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Automating Code Tray Management

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Effective emergency medication trays, also known as code or crash cart trays, are vital to ensuring an appropriate and timely response to patient emergencies within acute care facilities. While it is not unusual to take these trays for granted during the routine drug delivery process, they receive full attention in emergency situations when a matter of seconds can determine a patient's outcome. When emergency medication trays are readily available, appropriately organized, and well maintained, their facilitation of rapid and accurate usage of medications can be life-saving. West Virginia University Hospitals (WVUH) is a 543-bed academic medical center located in Morgantown, West Virginia, that spans three acute care facilities and multiple outpatient clinics throughout the greater Morgantown area. In total, 110 medication code carts are utilized throughout the hospital, each stocked with approximately 60 drug products comprising 28 different medications.

Improved Efficiency and Accuracy

Utilizing the automated code tray technology at WVU Ruby Memorial Hospital. Following the introduction of bar coding technology to the process, the efficiency and accuracy of code tray processing improved dramatically.

Manual Stocking Process

Historically, the processing of a code tray at WVUH was separated into two parts: filling and verification. To fill an emergency code tray, pharmacy technicians followed a paper checklist of medications and quantities to be stocked in each tray. The pharmacy technician documented each medication and its expiration date while moving through the checklist. Drugs expiring within 3 months were removed from the code trays, unless other options were unavailable. Once each medication was stocked and the expiration date recorded, the pharmacist checked the emergency medication tray to ascertain that the medications, quantities, and expiration dates were all correct. Following verification, the entire tray was sealed in a tamper-proof, amber bag along with the completed checklist and two identification lock ties. Finally, each paper checklist was filed and retained for at least 1 year.

As code carts were brought to the pharmacy for a code tray refill, the pharmacy technician unwrapped a prepared code tray and replaced the used or expired code tray within the code cart. The technician recorded the cart number and date, and then initialed the checklist, which was stored for accurate record-keeping. The technician also was responsible for recording the cart number and identification lock tie numbers in the emergency code tray log.

Evaluating the Need for Process Improvement

Manually filling the crash cart trays felt cumbersome and disorganized, which prompted a discussion about ways to improve the process. In order to

FIGURE 1

Pharmacist and Technician Satisfaction Survey Results

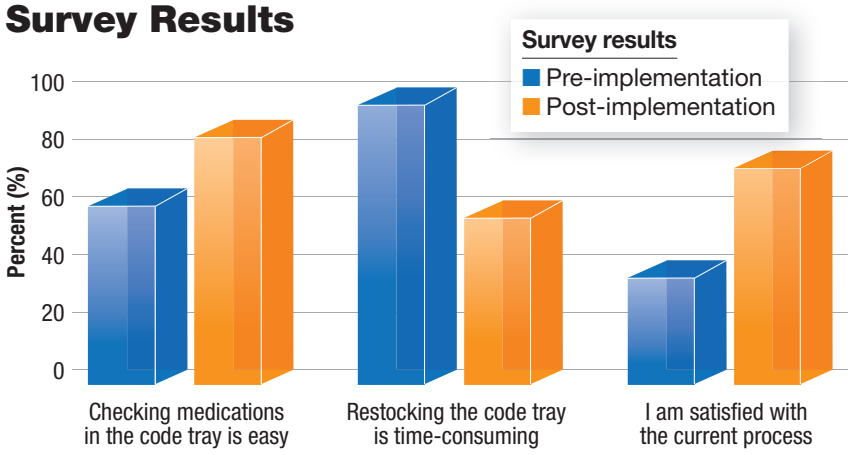
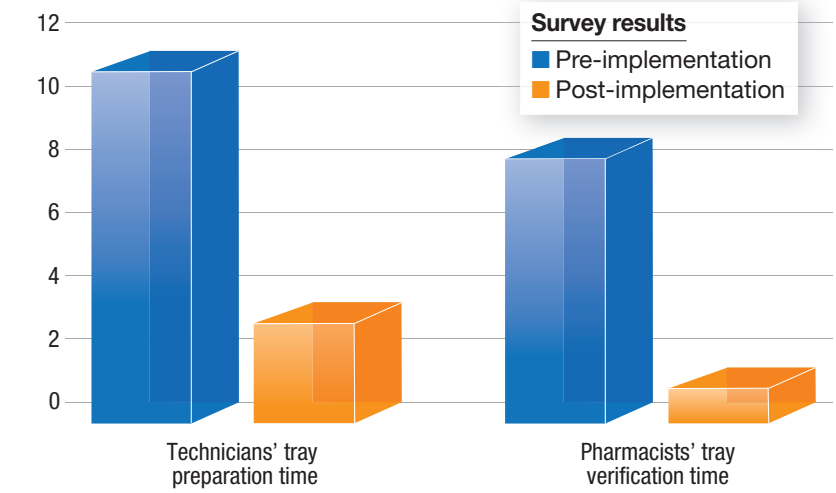


FIGURE 2

Time Study Results (in minutes)



qualify a true need for process improvement, the manual practices were evaluated via two methods. First, time studies were conducted to quantify the amount of time spent filling and verifying code trays. We calculated the average number of code trays processed per month and the amount of time devoted to processing each code tray. Over the course of 6 months, the department of pharmacy processed 416 code trays for a mean average of 69 code trays per month.

To get an accurate picture of pharmacy's practice, seven different technicians were timed while filling a total of 15 code trays. The average time for filling code trays was 11:00 minutes (with a range of 5:55 to 18:11). A total of 16 expired and 72 used medications were replaced within these 15 code trays. Additionally, 10 different pharmacists were timed during the verification process covering a total of 22 code trays. The average time for verifying the accuracy of the code trays was 8:32 minutes (with a range of 3:56 to 17:30). Fourteen errors, including incorrect, missing, or expired medications, were found and corrected by the pharmacists during verification of the 22 code trays.

For the second step in the practice evaluation, satisfaction surveys were distributed to both pharmacists and technicians. The surveys used a Likert scale and measured pharmacists' and technicians' satisfaction with the tray processing method. The five Likert terms used ranged from agree to disagree. A total of 38 pharmacists and 26 technicians responded to the survey. The results of the surveys are depicted in **FIGURE 1**. While the majority of pharmacists felt that checking medications in the code tray was easy (62.5% "agreed" or "somewhat agreed"), they did not respond positively to the survey question regarding satisfaction with the current code tray-filling process (26.3% were neutral and 44% somewhat disagreed or disagreed with being satisfied). Nor did technicians respond positively to this question, with 26.9% being neutral and 27% somewhat disagreeing or disagreeing. Additionally, over 95% of pharmacists and technicians agreed that the process for restocking medications was time-consuming.

Implementing Bar Coding Technology

Results from the time studies and the employee survey suggested that an alternative approach to processing code trays that saved time and improved satisfaction would be beneficial. For this reason, it was decided that a tray management system utilizing imaging and 2D bar code labels would be implemented at WVUH. We chose this approach based on the ease of use of the software, the cost of implementation per tray, and feedback from other institutions utilizing various tray management programs. Recognizing that process change can be disruptive, training on the new technology was emphasized for all involved staff. Prior to implementation of the new system, a user guide was created for technicians and pharmacists to help them understand the new software. Training sessions also were organized to introduce the new technology and provide demonstrations of how to process code trays from the perspective of both technicians and pharmacists.

Under the new process, pharmacy technicians place 2D bar code labels on each medication and file them into stock bins containing a bar code storing lot number, expiration date, and medication name. When filling a code tray, the pharmacy technician places medications into the code tray following the pre-defined layout. Once each medication is in the correct position, the pharmacy technician uses the computer system to initiate an image scan for each bar code to be read. The system alerts the pharmacy technician where expired or incorrect medications are located within the tray. Since each bar code contains an expiration date and lot number, there is no longer a need for the pharmacy technician to manually record these. Once the tray is approved through the software management system, the pharmacy technician prints out a report of each medication with the earliest expiration date. The tray, report, and lock tags for the code cart are then given to the pharmacist to verify.

The verification process for the pharmacist is still manual; however, the report printed by the technician confirms for the pharmacist that each required medication is located within the tray, each medication is the correct size and concentration, and all medications are in the correct location. There is no longer a need for the pharmacist to individually check each medication; instead, the pharmacist verifies that no miscellaneous medications were placed in the code tray, as any items without a bar code would not register on the automated system. As an additional safety check, the report supplied by the pharmacy technician cannot be printed unless the bar code reading confirms 100% accuracy.

Measuring Process Improvement

The time studies and surveys were repeated after the new code tray technology was implemented, and the results were instructive. The average time for technician preparation of code trays was reduced from 11:00 to 3:34 minutes (with a range of 1:40 to 4:43). A total of one expired and 47 used medications were replaced within the 12 code trays. The average time required for pharmacists to verify the accuracy of the code trays was reduced from 8:32 to 1:14 minutes (with a range of 0:28 to 2:10). The differences between the pre- and post-implementation tray processing times are illustrated in **FIGURE 2**. No errors were found by pharmacists during the code tray verification process, which is a significant improvement over the original 14 errors discovered during the manual preparation of 22 code trays. A total of 38 pharmacists and technicians took the post-implementation survey (see **FIGURE 1**). In the opinions of both pharmacists and technicians, real improvements were made in the ease, time, and overall satisfaction of processing code trays.

Expanding System Utility

The original code tray process at WVUH was time-consuming and the pharmacists typically discovered numerous errors during the verification process. Following the introduction of bar coding technology to the process, the efficiency and accuracy of code tray processing improved dramatically. Pharmacists and technicians are more satisfied with the new code tray process, and processing times have been reduced by over half.

Moving forward, we plan to expand the utility of the code tray bar code technology. The system has the capability to track and monitor each medication within a code tray by its lot number and expiration date. Implementing this capability would allow us to monitor each medication by its specific location, thus decreasing the number of expired medications within the code trays each month. As an added benefit, this tracking feature will allow for rapid identification of medications in the event of drug shortages or recalls. ■

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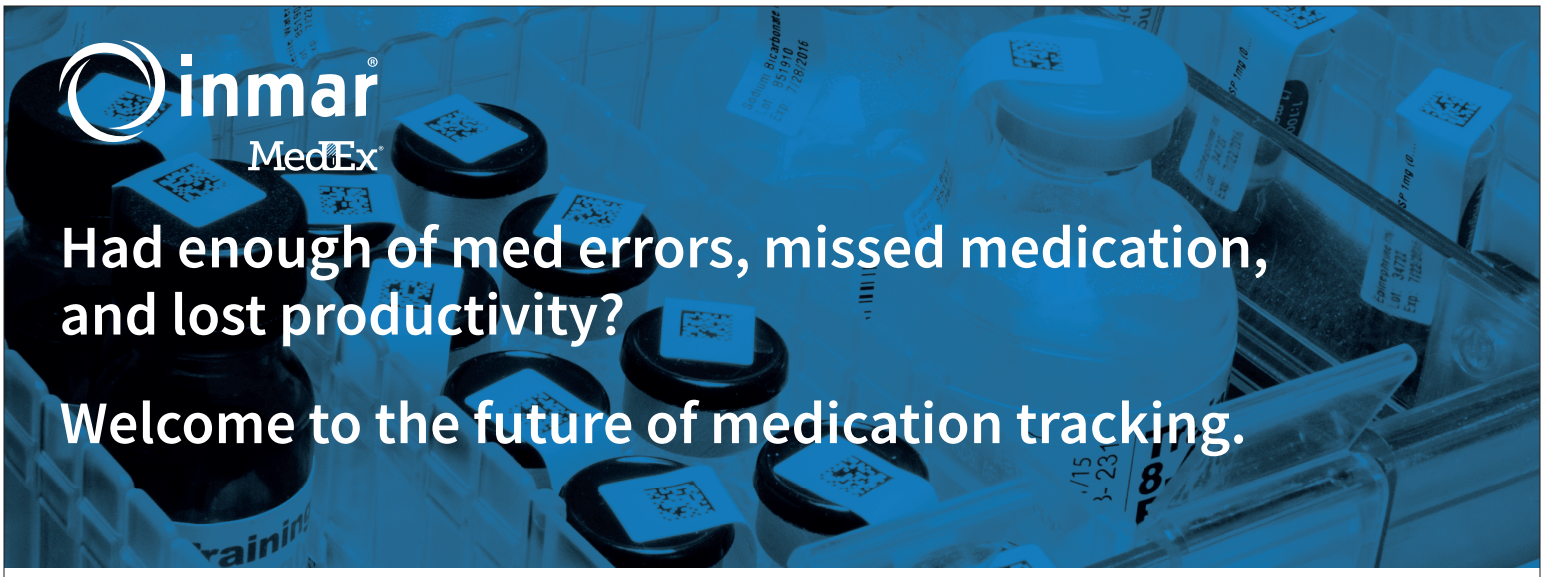

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