Implementing a Tech-Check-Tech Program at a University Health System

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ABSTRACT

Background: Tech-Check-Tech (TCT) allows a pharmacy technician to perform the final check of medications prepared by another technician. The effect of a TCT program on the time required to process medications in a hospital pharmacy has not been previously reported.

Objective: To evaluate the effect of implementing a TCT program on the time required to prepare, check, and deliver medications to automated medication supply systems (AMSS) located throughout an academic medical center.

Methods: The primary outcome was the difference in mean total time required to process AMSS medications between pre- and post-implementation periods. Forty-five days pre-TCT implementation was compared to 45 days post implementation. To assess the effect of the TCT program on pharmacist-time allocation, median times required to verify stat and routine medication orders in the computerized physician order entry (CPOE) system were analyzed.

Results: Mean total time spent processing AMSS medications was 24.16 ± 2.98 hours and 16.79 ± 2.65 hours for the pre- and post-TCT implementation periods, respectively (difference of 7.37 hours; 95% CI, 6.19–8.55 hours; $p < 0.0001$). Median verification times for stat medication orders were 5 (interquartile range [IQR], 2–12) minutes before and 4 (IQR, 2–9) minutes after TCT implementation ($p < 0.0001$). For routine orders, median verification times were 12 (IQR, 4–30) minutes before and 7 (IQR, 3–18) minutes after implementation ($p < 0.0001$).

Conclusions: The total time required to process AMSS medications was significantly reduced after a TCT program was implemented in an academic medical center. Pharmacist medication order verification times were also significantly reduced.

Key Words—hospital, interventions, order verification, pharmacists, pharmacy technicians, Tech-Check-Tech

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A report issued by the IMS (Intercontinental Marketing Statistics) Institute for Healthcare Informatics indicated in 2013 the number of prescriptions filled in the United States increased by 1.6% and hospital admissions rose by 2.6%.¹ These figures are expected to continue to rise as the number of Americans age 65 years or older increases. The Centers for Disease Control and Prevention predicts this age group will double over the next 25 years, eventually numbering 72 million.² In addition, the

2010 Patient Protection and Affordable Care Act is enabling more Americans to access health insurance through federal subsidies, health insurance exchanges, and the expansion of Medicaid. This legislation also encourages the use of preventive health services by making some services available with no copay, co-insurance, or deductible. Collectively, these factors have the potential to increase demand for all health care professionals and services, including pharmacists and their medication dispensing responsibilities.

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To meet this increased demand while continuing to allow pharmacists time for patient care activities, such as identifying medication-related problems and making recommendations to correct and enhance therapy, changes designed to increase the efficiency of medication dispensing should be explored.

Pharmacy technicians play a vital role in aiding pharmacists through their supportive and technical responsibilities. By handling many of the preparative and processing functions of medication dispensing, they help provide pharmacists the time to pursue other clinical activities with the goal of enhancing patient care. Tech-Check-Tech (TCT) is a process that allows a pharmacy technician to perform the final check of medications prepared by another technician. At least 15 states have now implemented laws permitting the practice of TCT.³ Several studies evaluating pharmacy technicians' ability to check medications have found that their accuracy is the same or greater than pharmacists.^{4,7} Additionally, the rate of serious errors (eg, accepting the wrong medication when checking) has been found to be similar between pharmacists and technicians.^{6,7} Implementing TCT processes has also been previously reported to reduce the amount of time pharmacists spend on checking medications.^{4,5,8} To our knowledge, no study has evaluated the effect of a TCT program on the overall time required to process medications, including preparation, checking,

and distribution. We report the development of a TCT program at a University Health System inpatient pharmacy and compare the times required to process medications before and after its implementation.

METHODS

TCT Program Design and Implementation

A TCT program was designed to allow technicians, who complete training, to check non-patient-specific medications for automated medication supply system (AMSS) refill batches. Training consists of a requisite 3-step program followed by continued quality assurance audits. Important terms used in the program are defined in **Table 1**. Those who successfully complete the training program are designated as Technician Checkers. Based on a review of the current TCT literature, the training, policies, and procedures of the program were designed to incorporate specific aspects previously studied (eg, validating accuracy of technician checking).

The 3-step training program is outlined in **Figure 1**. The first step, self-learning, involves self-directed studying by the technician of the TCT policies, procedures, and training manual. In addition to outlining the scope of implementation for the program, these materials review TCT information including background, evidence in the literature, possible benefits, and applicable state laws. The training

Table 1. Important definitions for Tech-Check-Tech (TCT)

Automated medication supply systems (AMSS)	Mechanical devices located throughout the hospital that perform medication storage and distribution functions and collect, control, and maintain all transaction information
AMSS refill batch	Includes only non-patient-specific medications (oral and injectable) packaged in discrete quantities (manufacturer packaging and pharmacy prepackage forms) for storage in AMSS to be accessed by authorized personnel (eg, nurses) upon receipt and verification of a medication order by the pharmacy
Checking mistake	During the checking process, the oversight of an error in an AMSS refill line item or identifying an error for a line item that is in fact filled correctly
Error	The occurrence of the wrong drug, strength, dosage form, quantity, or expired medication for any unit of a line item (each line item counts as only one checking mistake, regardless of the number of incorrect units in that line item)
Line item	A single unique medication listed for restocking on an AMSS refill report (regardless of total quantity)
Process AMSS medications	Prepare, check, and deliver medications to AMSS located throughout the hospital
Technician Checker	Pharmacy technician who has received specialized training in checking, has passed checking verification and all required quality assurance testing, and is authorized to check the work performed by another technician as outlined in the TCT policies and procedures

1. Self-learning

- Background and evidence for TCT
- TCT laws
- Scope of program
- Processes and procedures

Written competency assessment
Must score $\geq 90\%$

2. Hands-on Training

- Instruction on checking provided by pharmacist
- Opportunity to practice checking

Must complete at least 2 days

3. Accuracy Validation

- Required to check 300 line items over 3 days
- Pharmacist introduces ≥ 3 errors per day
- Accuracy of $\geq 99\%$ required

Figure 1. Tech-Check-Tech (TCT) 3-step training program.

manual emphasizes the importance of developing a systematic approach to medication checking, the most common checking mistakes, and frequently seen medication errors. To ensure that technicians-in-training have an adequate understanding of the program, a minimum score of 90% on a written competency assessment is required before they are allowed to proceed to the next step in training. Step 2, hands-on training, involves one-on-one instruction on checking provided by a pharmacist. The technician works alongside a pharmacist and has the opportunity to practice checking with direct oversight when AMSS refill batches are processed throughout the day. The technician is required to complete a minimum of two 8-hour training shifts, but may complete more at the discretion of the training pharmacist or by technician preference. Step 3, accuracy validation, is designed to ensure that the technician achieves the minimum required checking accuracy of 99%. Technicians-in-training are required to check 300 line items over a 3-day period. Each day, before the technician-in-training begins checking the refill batch, a supervising pharmacist secretly introduces a minimum of 3 errors into the batch. This ensures that errors exist in the batch and thereby guarantees a

test of the technician's ability to identify them. After checking is complete, the technician-in-training reports errors found to the supervising pharmacist. All introduced errors are carefully documented and corrected before any medications are delivered.

After a technician passes the TCT training, they are designated Technician Checkers and must continue to complete mandatory quality assurance audits for as long as they remain a Technician Checker. One audit is required every month for the first 3 months. If the technician passes these audits, the interval between audits is increased to quarterly for the next year, then semiannually thereafter. Quality assurance audits are conducted in the same way as accuracy validation, except Technician Checkers are required to check only 100 line items in one day. The minimum accuracy of 99% is still required. If an audit is not passed, the technician must be re-audited within one month. If the re-audit is not passed, the technician is no longer designated as a Technician Checker and must be retrained beginning with step 1.

Study Design

Establishment of a new TCT program in an inpatient pharmacy presented an appealing opportunity to collect and analyze objective variables of interest before and after implementation. The purpose of this study was to evaluate the effect of a TCT program on the time required to prepare, check, and deliver medications to AMSS located throughout an academic medical center (ie, process AMSS medications). The process of preparing medications involved technicians printing reports and then manually collecting the required medications without the use of packaging/processing technology. The AMSS refill batches were checked and finally hand-delivered to AMSS throughout the hospital. Each technician processing AMSS medications was responsible for the entire process from printing the report through delivery, with the medications to be delivered checked by a pharmacist (pre-TCT) or a Technician Checker (post-TCT). We hypothesized the cumulative time required to process AMSS medications would be less with a TCT process than with the traditional pharmacist-check process.

The TCT program was implemented during the weekday morning inpatient pharmacy shifts, which consisted of 3 to 5 technicians processing AMSS medications simultaneously. Forty-five days of pre-implementation data were compared to 45 days of post-implementation data. The primary outcome was the difference in mean total time per shift required

to process AMSS medications. The average monthly patient census during the pre- and post-intervention periods was assessed as a surrogate marker for the expected volume of orders being processed in each period. Median verification times for medication orders in the computerized prescriber order entry (CPOE) system were also analyzed as a secondary outcome to assess the effect of the TCT program on pharmacist-time allocation.

Data Collection and Statistical Analysis

Reports from the AMSS software were generated to collect the start and end times for processing AMSS medications. Start time was defined as the time a medication refill report was printed by a technician each morning. End time was defined as the time when the last medication was loaded into an AMSS by a technician. Due to variability in the number of technicians processing AMSS medications from one day to the next, all technician times in a single morning shift were added together to comprise the total time per shift. This allowed calculation of the primary outcome, difference in mean total time per shift required to process AMSS medications, with census data collected as an assessment of the expected volume of orders being processed. On days that primary endpoint data were collected, pharmacists' order verification times, from the inpatient pharmacy during a period of 2.5 hours each morning, were also collected. Individual verification times for each stat and routine medication order were collected directly from the CPOE system.

All data were compiled in Microsoft Excel then analyzed using JMP 11, 2012 (SAS Institute Inc., Cary, NC). The Student's *t* test was used for the primary outcome, and data are reported as mean and standard deviation. The secondary outcome was analyzed using Wilcoxon rank sum and is reported as median and interquartile range (IQR). An alpha level of 0.05 was set a priori for determining statistical significance.

RESULTS

The primary outcome, mean total time spent processing AMSS medications during the weekday morning shifts, was 24.16 ± 2.98 hours and 16.79 ± 2.65 hours for the pre- and post-TCT implementation periods, respectively (Figure 2). This represents a difference of 7.37 hours (95% CI, 6.19-8.55 hours; $p < 0.0001$).

For the secondary outcome, the median order verification time for stat medication orders was

Figure 2. Primary outcome of time to process automated medication supply systems medications (mean $\pm$ SD) during 45-day periods before and after Tech-Check-Tech (TCT) program implementation.

Figure 3. Secondary outcome of order verification times for stat and routine medication orders (median and interquartile range [IQR]). TCT = Tech-Check-Tech.

5 (IQR, 2-12) minutes before and 4 (IQR, 2-9) minutes after TCT implementation ($p < 0.0001$). For routine medication orders, median order verification times were 12 (IQR, 4-30) minutes before and 7 (IQR, 3-18) minutes after TCT implementation ($p < 0.0001$) (Figure 3).

The average monthly patient census for each 3-month pre- and post-implementation period during which the study was conducted was 11,287 and 11,516, respectively. The number of patient care

interventions documented was collected to assess the productivity of those pharmacists affected by TCT implementation. Pharmacists affected by TCT were defined as those who worked more than 75% of their shifts during weekday morning hours in the inpatient pharmacy for both pre- and post-TCT implementation study periods. Because pharmacists commonly work in several areas throughout the hospital, only one pharmacist met these criteria and documented 0.7 and 1.5 patient care interventions per day before and after TCT implementation, respectively.

DISCUSSION

TCT is a practice that has been shown to reduce the amount of time pharmacists spend checking medications.^{4,5,8} It has the potential to improve medication processing in inpatient pharmacies through more efficient utilization of pharmacy technicians. While the accuracy and safety of technicians checking medications has been studied, to our knowledge the time required to process (prepare, check, and deliver) medications with technician checking compared to pharmacist checking has not been previously reported.

After implementation of a TCT program as described, there was a significant reduction in the time required to process AMSS medications. Consequently, medications are restocked and available to health care providers and ultimately to patients sooner. While not assessed in this study, reducing occurrences of AMSS running out of medications would potentially reduce the number of delays in medication therapy. In addition, technicians may spend less time waiting for an available pharmacist to check medications prior to delivery, allowing more time to complete other tasks.

A secondary objective of this study was to determine whether the substantial reduction in pharmacists' medication checking responsibilities resulted in significant improvements in other duties. To help assess this reallocation of pharmacist time, we examined the pharmacists' primary responsibility of medication order verification. Our study demonstrated a significant reduction in median time to verify medication orders. A contributing factor could have been a reduction in the number of interruptions caused by the need to check medications, allowing pharmacists to focus more on order verification and associated clinical interventions. There was only one pharmacist who worked a majority of shifts during data collection times before and after TCT implementation, so assessment of the change in clinical interventions

completed was limited and susceptible to many confounding variables. However, the increase in average interventions per day from 0.7 to 1.5 suggests that the extra time pharmacists do not have to spend checking medications may result in more patient care clinical interventions.

There are several limitations to this study. Different technicians are inherently faster or slower at processing medications, and each participating technician did not work the same number of days before as compared to after implementation. In addition, one week into the post-implementation period, the structure of technician shifts was changed resulting in a reduced number of technicians processing medications for the same number of AMSS. These factors could be confounding variables independently affecting the time to process medications. Average hospital census data during each 3 month pre- and post-implementation period was collected to evaluate whether one could expect there to be more or less medications processed during one of the study periods. Even though the patient census was similar during both study periods, it is only a coarse surrogate marker for comparing the volume of medications being processed during each period.

The external validity of this study may be limited as the benefits of implementing a TCT program could be largely dependent on the pre-existing medication checking process. It is also important to note that Technician Checkers only checked non-patient-specific medications, so these results should not be extrapolated to programs allowing patient-specific medication checking.

CONCLUSION

After the implementation of a TCT program at a University Health System inpatient pharmacy, this study showed significant reductions in the times required to process AMSS medications and verify stat and routine medication orders. With the goal of improving patient care, a TCT program could help prevent delays in medication therapy by reducing the time required to process medications. Through more efficient use of pharmacy technicians, TCT is a process that could help meet the increased demand on pharmacy services and allow reallocation of pharmacist time to clinical activities other than medication processing.

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The authors declare no conflicts of interest.

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