Decreasing Laboratory Turnaround Time and Patient Wait Time by Implementing Process Improvement Methodologies in an Outpatient Oncology Infusion Unit

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Abstract

Purpose: Prolonged patient wait times in the outpatient oncology infusion unit indicated a need to streamline phlebotomy processes by using existing resources to decrease laboratory turnaround time and improve patient wait time.

Methods: Using the DMAIC (define, measure, analyze, improve, control) method, a project to streamline phlebotomy processes within the outpatient oncology infusion unit in an academic Comprehensive Cancer Center known as the Comprehensive Treatment Unit (CTU) was completed. Laboratory turnaround time for patients who needed same-day lab and CTU services and wait time for all CTU patients was tracked for 9 weeks.

Results: During the pilot, the wait time from arrival to CTU to sitting in treatment area decreased by 17% for all patients treated in the CTU during the pilot. A total of 528 patients were seen at the CTU phlebotomy location, representing 16% of the total patients who received treatment in the CTU, with a mean turnaround time of 24 minutes compared with a baseline turnaround time of 51 minutes.

Conclusions: Streamlining workflows and placing a phlebotomy station inside of the CTU decreased laboratory turnaround times by 53% for patients requiring same-day lab and CTU services. The success of the pilot project prompted the team to make the station a permanent fixture.

Introduction

It was recognized that the outpatient oncology infusion unit known as the Comprehensive Treatment Unit (CTU) was not meeting its organizationally defined Critical to Quality (CTQ) metrics, including patient wait time and laboratory turnaround time (TAT). To address this, a multidisciplinary team was formed to focus performance improvement efforts on improving these metrics.

The purpose of this study was to streamline phlebotomy processes using existing resources to decrease lab result turnaround time and ultimately decrease patient wait time. Anticipated outcomes include decreased laboratory TAT for complete blood count and complete metabolic panel and improved patient flow through the CTU (experienced as decreased waiting times for all patients, regardless of pilot participation status).

Methods

The multidisciplinary team completed the DMAIC (define, measure, analyze, improve, control) process, starting in the “define” phase with creation of a project charter and project objective to address our CTQ metrics including decreasing laboratory TAT (operationally defined as time elapsed from blood drawn to results available in electronic medical record) and wait time from arrival to treatment chair (operationally defined as time elapsed from registration to sitting in treatment chair). The team then documented the process flow diagram for laboratory services and identified opportunities for improvement.

In the “measure” phase, baseline data were collected for our CTQ metrics. Our first CTQ metric, laboratory TAT, was collected from a random sample of 59 visits (estimated sample size based on a 95% CI and ± 7 minutes margin of error) over the course of 3 months before the pilot. Because of the unavailability of electronic laboratory TAT and the need to manually collect data, random sampling was selected. Randomness was guaranteed by taking medical record numbers for all patients who received same-day laboratory and CTU services for all dates over the course of 3 months before the pilot, randomly assigning all eligible patients using a random number generator that selected the smallest 59 randomized number samples, and analyzing for TAT. Our second CTQ metric, wait time from arrival to treatment chair, was pulled from the electronic medical record for the same period. Data were also analyzed to identify peak hours for patients who needed same-day laboratory and CTU services. On the basis of these data, inclusion criteria encompass patients with same-day laboratory and CTU appointments, Monday through Friday 7:00 a.m. to 12:00 p.m. (identified peak hours, representing more than 66% of total volume). Exclusion criteria include patients with same-day laboratory, physician, and CTU appointments; patients scheduled after 12:00 p.m.; and patients scheduled for weekends or holidays. In addition, a Pareto diagram (Figure 1) was created using 92 observations of delay and shows that laboratory delays were the second greatest reason for CTU delays, representing more than 21% of all delays. For the greatest reason for delays, missing treatment orders, a long-term enterprise solution was planned to begin soon after the proposed timeline for the new phlebotomy station, making laboratory delays an appropriate metric for the multidisciplinary team to address.
In the “analyze” phase, a root cause analysis via a fish bone diagram (Figure 2) was completed to identify process change failures in each area associated with opportunities previously identified in a process flow diagram. The multidisciplinary team evaluated the change failures present in the fish bone diagram and identified those that had the greatest impact on laboratory TAT (shown in blue in Figure 2). Solution generation for these identified process change failures was the focus as we entered the “improve” phase.

In the “improve” phase, a new workflow diagram was created that decreased patient touch points (operationally defined as all required patient encounters with hospital staff) from eight to four. The new front-end workflow included one stop for all registration, laboratory, and CTU services and use of a yellow “passport to health” affixed to each chart as a visual cue to follow the new workflow. The new back-end workflow included the use of special orange blood sample tubes with decreased clotting time (which also serve as a visual cue for the new workflow), reservation of phlebotomy equipment to run CTU samples, a change from batch to continuous flow to process samples as they are delivered, and the use of a communication tree for relaying results and issues.

Once it was validated that a solution to each of the process failures identified in the root cause analysis was present in the final solution and workflow diagram, meetings were held with key stakeholders to obtain buy in and approval. All CTU nurses, nursing assistants, and patient access representatives, as well as laboratory personnel, were trained on the pilot and workflow protocols. Several practice sessions were held before

![Figure 1. Pareto chart of reasons for Comprehensive Treatment Unit delay with 92 observations of delay.](image)

![Figure 2. Root cause analysis fish bone diagram. CBC, complete blood count; CMP, complete metabolic panel; CTU, Comprehensive Treatment Unit.](image)
beginning the pilot with front line staff to ensure that the updated workflow and implementation strategy were congruent with current processes inside of the CTU.

Data on both CTQ metrics were collected during the 9 weeks the pilot ran using the time stamps within the electronic medical record and analyzed using statistical software for analysis including control charts and two-sample t tests. CTQ metric results were posted daily in the patient waiting room and were verbally announced during daily staff huddles and staff meetings. A daily e-mail was sent to laboratory pilot team members that included a run chart with average TAT and total volume to assist in identifying laboratory TAT trends.

Results
An I chart with three sigma control limits for our first CTQ metric, laboratory TAT (Figure 3), was created to compare individual measurement case performance pre- (baseline) and postimplementation with random samples of 59 observations compiled for each project phase (pre, post), totaling 118 observations. Random sampling for pre pilot samples was guaranteed by taking medical record numbers for all patients who received same-day laboratory and CTU services for all dates over the course of 3 months before the pilot, randomizing by using a random number generator that selected the smallest 59 randomized number samples, and analyzing for TAT. Random sampling for the pilot period was guaranteed by taking all medical record numbers and visit date for all patients who met inclusion criteria (same-day laboratory and CTU appointments, Monday-Friday, 7:00 a.m.-12:00 p.m.), randomizing by using a random number generator that selected the smallest 59 randomized number samples, and analyzing for TAT. At baseline, the mean for the 59 samples was 51 minutes, with a range of 127 minutes between the lower control limit and upper control limit; two points were greater than 3 standard deviations from the center line depicting special cause variation. Data points were validated and therefore were not excluded. Postimplementation, the upper control limit was equal to the mean of the baseline process, demonstrating a 53% reduction in TAT. Results also demonstrate substantial decrease in variation: all observations demonstrate only common cause variation (represented by no observations greater than 3 standard deviations from the mean), creating a more predictable process.

During the pilot, 16% of the total patients seen in CTU were also seen at the CTU laboratory pilot location. Our second CTQ metric, wait time from arrival to CTU to sitting in treatment chair, decreased from 46 minutes to 38 minutes, resulting in a 17% decrease in total wait times for all patients treated in the CTU during this time. This difference was statistically significant at a 95% CI, with \( P < .001 \), as evaluated with a two sample t test.

Discussion
The intervention met the prescribed goals of the pilot. In addition, the results highlight the power of changing workflow in a small subset of patients and the impact it can have on overall wait times through increased efficiency and throughput. This study suggests that having a dedicated phlebotomy station inside of outpatient oncology infusion units and a workflow to promote identification and immediate processing of these patients’ samples can decrease turnaround times and subsequently wait times.

After 9 weeks, it was clear to the team, on the basis of the TAT and wait time data, that the intervention had been successful, and a decision was made to make the phlebotomy station inside of CTU a permanent fixture as we entered our “control” phase. Control plan included a random sample of \( n = 20 \) weekly to allow for tracking of TAT trends, with results shared weekly via e-mail and on a publicly displayed dashboard. The key to success, in our view, was multidisciplinary participation in the pilot group, constant evaluation of outcomes, and transparency in results sharing.

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