Decreasing medication errors through bedside barcode scanning (BCMA): our patients deserve the additional safety barrier

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ABSTRACT: Administration is one the most error prone steps of inpatient medication use. Barcoded medication administration is used at most US hospitals, but limited in European hospitals. This is unfortunate, as this technology can decrease medication administration errors by 50%. To achieve the full benefit of this technology, BCMA requires the continuous monitoring of appropriate use and analysis of alert data.
Our approach is based on two pillars: making sure end users can seamlessly use the technology and that they will use it appropriately.

Introduction

St Jansdal Hospital, Harderwijk, is a 340-bed community hospital in the centre of The Netherlands with 17,350 clinical admissions, 85,000 first outpatient visits and 300,000 subsequent outpatient visits annually. The hospital's vision is to provide safe, effective and efficient care by fully harnessing the power of information technology. In November 2017, St Jansdal Hospital, Harderwijk was only the 4th hospital in Europe to be granted the HIMSS Electronic Medical Record Adoption Model (EMRAM) Stage 7 award. Stage 7 is the highest level of the EMRAM model and is a certificate of excellence for the effective adoption and widespread use of the Electronic Medical Record (EMR).[1]

A closed loop medication system is an essential part of the EMR. **Figure 1** illustrates the typical inpatient use of medication and summarizes how we optimize this cycle by applying the EMR. In this article, we focus on barcoded medication administration (BCMA).

The challenge

Administration is one the most error prone steps of inpatient medication use. In 8 out of every 100 cases, medication is not administered to the right patient in the right form, dose or route.[2] Barcoded medication administration (BCMA) is a mature technology and standard of care in hospitals in the United States. Already by 2013, almost 75% of all US hospitals had adopted this technology and an additional 17% were planning to implement it within the next 3 years.[3] Multiple studies have shown that, when implemented correctly, medication administration errors decrease by 50%.[4] A recent study by the Dutch Ministry of Health concluded that 47 deaths could be prevented annually in the Netherlands

alone if this technology was universally adopted.[5] However, another recent study showed that the full effect of BCMA on medication error reduction is often not achieved due to the emergence of many workarounds.[6] The authors conclude that BCMA needs more post-implementation evaluation.

We describe pre- and post-implementation strategies resulting in high barcode scanning compliance rates. In addition, we implemented a continuous quality improvement cycle to detect and fix workarounds so we can fully harness the medication error reduction potential of this technology (Fig. 2).

Our approach

We focused on two key aspects:

1. *Making it easy to do it right*. Keep the objective in mind, only implement the technology when it is relevant and feasible:

   a. Don't scan everything! We created an institution-wide BCMA policy describing where and what to scan. We only scan those administrations that present relevant patient safety risks due to the systemic effects of the medication. Therefore, we do not require barcode scanning of topical, ear, eye, nose and local administrations.

   b. Make full use of the electronic Medication Administration Record (eMAR). Highlight medication orders that do not require scanning on the eMAR, so nurses know which orders require scanning and which orders may be scanned.

   c. If barcode scanning is required, make sure the items in question are barcoded from the start of the project.

FIGURE 1: INPATIENT MEDICATION MANAGEMENT PROCESS AND INFORMATION TECHNOLOGY
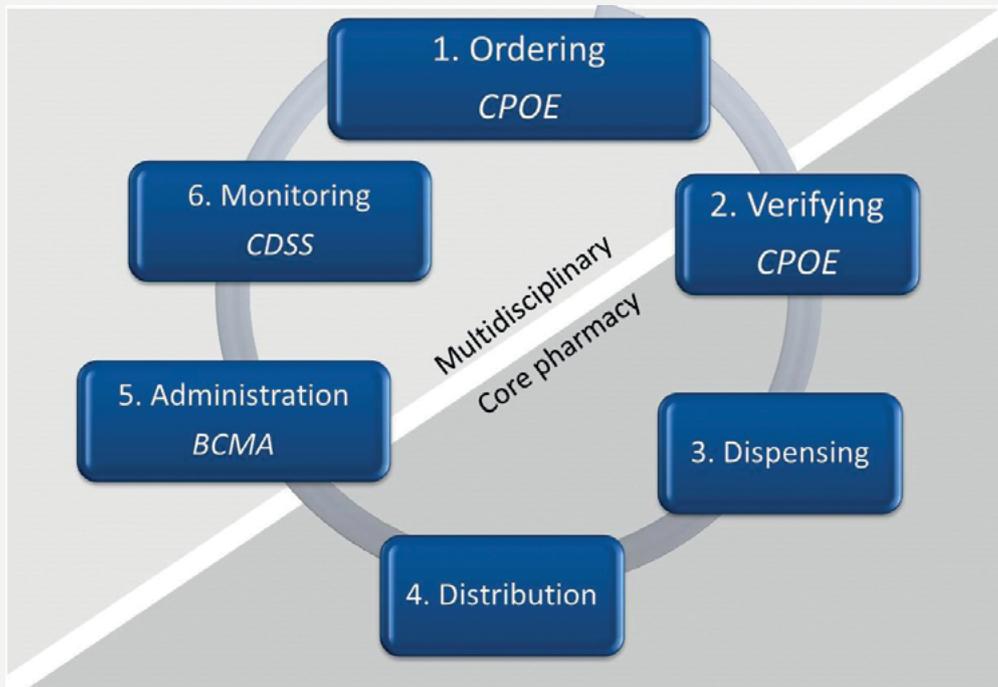
Source: HIMSS Guidance document: "Costs, Benefits and Potential Unintended Consequences of Automating the Pharmacy Medication Cycle in Acute-Care Settings" 2010.

Available from: https://www.himss.org/system/files/Downloads/PharmacyGuidanceDocumentAcuteCareSetting.pdf

CPOE: Computerized Provider Order Entry
BCMA: Barcoded Medication Administration
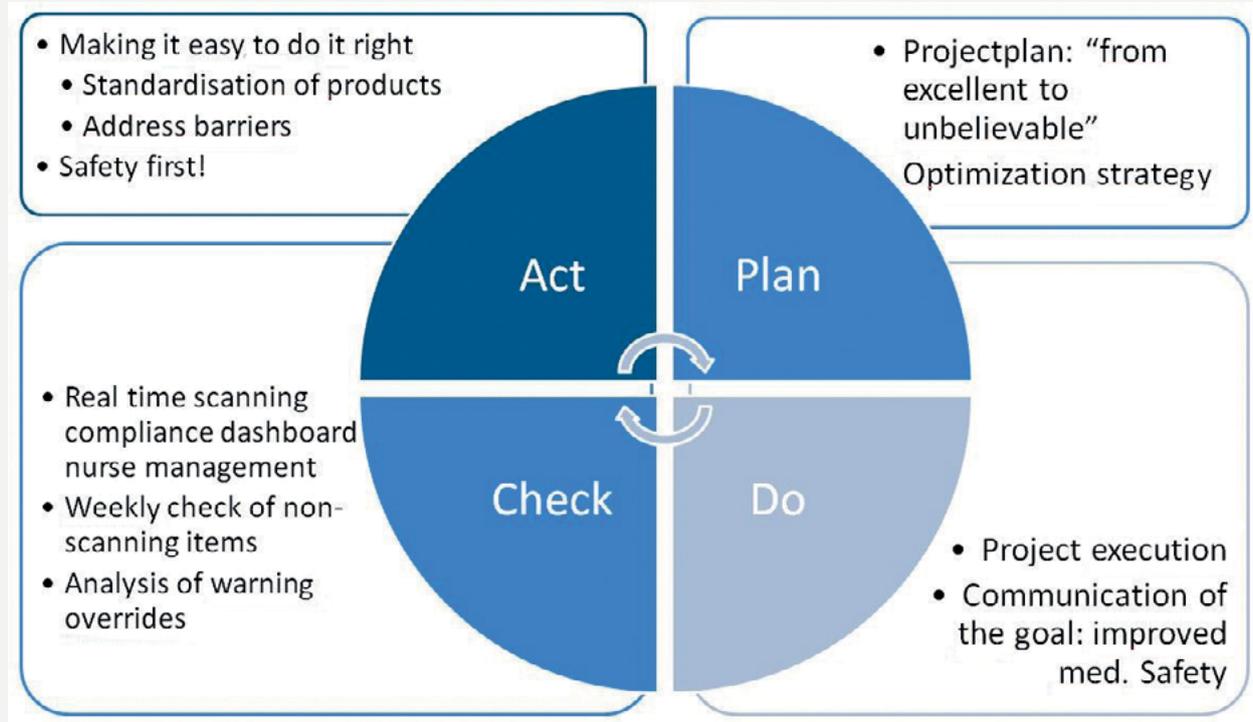*CDSS: Clinical Decision Support System*

We used a mobile printer/scanner combination which allowed us to barcode medication stock on the floors and in our Automated Dispensing Cabinets prior to go-live.

4. Create custom barcodes for the primary package (individual tablet/capsule) based on the secondary package. These barcodes are already loaded onto our EMR through our national G-Standard medication loading system, which eliminates the need for the custom "mapping" of barcodes.

2. *Safety first, so adhere to our policies and procedures!* Our institutional BCMA policy is the basis of our BCMA implementation. We created a nurse manager BCMA compliance dashboard which shows daily BCMA compliance for each ward. The dashboard also has a preformatted pivot table which ranks nurses by lowest to highest BCMA compliance and is used by managers to provide direct feedback to their nurses. Last, we use the dashboard to provide feedback to the user when relevant alerts have been ignored.

Our results

1. We achieved 95% patient identification and 90% scanning compliance at go-live (12% higher than other BCMA adopters using the same EMR in the Netherlands).

2. Continuous post-implementation feedback increased medication scanning compliance by an additional 6% to 96%.

3. BCMA prevented 654 medication administration errors in 50,254 administrations during the first month after going live.

4. Continuous focus on nursing workflow resulted in a reduction of the number of alerts/10.000 administrations by 16%, from 403/10.000 administrations at go-live to 340/10.000 administrations in September 2017.

5. Continuous data monitoring showed 42 overrides of relevant alerts in one month and highlighted several workarounds and system errors (Tab. 1).

6. Nursing staff appreciate the continuous feedback and the focus on the goal of BCMA (e.g. zero BCMA preventable medication errors).

FIGURE 2: BCMA SCANNING COMPLIANCE OPTIMIZATION

Act
- Making it easy to do it right
- Standardisation of products
- Address barriers
- Safety first!

Plan
- Projectplan: "from excellent to unbelievable" Optimization strategy

Check
- Real time scanning compliance dashboard nurse management
- Weekly check of non-scanning items
- Analysis of warning overrides

Do
- Project execution
- Communication of the goal: improved med. Safety

Source: St Jansdal Hospital. Scanning Optimization Quality Improvement Process

TABLE 1. MOST FREQUENTLY OCCURRING SCANNING ISSUES AND WORKAROUNDS

Type	Issue	Cause	Fix
Workaround	A duplicate print of patient wristband is scanned instead of the actual band worn by the patient.	Easier Didn't want to wake the patient	Periodic audits and direct feedback to nurse and nurse manager: a patient sleeping is not a valid reason for deviating from a safety measure
System issue	Medication scanning compliance is low at night and high during daylight	Scanner laser light is bright and always on	Setting on scanner: fixed.
System issue	Multiple "barcode does not scan" alerts for products that normally scan perfectly	Caps Lock key on keyboard is on: barcode is case sensitive	Setting on scanner to ignore Caps Lock on keyboard: fixed.
System issue	Patient has order for combination product, ingredients are given separately	Formulary constraints	Addition of most frequently occurring items to the formulary and EMR pop-up to change order to individual ingredients at admission

Source: St Jansdal Hospital Electronic Medical Record Source Data.

Lessons learnt

1. You have only one chance to make a first impression: use a mobile scanner-printer solution to quickly barcode ALL your floor stock so almost everything scans upon go-live.
2. BCMA implementation does not stop at go-live, it requires continuous focus on medication administration safety.
3. Create a preformatted dashboard which can be easily accessed by nurse managers and team leaders.
4. Use the dashboard to make it even easier to do it right: the EMR is a great source for finding and addressing workarounds and non-adherence cases.
5. Praise your nurses, they deserve it! The do the hard work, so keep focusing on supporting nursing workflow.
6. Scan relevant medications ONLY!

Conclusions

Barcode scanning at the bedside is a mature technology and has the potential of decreasing the number of medication administration errors by 50%. This article outlines our efforts to correctly implement this technology and continuously monitor its use.

However, the biggest drawback for institutions against adopting this technology is the lack of a barcode on the primary unit of dispense (e.g. the individually packaged tablet) in about 20% of the products found in the hospital pharmacy. Based on the secondary barcode (the one on the outer box), our hospital pharmacy manually affixes barcode labels to each individual tablet, ampoule etc. that does not contain a barcode, which is labour intensive. In addition, the barcodes of 80% of barcoded medications are not standardized, they are sometimes poorly readable and need to

be manually linked to the right product in the EMR ("mapping"). Indeed, barcode scanning technology can be implemented more rapidly and effectively if two conditions are met:

1. A standardized barcode is part of the labelling of every primary package; the GS1 standard is a great example of how standardization leads to further efficiency gains. This barcode standard also includes a lot number and expiration date, making inventory control and expiration date checking possible with a single scan.
2. The barcode data of the primary package is part of the EMR's drug information database update that is already performed monthly.

Even with the aforementioned drawback, we have demonstrated that barcode scanning can already be implemented effectively and efficiently. Let's not wait any longer and prevent patient harm by introducing an additional electronic barrier between medication errors and our patients. They deserve it!

Biography

Pieter Helmons, Ph.D, MAS

From 2007-2011 Pieter Helmons was the Pharmacoeconomics Specialist at UCSD Medical Center in San Diego, California. Since 2011, Pieter Helmons works as a hospital pharmacist at St Jansdal Hospital Harderwijk, The Netherlands. He obtained his PhD in Pharmacy Informatics in 2014 and is recently appointed as the Chief Pharmacy Informatics Officer (CPIO).

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