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Title of project: Safety and Efficiency of Workflow Automation in Medication Tray Verification

Course title: PHPR 862, PHPR 896A, PHPR 896B

Date: 4/6/20

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ABSTRACT

Specific Aims

The purpose of this study was to determine the impact of using barcode assisted automation in the medication tray verification process on efficiency and error rates.

Methods

The time required to prepare a medication tray was initially recorded. This was followed by a secondary employee reviewing the tray and recording medication errors in the tray. Following the implementation of the automation system, the time for each tray preparation was logged by the system and trays were randomly audited for errors via convenience sampling.

Main Results

Automation produced an elimination of all observed errors, which can be quantified as an estimated mean reduction of 6.86 errors per day (95 percent CI, 6.53 to 7.19 errors, p-value of 0.00017). Additionally, efficiency in tray preparation improved with a mean reduction of 38.5 seconds per tray (p-value of 0.0003).

Conclusions

Automation proved to improve both safety and efficiency during the tray verification process. The number of errors found in the trays were reduced significantly after the implementation of the barcode assisted automation system.

INTRODUCTION

Medication trays, or simple trays filled with particular medications, act as an organization tool allowing for reliability and easy access to commonly used medications during high-risk situations within hospitals. These situations range from codes to anesthesia. They are utilized because safety and speed of availability are of the utmost importance when it comes to these medications and the situations that require them. These trays need to be checked to ensure that all of the medications are there and that they are all appropriate to be used. These checks typically occur periodically for unused trays and then after each use.

Verifying code trays is an essential safety step, where pharmacists will go through and verify that the right medications are in the tray and that they aren't adulterated or expired. This process is often time-consuming and doesn't always mitigate errors. Used or expired medications may be accidentally left in the tray or others may be left off the tray altogether due to human error. If errors exist in the trays, this introduces the possibility of harm to the patient. The patient may have an expired or adulterated medication administered to them or they could urgently need a medication that isn't readily available when it should be.

Automating this process of tray checking could reduce errors and the time required to prepare the medication trays. By introducing barcoding to this element of the process, technological stops can help catch items that may be missed by an individual manual check. This study is intended to evaluate the impact of the technological intervention of item-specific barcoding and scanning on the error rate and time to check the medication trays.

METHODS

Design: This study used a pretest-posttest design to determine the impact of a barcoding system on anesthesia tray preparation and verification.

Subjects: Trays were included in our sample if they were prepared and verified by pharmacy staff during either the pre or post periods and logged either on the paper forms in the pretest or in the electronic system during post. A sample of 80 trays was audited in post at random intervals using convenience sampling. Trays not included in any of the above groups were excluded from the study.

Intervention: The intervention for this study was the implementation and use of the barcode assisted automation system. Barcodes were affixed to medications that were to be included in the preparation and use in anesthesiology trays. These barcodes were linked in the barcode assisted automation system with the corresponding medication. Post-implementation, the trays were scanned electronically for any missing or expired medications rather than being checked manually by an employee.

Measures: Over a 22 day period prior to the implementation of the barcode assisted automation system, employees reported time spent and errors found in preparing medication trays. Time reporting was done using a modification of an existing check form, with the addition of end times to characterize total time spent. The time spent to prepare a medication tray initially was reported as time, in minutes, to prepare a batch of trays. A second, verifying employee reported the number of errors found during their check as a cumulative tally over the course of the day. Following the implementation of the automation system, over a 22 day period, the time for each tray prep was logged by the system, and trays were randomly audited for errors via convenience sampling. Copies of both the error log and time to check form are available in the appendix.

Data Collection: Time required to check trays was recorded by staff performing tray checks as time started and time completed in the pre-intervention phase, and by the barcode assisted automation

system in the post-intervention phase. The error incidence was recorded as a tally by the staff member performing the second check-in pre-intervention, and by the auditor in the post-intervention phase.

Data analysis: Daily means were calculated for tray preparation time in pre- and post-intervention. Error rates were reported as an incidence of errors reported as a percentage of trays checked. The p-values for the measured outcomes were calculated using a two-tailed t-test for difference in average time per tray preparation and a difference in error rates.

RESULTS

During the pre-implementation period, 854 trays were checked, with an average time to check of 81.6 seconds per tray (95 percent CI, 78.9 to 84.3 seconds). During that period, 96 errors were identified, an error incidence of 0.1124 errors per tray checked.

Post-implementation, 1343 trays were checked, with the average time to check dropping to 43.1 seconds per tray (95 percent CI, 42.0 to 44.2 seconds) and no errors, 0 errors per tray checked, were identified in the 80 trays audited.

Additional results are summarized below in table 1.

Table 1: Summary of Results	**Mean Time to Check per Tray (sec)**	**Error rate in errors per tray (%)**
Pre-Implementation	**81.6**	**11.24**
Post- Implementation	**43.1**	**0.00**
Difference	**-38.5**	**-11.24**

Automation produced an elimination of all observed errors, which can be quantified as an estimated mean reduction of 6.86 errors per day (95 percent CI, 6.53 to 7.19 errors, p-value of 0.00017). Additionally, efficiency in tray preparation improved with a mean reduction of 38.5 seconds per tray (p-value of 0.0003).

DISCUSSION

The most important finding in this study was the impact that the automation had on the safety of the tray verification process, reducing error rates to near undetectable levels. Efficiency in tray preparation was likewise improved after the implementation of the barcode scanning system. Cercere et al.[1] showed that implementation of an automated barcode scanning system reduced time for code tray preparation and reduced errors to an undetectable level. However, their study was performed at a small regional center with a small sample size of only 22 trays.

This study has several implications regarding the implementation of automation in the medication tray verification process. Primarily, the reduction in errors offers a lot of promise when it comes to medication safety and reducing errors in a hospital setting. The barcode assisted automation system added a level of consistency with verification that proved superior to the former processes. Also, there was a decrease in the amount of time utilized for each individual tray. Further research is needed to understand the impact of this implication from a facility-wide level, but from a narrow scope, the efficiency of the process itself was improved.

There were several limitations to this study. First, the project scope did not account for time spent preparing and barcoding items prior to placement in the trays. Therefore, it cannot be determined whether the automation process saved time overall when considering the time invested outside the actual process of tray preparation. Further, due to the loss of a data collection form, the original study period had to be reduced from 30 days to 22 days. Additionally, due to the reliance on manual identification of errors, error rates are likely higher than reported, especially during the preliminary phase. Lastly, the data is limited to a single hospital.

CONCLUSION

Automation in the tray verification process proved to improve both safety and efficiency. The number of errors found in the trays was reduced significantly after the implementation of the system. There was also a significant reduction in the average time to check each tray post-automation implementation, however additional research is needed to assess the overall time comparison accounting for preparation time required with the system.

REFERENCES

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APPENDICES

Data Collection Forms

A-Tray Check Error Log

Date	# of Misplaced Meds	# of Missing Meds	# of Expired Meds	# of Contaminated /Used Meds*

OR Tray Refill and Check Log

# of Tray	Date	First Check	Start Time	End Time	Double Check	Start Time	End Time