (5)
Wrong dose ordered	1 (2.6)	0
Wrong dose given	2 (5.1)	1 (5)
Unordered drug	1 (2.6)	0
Wrong time	12 (30.8)	9 (45)
Wrong administration rate	3 (7.7)	0
Faulty administration technique	1 (2.6)	1 (5)
Reconciliation error	0	1 (5)
Transcription error	0	2 (10)
Duplication order	1 (2.6)	0
Other error*	4 (10.3)	5 (25)

Data are number (%).

**Table 3. Classes of Medication Errors Associated With Targeted, Preventable Adverse Drug Event**

Morriss, et al (2009) detected more total medication errors after the BCMA system was implemented than before, primarily because more wrong-time errors were detected by the system.

This is partly due to the precision of the recorded time of administration by the BCMA system. Most other medication error types, notably omitted doses, clerical errors and transcription errors, were reduced when the BCMA system was implemented. More severe medication errors decreased with the implementation of BCMA.

Human factors engineering and normal accident theory explain





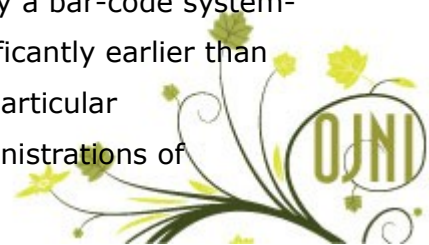
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why errors are common in complex processes such as preparation, dispensation, and administration of medications. Human factors engineering proposes that human characteristics, both limitations and abilities, are what define human interactions with systems. Limitations on human memory and our ability to find, differentiate, and integrate information and remain focused over time shape how people interact with systems. The ability to reason and learn from past experiences allows for the development of robust systems that support human work. It is important to understand human limitations and abilities when designing a system or when trying to understand why errors are occurring within a system (Kuiper, McCreadie, Mitchell, & Stevenson, 2007).

**A**lthough the improvement rates in figure 14 are significant, 100% improvement is not achieved due to some extraneous variables including malfunctioning bar scanners, and human limitations such as nurse entry error and nurse distractions. If a bar scanner malfunctions, the nurse could manually enter a drug identification code into the computer in place of scanning. If an erroneous drug identification code is entered, a medication error could result. Another reason the 100% improvement rate has not been achieved is due to nurse distractions. If a nurse is distracted from the medication administration process, for example, after having scanned the correct patient and medication, he/she could lock the BCMA screen, exit the room to address an emergency situation, and return to complete the medication pass. Upon returning, if the medication nurse forgets to give the patient 2 Tylenol tabs of 325 mg strength to total the ordered dose of 650 mg, a medication error has occurred. The human factor is still present and can result in decreased error improvement from its 100% potential.

The top three types of medication errors prevented by a bar-code system-generated warning were constant: doses administered significantly earlier than scheduled, instances where the system had no record of a particular medication being ordered for a patient, and attempted administrations of





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medications whose order had been discontinued or expired (Schneider, Bagby, & Carlson, 2008).

**I**n comparing pre and post BCMA medication administration, it is vital to also consider essential issues such as authentication, security, and confidentiality. In pre BCMA, the medication administration record (MAR) was a piece of paper which had some serious flaws. With a paper MAR, one cannot authenticate who actually wrote on it. For example, if nurse A gave a medication before leaving home and forgot to sign it on the MAR, he/she could have called and asked nurse B to write nurse A's initials on the MAR, which is illegal and incorrect practice. With BCMA, nurse B cannot document the administration of a medication on nurse A's behalf. All BCMA users have been processed by Human Resource Department, fingerprinted, submitted for background checks, and have been subjected to independent credentialing verification prior to receiving a set of codes that are unique to each user (United States Department of Veteran Affairs-VISN 18 Phoenix VA Health Care System, 2008).

The implementation of BCMA has had a major positive impact on the daily practice of licensed nursing personnel, as identified in table 4 below. BCMA, since its initial implementation between 1999 and 2000, is well accepted by nursing staff as a patient safety tool (Coyle, Heinen, 2005).





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<b>Impact of BCMA on nurses</b>
— Nursing must transition from hand-written documentation to electronic documentation, requiring content and process analysis.
— Nurses need to develop computer skills to administer medications. The learning curve is modest when nurses have 24/7 on-site implementation support and help desk support during daily practice.
— Nurses have had input into software design to refine functionality, workflow and process issues necessary to logically accomplish their work.
— Nursing staff attend vendor fairs to choosing hardware since nurses can best define their practice needs.
— Nurses have participated in continued evaluation of medication administration practices.
— BCMA is a pure patient safety tool and is not designed to speed the delivery of medication administration.
— BCMA provides safety features for nurses and patients alike.
— <b>BCMA has been well accepted by nurses, due to the continued demonstration of benefits of patient safety.</b>

**Table 4. Impact of BCMA on nursing practice (Coyle, Heinen, & Hamilton, 2004).**

Lack of security and breach of confidentiality are other concerns with paper MARs. Paper MARs are often left in patients’ rooms, at nurses’ stations, or even inadvertently placed in the trash. In addition, anyone can have access to a paper MAR. On the contrary, with BCMA only the people who have been granted access to BCMA can view an electronic MAR. Furthermore, multiple users can access the medication administration information, decreasing interruptions to the medication nurse (Johnson, Carlson, Tucker, & Willette, 2003). In contrast, only one person can view and use a paper MAR at a time.

BCMA is a revolutionary use of technology to administer medication while decreasing medication errors. After comparing pre BCMA and post BCMA practices, it is evident that BCMA has created a safer medication administration





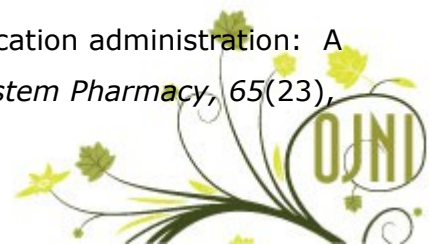
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environment for hospitals throughout the nation.

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### Authors' Bios

#### **[Valentin O. Rivish](#), RN, BSN, MSN**

Valentin is currently one of the Nursing Supervisors at the Phoenix VA Health Care System (PVAHCS), as well as a Nursing Instructor for University of Phoenix, and an Adjunct Faculty for the Nursing Division at the GateWay Community College. His previous positions at the PVAHCS include Clinical Applications Coordinator (CAC), Care Coordinator for the Care Coordination Home Telehealth (CCHT) program., Inpatient Case Manager, and Intensive Care Unit Nurse. As a CAC, he taught hospital-wide employees how to use the VA's Computerized Patient Record System (CPRS) and Bar Code Medication Administration (BCMA) software.

#### **Manolo D. Moneda, RN, BSN, MBA**

Manny is currently working as the Nurse Manager for the Emergency Department at the Phoenix VA Health Care System (PVAHCS). He also holds an Adjunct Faculty position in the Nursing Division at GateWay Community College. He is also in charge of Nursing Education and Training in the U.S. Air Force Reserves. Manny's previous positions at the PVAHCS include being a Clinical Applications Coordinator (CAC) for eight years, Nursing Supervisor, and Medical/Surgical Nurse. As a CAC, he implemented the roll-out of the Bar Code Medication Administration software at the VA. He was also instrumental in the development of standards of practice order sets in the Computerized Patient Record System (CPRS) at the VA.

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