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BarCode Medication Administration in ICU: Learning from Our Nurses

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Abstract

Errors during drug administration stage represent a significant percentage of adverse events associated with health care. Its prevalence is higher in critical care units, due to vulnerable patient population, characteristics of intensive care as well as complexity of pharmacotherapy. Errors can occur at any stage of the medication cycle although they often occur during administration, so nurses' role in prevention is essential. The bar code medication administration (BCMA) technology increases patient safety by instituting control time, but a poorly designed system or a faulty implementation can lead to low utilization in future. This paper describes implementation, evaluation, detection of problems and search for their possible solutions of a BCMA system in the intensive care unit at Hospital Italiano de Buenos Aires.

Keywords:

Patient Safety; Medication Systems; Medication Errors

Introduction

Patient safety has become a priority for health care systems around the world. Several studies have shown that morbidity and mortality caused by drugs are very high. Even more alarming issue is that this problem is largely due to errors or faults that occur during hospitalization [1-2]. (Leape, 1995) and (Bates et al., 1998) also indicated that drug-preventable errors occur more frequently in prescribing (56%) and administration (34%), and to a lesser extent in transcription (6%) and dispensation (4%). The easily intercepted errors were those that occurred in the early stages of the process, specifically prescription (48%) – of which 29% were due to lack of knowledge of the drug or that of the patient [3-4]. Other authors indicate that errors occur more frequently in the stages of preparation and administration of drugs, as well as 78% of medication errors leading to an adverse effect are due to failures in the prescription-dispensation-administration circuit, which could be optimized with the use of computerized information systems [7-8]. In intensive care unit (ICU), medication errors can occur in one-third of hospitalized patients and have the potential to cause permanent damage to patients, prolong hospital stay, and add to the associated emotional and financial costs [3-4]. Preparation and administration of drugs are the sole responsibility of nursing staff in most health organizations and hence we need to emphasize the importance of the safety culture. Furthermore, there are multiple causes for errors in preparation and pharmacological administration in hospital environment, such as: overload, lack of knowledge, human errors including inattention and defective work processes [9].

The bar code medication administration (BCMA) technology represents an additional strategy to prevent drug errors in the administration stage and an improvement in patient safety [3][6]. These systems have been shown to reduce errors of drug administration when used as a closed loop system,s where drug prescription, dispensing, and drug delivery processes are electronically linked [4] [6].

The BCMA system makes the drug administration process safer by reading the barcode on patient's identification bracelet and that of the medication pouches to ensure that the correct medication, in the correct dose, is administered to the right patient in the right way and at the right time [10]. The processes intermediated with barcode control, such as medication administration, contribute to patient safety through barcode technology and real-time network connectivity and are used to improve the accuracy of drug administration. This system is currently limited to environments equipped with computers, barcode readers at bedside, and compatible information systems [11-12].

The objective of this work is to describe implementation of a BCMA system and evaluation of its use in the ICU at Hospital Italiano de Buenos Aires (HIBA).

Methods

Setting

Hospital Italiano de Buenos Aires (HIBA), in Argentina, is an institution with 150 years of history, with over 2700 physicians, more than 1200 nurses, and 1800 administrative and support employees. It is a university hospital that covers the entire spectrum of health care from outpatient care, emergencies, acute care, medical and surgical specialties, critical care, home care, and chronic care. It encompasses a network of two hospitals with 750 beds (200 for intensive care), 41 operating rooms, 800 home care beds, 25 outpatient clinics, and 150 associated private practices located in Buenos Aires city and its suburban area.

The institution has been designing and building its own health information system since 1998 that includes clinical and administrative data. Its Electronic Health Record (EHR) system is an integrated, modular, problem oriented, and patient centered system that works in different clinical settings and allows computer physician order entry for medications and medical tests, storage and retrieval of tests results and images, and communication system. It is Joint Commission International (JCI) accredited and has been recently certified by the HIMSS as level 6+ in the Electronic Medical Record Adoption Model (EMRAM), being the first hospital in Argentina and the second in Latin America reaching this stage. The electronic nursing record was developed in stages since 2010. It is integrated in the EHR and organized by sections: Assessment, Diagnosis, Planning, Implementation and Evaluation. Nurses are expected to follow the nursing process logic to document the care provided.

The intensive care unit (ICU) consists of 38 beds, divided into four sectors according a severity criteria and therapeutic requirements of the patients. Rooms are individual for each patient and each one has a computer on wheels dedicated to the room. 100 nurses work in the area, distributed in 5 shifts (morning, afternoon, night A, night B, and weekend).

Design

Descriptive, observational study with quantitative and qualitative data analysis.

Area selection

Situation diagnosis: Different inpatient scenarios were surveyed during 2015, taking into account nurse-patient ratio, workstation locations, displacement spaces, and feasibility of diverse devices (computer/mobile). Finally, the ICU was selected because it had a specific bunker for preparation of medications, and also the ICU rooms are individual, each having a computer.

Equipment: Each room was equipped with a barcode reader with a usb cord because the distance between the computer and the patient was short (3-5 meters) and the usb type was less expensive than the wireless one. The area (called a bunker) for preparation of medications was equipped with label printers to identify medications.

Software Development

New Features: A medication preparation work list was initially developed in the EHR, where the medication preparer can filter the medication according to its sector, patient, route and schedule and print medication identification labels with QR codes ("Quick response" codes, a type of two-dimensional barcode) which contain the ID of the medical prescription, patient ID, drug, dose, route, and schedule. At the time of the medication administration, the data are checked against the identity of the patient by reading an identifying bracelet containing the data in the QR code. In addition, a new functionality was developed to record administration through barcoding, only visible in the EHR in the Adult Intensive Care Unit (ICU) and embedded in the administration section of the nursing e-chart. The barcode scanning of drugs is not available for 100% of the drugs administered to patients and hence the possibility of manually recording them remained available. This way nurses can choose the method they want to use.

Implementation

In-service Education and Training: Informatics nurses and physicians trained ICU nurses for all shifts. The bar-code scanner use and the new EHR feature were demonstrated. The new functionality was launched in April 2015.

Support: Support was provided in the sector during the first month after implementation to answer questions arising from the use, solve problems associated with the scanners and codes, and to train nurses who had been absent during the in-service training. In addition, the nurses had an institutional help desk for ordering.

Evaluation

Usage Rates: Queries were made to the database to know the barcoding (BC) frequencies in comparison to the manual records in the EHR in the following months after implementation.

The use of BC was always below the expected values compared to the manual ones, taking into account the drugs available for barcode scanning in our institution.

Survey and Operating Groups: An evaluation was made using the survey technique and operating groups (OG) for data collection in November of 2015. Two meetings were conducted based on a convenience sample with 30 ICU nurses. They were given a semi-structured questionnaire to evaluate how they felt about the BCMA system that asked about: ease of use, weight of scanner, system utility, interference with patient care, training, support, level of satisfaction with the system, and suggestions. The coordinators of the evaluation then proposed group reflection and discussion activities based on topics related to: a) BCMA benefits, b) problems associated with its implementation in the ICU, c) knowledge of process steps, and d) technical support.

The activities were carried out during working hours and in both meetings the nurses were separated into subgroups of 4-5 people who were given a paper and pen to take notes.

The data analysis included descriptive statistics and content analysis for observations and suggestions.

Results

248,091 records of medication administration were made in the EHR during 2015 – of which 63,741 were made by BC and 184,350 were made manually. 249,238 records of administration were made during 2016 – of which 118,059 were made by BC and 131,179 were made manually. Figure 1 shows the number of administrations with both methods by month for both the years. There are more records of administration carried out manually during 2015 versus with barcode scanners, with the exception of September 2015 when the records using BC were slightly higher. During 2016, there was an increase in BC records in the month of April and the period from July to October, with a decrease in November.

21 nurses answered the questionnaire. 58% had been working in the hospital for 1-10 years and 33% between 11-20 years. 62% belonged to the shift 'morning', and the rest from afternoon shift. 50% were within the range of 30-39 years of age. In addition, 76.2% had a bachelor's degree in nursing. 18 participants (95%) indicated that the BCMA system was Very easy/Somewhat easy to understand and 15 (79%) reported that it was Very easy/Somewhat easy to use. Regarding the ease of scanning the bar-codes, 13 respondents (68.5%) indicated that it was Very easy/Somewhat easy and 2 persons noted that it was Somewhat difficult (10.5%). 17 of the respondents (90%) Agreed/Somewhat agreed that the BCMA system was useful for their work. Regarding interference with patient care (awakening or discomfort), 7 nurses (37%) considered that it interfered with the patient, while 53% (10) indicated that it did so Little/Nothing. At the same time, 18 (95%) participants indicated that the system reduces the probability of medication errors. In addition, 14 nurses (77.8%) indicated that they had received training to use the system while 4 responded that they did not. 56.3% (11) indicated that system failures received technical support to solve it, while 37% (7) said no. Of the total respondents, 58% indicated that they were satisfied with the use of BCMA for medication administration while the remaining (42%) were moderately satisfied.

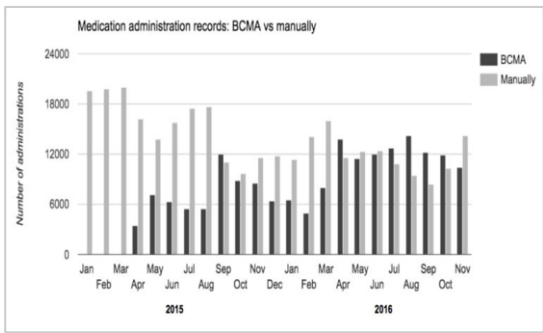

Figure 1– BCMA vs manually administrations

Three themes were identified related to: hardware, software, and process and infrastructure (including sub themes like training and technical support). Problems related to bracelets and difficulties in scanning the codes were reported. Other obstacles identified were: the slowness of EHR when the nurses choose to do administration with BC, the wires of usb scanners that drag over the floor and then pass over the patient's bed, which makes them unhygienic or they are unplugged when scanning the identification bracelets, so the process must be started all over again. Also the impossibility of scanning some medication such as the so-called 'multi dose' emerged, and those related to changes of the daily programmed medical indications. The most important findings are presented in tables 1-3:

Table 1– Hardware

Problems
'We must scan several times until we read the code (three attempts)'
'The legend "wrong patient" appears and does not decrease with the wristband replacement'
'The patient, the bracelet and the medications are correct and still shows that 'is not correct' and you have to reset the computer'
'Medications code is printed cut out'

Table 2– Software

Problems
'The system fails'
'The system slows down'
'After 5 PM, once the medical prescriptions' schedule changed, if you want to scan a drug label printed just before, you cannot, says incorrect'
'The bracelets are changed systematically on Tuesdays and Fridays but reading does not improve'
'The BCMA system does not record the minutes'

Discussion

The objective of this work was to describe the implementation of barcode technology for medication administration as well as the evaluation of its use in the adult ICU. 18 months after implementation, BCMA records continue to be lower than those manually recorded. They could not be 100% since we do not have the possibility to scan all medication labels, a factor to consider when implementing a BCMA system [13]. In those months where improvements were appreciated, it is due to greater monitoring and support in the area, associated with the processes of accreditation we were going through, similar to those during JCI audit (September, 2015) and the EMRAM-HIMSS certification process (April, 2016). Under such circumstances, each problem was solved by assigning specific personnel to the task. Also problematic computer equipment was replaced immediately, a practice recommended to avoid decreasing nurses' productivity while waiting for the equipment to be repaired [14]. But when that support is removed and supervision goes down, so does the barcode use. The reasons reported by nurses who give up its use are related to the findings of the evaluation, such as: inadequate reading of codes in the face of repeated attempts, failure of the scanners or the computer, delayed response of the help desk, discomfort caused to the patients, drugs that cannot be scanned. A mixed process (barcode and manual) slows the workflow for nurses, who then choose to do it only manually or by using the so-called 'shortcuts' [15], such as using a larger size code printed on a paper, instead of scanning it directly from the patient bracelet. Lack of improvement in the frequency of use of the BCMA system is probably because the reported problems have not yet been solved.

Table 3– Process and infrastructure

Findings and problems
In-service Training
'Reached with the training to use it'
Patient's Unit
'The computer carts are moved a lot and the wire is disconnected'
The wire:
● *'It is uncomfortable'*
● *'Is very long or is very short (without extender)*
● *'You may stumble (insecure)'*
● *'Gets dirty and then goes over the patient's sheets'*
"When the ICU was built it was not known that we would end up using BCMA, and the distance from the computers to the patient was not contemplated when installing them. Hence the idea of having wireless scanners "
Patient's discomfort
'When the patient is lucid and awake it is uncomfortable, it is annoying for the patient'
'It awakens him'
'If the patient sleeps, the second time it fails I do it manually'
Support
'They come sometimes'
'We ask for a 'help desk' but we do not have time'
'The help desk response is not immediate'
'I do it manually and then I ask for help desk'
'The help desk calls you after two days, is not immediate'
Miscellaneous
'During urgencies' we cannot record the medication'
'Some medication like syrups, creams, we cannot scan them (they have no code)'
'It's easy to use'

We do not have a support system to date that responds immediately to a failure to read a code, computer failure, or EHR freezes – this is a recommendation reported by the literature as good practice [14]. Our BCMA system has not

achieved the expected adoption, however, the attitude of the nurses in the ICU regarding the system as a whole is positive and they consider it useful and easy to use; an aspect that shows positive attitude towards the acceptance of a new technology [16].

We learned that if we want our nurses to adopt the BCMA system in their practice, we must improve it, looking for a solution to each previously reported problem [17].

We are currently reviewing the bracelet printing circuit implemented eight years ago for this purpose. We are also working to adapt the drugs labels that cannot yet be scanned by our BCMA system, such as "multi doses" (ointments, aerosols, syrups) and some "single dose" preparations (insulin) and evaluating the possibility of replacing scanners with USB cord with wireless ones. In addition, as the HIBA is working on the development of barcode reading for other products in addition to medication, such as human milk, blood, enteral and parenteral nutrition, a specific help desk for barcoding based systems is also being considered.

Conclusion

The adoption of a bar code reading system by nurses to verify patient identity and administer medication is influenced by different factors. The evaluation of all parts of the process, identification of associated problems and working on solutions according to recommendations could create greater adherence to barcode use and could have positive impact on patient safety.

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