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Exploring the impact of an automated prescription-filling device on community pharmacy technician workflow

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Abstract

Objective—To explore community pharmacy technician workflow change after implementation of an automated robotic prescription-filling device.

Methods—At an independent community pharmacy in rural Mayville, WI, pharmacy technicians were observed before and 3 months after installation of an automated robotic prescription-filling device. The main outcome measures were sequences and timing of technician workflow steps, workflow interruptions, automation surprises, and workarounds.

Results—Of the 77 and 80 observations made before and 3 months after robot installation, respectively, 17 different workflow sequences were observed before installation and 38 after installation. Average prescription filling time was reduced by 40 seconds per prescription with use of the robot. Workflow interruptions per observation increased from 1.49 to 1.79 ($P = 0.11$), and workarounds increased from 10% to 36% after robot use.

Conclusion—Although automated prescription-filling devices can increase efficiency, workflow interruptions and workarounds may negate that efficiency. Assessing changes in workflow and sequencing of tasks that may result from the use of automation can help uncover opportunities for workflow policy and procedure redesign.

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Keywords

Automation; community pharmacy; task analysis; dispensing

Many community pharmacies have implemented automated prescription-filling devices to help improve overall efficiency. Studies have shown reductions in medication errors and improved technical competence of pharmacy staff in pharmacies using automated devices.^{1,2} Automation also has been associated with higher prescription volumes per full-time pharmacist and fewer technical dispensing tasks being performed by pharmacists. This illustrates the possibility of automated dispensing systems to improve pharmacy workflow, increase accuracy, and eliminate the need to hire additional support staff as prescription volumes increase. However, staffing adjustments must be anticipated and made in order to take full advantage of any gained efficiency, as reported in one study assessing the effects of automation in community pharmacy.³ The study found that although prescription-filling time decreased significantly with pharmacy automation, the percentage of time spent on nondispensing activities increased. Pharmacy automation also was found to decrease time spent by pharmacists on prescriptions while increasing that required by technicians, therefore requiring adjustments in pharmacy staffing to accommodate the new system.

The most comprehensive types of automated dispensing systems used in community pharmacies today are robotic devices integrated with pharmacy computer software; the devices are capable of counting, packaging, and labeling dosage forms. Although these capabilities allow for increased prescription-filling efficiency, automation surprises and errors in the workflow may be introduced in the presence of pharmacy robotics.⁴ Further, it has been demonstrated that health care workers may still choose to work around established sequences of workflow steps even when robotic systems are being used.⁵

Objective

The objective of this study was to explore changes in pharmacy technician dispensing duties as a result of robot implementation, with a specific focus on aspects of efficiency in workflow sequences.

Methods

Automation and setting of study

The robotic device used in this study was a Parata Max (McKesson) that contained more than 200 individual cells to store frequently dispensed medications. Medications not stored in the robot primarily consisted of those less frequently or not easily dispensed by the robot (e.g., unit or carded doses, blister packs, suspensions). The study site was one community independent pharmacy in rural Mayville, WI, that dispensed an average of 350 prescriptions daily. Pharmacy workflow was well defined using distinct roles for each pharmacy technician (Figure 1). On a typical day, full-time employees (i.e., those working 40 hours per week, or five 8-hour shifts) included three pharmacists and four to five technicians. The only staffing change that occurred between the two observation periods was the replacement of one full-time technician with a new employee. All staff received equal robot training, except for a few pharmacists and technicians who were designated as “robot specialists” and received slightly more extensive instruction.

Data collection techniques

Data collection and analyses were performed and developed by one community pharmacy resident affiliated with the pharmacy of study. Before data collection, a standard observation

form was developed to map out all possible sequences of steps pharmacy technicians used to fill prescriptions. Before official observations were made, institutional review board approval was obtained. Pharmacy technicians were informed of the project purpose and were not identified during the observations.

Data collection occurred during two time periods: 5 weekdays before robot installation in October 2008 and 5 weekdays 3 months after robot installation in the third week of January 2009. Timing for postinstallation data gathering was chosen to allow for training to be conducted and workflow to stabilize after implementation of the robot. Approximately 10 random blocks of time 2 to 3 hours each were chosen during each of the two 5-day observation periods, based on when the pharmacy resident was able to step away from daily duties. Direct observations were made of pharmacy technician tasks using the observation form and a standard noiseless stopwatch. A second observation form was developed for the postinstallation data collection period to reflect modified workflow steps and sequences used as a result of robot implementation.

The unit of analysis was the basket of prescription order(s) requested by a waiting patient. Data collected included:

- Sequences of workflow steps.
- Time (in full seconds) for each step and overall sequence of steps.
- Number of prescriptions per basket.
- Prescription type (all new, all refill, or a mix of new and refill prescriptions).
- Workflow interruptions, defined by the researcher as actions made outside of the normal workflow steps identified in the flowchart (i.e., any event that slowed or caused a block in technician workflow).
- Automation surprises (i.e., robot nonfirings after computer entry, requiring technician manual fills using the robot's touch screen).
- Workarounds, defined as deviations from explicitly described policies in the pharmacy's technician manual.

Timing started upon pharmacy technician computer entry and ended upon placement of the basket for pharmacist verification.

The average time to fill one prescription was obtained by dividing the total observation time by the number of prescriptions per basket per observation. A *t* test was used to determine the difference between pre- and postinstallation period average filling times and to compare the rate of interruptions per observation. Statistical significance was determined a priori at $\alpha = 0.05$.

Results

Workflow sequences and times

A total of 77 and 80 observations were made before and after robot installation, respectively. Different workflow pathways used by technicians are represented in Figure 2 as different letters sequenced in the order in which they were observed. A total of 17 and 38 sequences were observed during the pre- and postinstallation periods, respectively. The robot was used in 45% of the postinstallation observations, represented by an inclusion of step L (drug[s] pulled from the robot), N (drug[s] pulled from both the robot and the shelf), and/or P (manual fill from the robot). Refill orders most often represented the top 25% quickest pathways in both observation periods. However, the top three most frequently used

pathways both pre- and postinstallation often did not coincide with the most rapid pathways identified. Finally, the robot was found to be involved in all of the top 25% quickest postinstallation pathways observed.

Of the various pathway sequences used to fill prescriptions, more pathways used shorter average prescription-filling times post- versus preinstallation, and less outliers exist in longer time periods in the post- versus preinstallation period (Figure 3). Although postinstallation average prescription-filling time was reduced by 40 seconds per prescription, this difference was not significant ($P = 0.097$; Table 1).

Workflow interruptions

The number and type of interruptions observed during each observation period are described in Figure 4. Although the average number of interruptions per observation was increased from 1.49 to 1.79 with use of the robot, this difference was not significant ($P = 0.11$). The top one-third of the interruption types observed in both the pre- and postinstallation periods involved technicians answering the phone, having to pose questions to the pharmacists, questions being asked by another technician, socializing with another technician, working on a prior order that may or may not have been of equal time priority, and assisting a patient not involved in the current order. Whether these interruptions were directly related to the robot was not assessed.

Individual workflow steps also were identified in which interruptions occurred. Notable differences included a reduction of step D interruptions (i.e., those occurring while an entry technician was entering a new prescription and pulling a shelf drug in the same step) by 21%. The robot also decreased step I interruptions (i.e., those occurring while a filling technician was packaging an order, making some use of the Kirby Lester manual counting device) by 17%. Finally, step G interruptions (those occurring while prescription[s] were already entered and waiting on the counter to be completed by the filling technician) were increased by 21%.

Automation surprises

Pharmacy technicians were found using robot manual fills (step P) during 5% of the observations. Although some of these nonfirings were attributable to the robot (i.e., miscounts, jams), most others were later found to be related to certain keystroke patterns used by technicians, especially if rebilling or reprocessing of an order was required. Further, it was later discovered that regular robot and/or computer software updates could help remedy some of the unexpected nonfirings that could not be related to specific keystroke patterns.

Workarounds

The only workaround observed involved steps that entry technicians used when processing new prescription orders. Per pharmacy policy both before and after robot installation, entry technicians were expected to pull drugs stocked on the shelf during the order entry process both to aid them in prescription entry and to have the medications ready for packaging. Therefore, a workaround occurred whenever entry technicians used step C (i.e., entry of new prescription without pulling shelf drugs). This deviation occurred 10% and 36% of the time pre- and postinstallation, respectively.

Discussion

Robot presence in the community pharmacy has been shown to increase the complexity of prescription-filling steps used by technicians, as demonstrated by an increased number of

pathways used. This likely is caused by the increased number of locations in which technicians can gather medications, thus increasing the number of possible workflow steps. Despite this increased workflow complexity, the robot has demonstrated an increased prescription-filling efficiency based on reduced overall prescription-filling times. However, the lack of statistical significance of this time difference proves the need for further study of how this change affects community pharmacy demands.

The fact that the robot was used during less than one-half of the observations may be because only waiting prescription orders were observed. The majority of medication types used during the observations were likely for new/acute prescriptions (e.g., miscellaneous antibiotics including oral suspensions, narcotics) instead of maintenance medications that tend to be stocked in the robot and are usually called for ahead of time. This also may explain why the most frequently used pathways did not coincide with the most rapid pathways identified, as the quicker pathways tend to involve refill orders that do not require extensive computer entry.

Although the overall interruption rate was increased with use of the robot, whether the robot was directly responsible, given the types of interruptions that were most often observed, is unclear. Considering the workflow steps in which interruptions were observed, use of the robot appeared to increase efficiency of technician entry of new prescriptions (step D) and packaging of prescriptions in conjunction with use of the Kirby Lester automated countertop counting device at some point (step I). However, given the number of interruptions occurring while prescriptions were waiting to be packaged by the filling technician (step G), technician efficiency during this step appeared to be reduced with presence of the robot. Technicians may be performing actions unrelated to dispensing while they wait for the robot to complete tasks. Therefore, the realization that the robot has completed an order and requires input to move things along might be delayed, preventing technicians from taking full advantage of the robot's efficiency.

When implementing any form of new pharmacy automation, the presence of automation surprises becomes inevitable. Feedback to the manufacturer and regular software updates are necessary for addressing and preventing such surprises. Regular assessment also should be done to determine which pill shapes and sizes make the best fit for robot dispensing in order to avoid some of the identified robot miscounts and physical jams.

Technicians were observed deviating from current policies and procedures nearly four times more frequently after compared with before robot installation. This primarily was a result of one step, step C (i.e., entry of new prescriptions without pulling of nonrobot shelf drugs by the entry technician). Entry technicians appeared more apt to skip drug pulls with the presence of the robot, perhaps because they assumed many of the orders to be for medications stocked in the robot. The frequency of this workaround may decrease as entry technicians gain greater familiarity with which medications are robot drugs.

Limitations

Pharmacy technician behavior may have been altered by the presence of the study observer, and robot installation may have caused physical adjustments to the pharmacy workspace. Further, timing may have been affected by observation days and times not exactly coinciding between the pre- and postinstallation periods and that new, refill, and new and refill prescription baskets were considered equal during timing. Future research would likely benefit from matching observation blocks as closely as possible between the two periods and possibly by using different arms of study when considering prescription type, given that new prescriptions often require additional preparation time. The replacement of one full-time technician with a new employee between the two observation periods also may have

affected workflow sequences and times. Finally, the current study had a small sample size (i.e., one pharmacy site); future studies should consider including more pharmacy locations.

Conclusion

Robotic dispensing systems can increase technician prescription-filling efficiency based on overall time but also can increase complexity. To prepare for changes in pharmacy workflow as a result of automation implementation, studying how the use of the robot will change workflow and sequencing of tasks is important. Appropriate policies and procedures based on this evaluation then can be developed and continually updated by pharmacy personnel. This also will help pharmacies to take full advantage of the increased efficiency that automation can bring to the workplace.

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Figure 1.
Pharmacy prescription-filling workflow and defined technician roles

Figure 3.
Number of pathways used per range of mean times to fill one prescription

Figure 4.

Number of occurrences observed per interruption type

Codes used for interruption identification: 1, answer phone; 2, question to pharmacist; 3, question to other technician; 4, question from pharmacist; 5, question from other technician; 6, discussion/chat with other technician; 7, discussion/chat with other pharmacist; 8, prior order(s) being finished first; 9, wrong drug or drug missing, new drug pull needed; 10, help patient (involved in current order); 11, help patient (not involved in current order); 12, computer or printer issue needing to be fixed; 13, insurance problem needing to be fixed; 14, more orders being entered before moving current order along; 15, question from store clerk; 16, drug not available at time being, wait to obtain from elsewhere.

Table 1

Characteristics before and after installation of automated prescription-filling device

	Preinstallation observations No. (%)	Postinstallation observations No. (%)	Robot-only observations No. (%)	<i>P</i>
All new prescriptions in basket	45 (59)	51 (64)	23 (64)	—
All refill prescriptions in basket	31 (40)	29 (36)	13 (36)	—
Newand refill prescriptions in basket	1 (1%)	0	0	—
Time to fill one prescription (seconds), mean $\pm$ SD	361 $\pm$ 199	321 $\pm$ 189	—	0.097