A Strategy for Optimizing Staffing to Improve the Timeliness of Inpatient Phlebotomy Collections

Aileen P. Morrison, BSc; Milenko J. Tanasijevic, MD, MBA; Joi N. Torrence-Hill, MHA; Ellen M. Goonan, MS, MT(ASCP)SH; Michael L. Gustafson, MD, MBA; Stacy E. F. Melanson, MD, PhD

Context.—The timely availability of inpatient test results is a key to physician satisfaction with the clinical laboratory, and in an institution with a phlebotomy service may depend on the timeliness of blood collections. In response to safety reports filed for delayed phlebotomy collections, we applied Lean principles to the inpatient phlebotomy service at our institution. Our goal was to improve service without using additional resources by optimizing our staffing model.

Objective.—To evaluate the effect of a new phlebotomy staffing model on the timeliness of inpatient phlebotomy collections.

Design.—We compared the median time of morning blood collections and average number of safety reports filed for delayed phlebotomy collections during a 6-month preimplementation period and 5-month postimplementation period.

Results.—The median time of morning collections was 17 minutes earlier after implementation (7:42 AM preimplementation; interquartile range, 6:27–8:48 AM; versus 7:25 AM postimplementation; interquartile range, 6:20–8:26 AM). The frequency of safety reports filed for delayed collections decreased 80% from 10.6 per 30 days to 2.2 per 30 days.

Conclusion.—Reallocating staff to match the pattern of demand for phlebotomy collections throughout the day represents a strategy for improving the performance of an inpatient phlebotomy service.


T

imeliness of inpatient tests is central to physician satisfaction with laboratory services. In the 2009 Q-Probes study, 27% of physicians listed either routine test turnaround time or inpatient stat test turnaround time as the most important laboratory service category. In addition to quick turnaround times, the availability of results in time for morning rounds may be another important laboratory quality indicator, because results that are not back in time for physician rounding may lead to delays in patient management and increased length of hospital stay. For institutions with a phlebotomy service, the timely availability of test results is likely to depend on the timeliness of blood collections.

Lean, which originates in the Toyota Production System, seeks to reduce waste and non-value-added steps while improving quality, and has been increasingly applied to health care settings in recent years to improve workflow, safety, and patient and clinician satisfaction.

In 2009, laboratory management at Brigham and Women’s Hospital (BWH) recognized an opportunity to improve the timeliness of inpatient phlebotomy morning rounds through staffing optimization. Collection volumes

reach a peak during morning rounds, and this time was associated with incident reports and complaints pertaining to delays. We considered ways to apply Lean principles to phlebotomy staffing to reduce delays and improve efficiency. One strategy was to match the number of scheduled phlebotomists to the demand for collections at each hour of the day. In accordance with Lean principles, we sought to develop a model that improved quality but did not expand the total number of full-time equivalents. Here, we discuss the development of the new staffing model and report the effects of the model on the timeliness of morning collections and the number of incident reports pertaining to delays.

METHODS

Study Site and Operational Workflow

Brigham and Women’s Hospital is a 777-bed academic medical center located in Boston, Massachusetts. The inpatient phlebotomy service at BWH fills more than 200,000 requests for phlebotomy per year, or approximately 600 per day, covering all inpatient care areas (approximately 21 floors and 50 inpatient care units) except the neonatal intensive care unit. This amounts to approximately 50% of all inpatient blood samples obtained at the hospital; the remaining are obtained by other care providers. About 60% of inpatient phlebotomy collections occur between 5:00 and 11:30 AM, which we will refer to here as the period of morning collections. During rounds, phlebotomists use both carts and bags to carry supplies and specimens, and typically send specimens via pneumatic tube to the laboratory after completing collections from all patients in a care unit (typically

Accepted for publication April 8, 2011.

From the Departments of Pathology, Clinical Laboratories Division (Ms Morrison, Torrence-Hill, and Goonan and Drs Tanasijevic and Melanson) and Medicine (Ms Morrison) and the Center for Clinical Excellence (Dr Gustafson); Brigham & Women’s Hospital, Harvard Medical School, Boston, Massachusetts.

The authors have no relevant financial interest in the products or companies described in this article.

Reprints: Stacy E. F. Melanson, MD, PhD, Brigham and Women’s Hospital, 75 Francis St, Amory 2, Boston, MA 02115 (e-mail: semelanson@partners.org).
batches of 8–10 patients), or after collecting 3 or 4 stat specimens. To transition between floors during morning rounds, phlebotomists primarily use elevators, although stairs may be used for short distances between floors when a phlebotomist is using a bag to carry supplies.

Data Sources

Positive Patient Identification Device.—Phlebotomists at BWH use a positive patient identification (PPID) handheld device to confirm patient identification before obtaining samples. This device saves a record of each collected sample to a database, including the collection time. We accessed this database to generate reports of performed collections.

Assignment Sheets and Pod Sheets.—Phlebotomists receive an assignment sheet—a sheet of paper listing the care units assigned to them for each round—at the start of each shift. When a phlebotomist has completed his or her scheduled assignment for a round, he or she informs a team leader, who records the completion time for that assignment.

Each care unit or “pod” keeps a daily “pod sheet” for phlebotomy listing all the patients who require a specimen collection during the designated round. After a phlebotomist has obtained a blood sample, he or she fills out the pod sheet with the name of the patient from whom the sample was obtained, the type and time of the sample, the round the sample was ordered for, and the phlebotomist ID.

We used the assignment sheets and pod sheets to supplement PPID data in our analysis, because PPID does not record which round each blood collection was ordered for, and does not capture collections not performed with the PPID device.

Laboratory Information System.—Samples received by the BWH clinical laboratories are logged into a laboratory information system (LIS). We accessed the LIS to download a record of performed collections, in order to capture blood draws that occurred without use of PPID.

Data Analysis

Although it would be optimal to base our staffing model on the number of requests for phlebotomy at each hour, these data are not electronically recorded. Instead, we used PPID data, which is a record of actual collections performed, in our analysis.

We first used PPID data to assess variation in collection volumes among different days of the week under the existing staffing model. Based on this assessment, we developed 2 separate staffing schedules: 1 for high-volume days (Tuesday through Saturday) and 1 for low-volume days (Sunday and Monday).

We then determined typical collection volumes for each hour of the day under the existing staffing model using PPID data recorded during a 4-week period. Because collection volumes might not reflect real clinical demand—for example, if phlebotomy could only obtain samples for 75 of 100 patients requiring collection between 5 and 6 AM—we performed a more detailed analysis. Using assignment sheets, pod sheets, and LIS data for 2 dates (1 high-volume and 1 low-volume day), we determined the proportion of samples obtained later than scheduled. Based on this analysis, we adjusted the collection pattern to more accurately reflect clinical demand. We used the highest averages for each day of the week during the 4-week analysis period in order to allow for between-day variation when building the staffing model. The determined pattern of collection demand is shown in Figure 1.
Original Staffing Model

Originally, the staff schedule consisted of 3 shifts, with 14 phlebotomists working between 5 AM and 1:30 PM, 6 between 1:30 and 10:00 PM, and 4 between 10:00 PM and 6:30 AM (Figure 2). Staffing was identical for each day of the week.

New Staffing Model

Based on internal data and direct observation and confirmed by external benchmarks, we estimated that phlebotomists could fill requests for 5 patients per hour. Accordingly, we calculated the number of staff needed to match the collection demand at each hour.

Comparing our existing staffing levels to the demand at each hour (Figure 2), we identified periods of understaffing between 6:30 and 9 AM and between 7 and 9:30 PM. A period of significant overstaffing extended from 10 AM to 1:30 PM. In order to more closely match demand at each hour of the day, we developed 2 different staff schedules: 1 for high-volume days (Tuesday through Saturday; Figure 3) and 1 for low-volume days (Sunday and Monday). The staff schedule for low-volume days was similar to that for high-volume days, but used 3 less full-time equivalents. By creating 4 new shifts, staggered at different hours of the day, including a part-time shift from 5 to 9 AM, we increased staffing between 6:30 and 8:30 AM and between 3:30 PM and 12 AM, while reducing staffing between 9 AM and 3:30 PM. The total number of full-time equivalents remained identical between the new and old staffing models. The new staffing model was implemented on April 5, 2010.

Outcome Measures

Study Period.—We analyzed performance during a 6-month preimplementation period (July 1–December 31, 2009) and 5-month postimplementation period (May 1–September 30, 2010). The period from January 1 to April 4, 2010, was considered a period of understaffing, with at least 6 vacancies in inpatient phlebotomy staffing, and not included; both the preimplementation and postimplementation periods had fewer than 6 vacancies per month. The period from April 5 to April 30 was considered the implementation phase and was also excluded.

Time of Collections.—We determined the median and interquartile range for the collection time of morning samples (5–11:30 AM) before and after staffing reallocation. All outcome measures were calculated from PPID data. February 12, 2010, and May 7–10, 2010, were excluded because of missing data.

Safety Reports.—Brigham and Women’s Hospital has a confidential electronic safety reporting system. We compared the number of reports filed per 30 days for delayed phlebotomy collections during the preimplementation and postimplementation phases.

RESULTS

Time of Collections

The median time of morning collections was typically earlier for dates in the postimplementation period (Figure 4). The median collection time of all morning samples was 17 minutes earlier with the new staffing model (7:42 AM preimplementation; interquartile range, 6:27–8:48 AM; versus 7:25 AM postimplementation; interquartile range, 6:20–8:26 AM).

Safety Reports

The average number of safety reports filed per 30 days pertaining to delayed phlebotomy collections decreased 80% from 10.6 to 2.2 (Figure 5).

COMMENT

Other quality improvement initiatives have targeted outpatient phlebotomy wait times9,10 or emergency department wait times.11 To our knowledge, this is one of the first studies to describe the application of Lean principles to improve the timeliness of morning collections at a large academic medical center. After implementing the new staffing model, we saw the time of morning collections shift by about a quarter of an hour. Safety reports concerning delayed collections became less frequent. These improvements were made without any increases to the total number of full-time equivalents in the staffing model, representing a key theme of Lean improvements: increasing quality using existing resources.

Before this improvement initiative, the phlebotomy service at BWH had previously engaged in multiple efforts to increase quality and safety, including changing the first round from 7 AM to 5 AM, increasing use of “stat” and “discharge” stickers to prioritize necessary labs, and servicing floors in order of clinical priority. In spite of incremental improvements, we still received numerous safety reports concerning the timeliness of phlebotomy collections during the preimplementation and postimplementation periods.

Figure 4. Median collection time of morning samples. The median collection time of samples collected between 5 and 11:30 AM before and after implementation of new staffing model.

Figure 5. Safety reports per month. The monthly volume of safety reports pertaining to delayed collections during the periods before and after new staffing model.
rounds. Thus, in designing a new staffing model for the phlebotomy service, we had 3 goals: to more consistently collect specimens in a timely manner in order to meet clinical need, to decrease waste by more closely matching staffing to demand, and to be equipped to buffer staff absences and between-day variation in the volume of phlebotomy orders.

Our general strategy was to determine the demand for collections at each hour of the day, as measured in samples per hour, and to then match staffing to this pattern, thus improving service. Following Lean principles, we took time to carefully characterize the existing staffing model and performance and accurately estimate the true clinical demand at each hour. Because our PPID system does not electronically capture the number of orders for each phlebotomy round, we relied on a combination of paper-based and electronic data to estimate the workload at each hour of the day. Although imperfect, such strategies may be necessary for the many institutions not yet using electronic requisitions. Similar initiatives should be possible as long as a database with recorded collection or processing times of samples is accessible, such as through a PPID system or LIS.

One of the main hurdles of this initiative was how to accomplish extensive staffing reorganization. Because of a period of staffing vacancies while we developed the new model, staff morale was already less than optimal (as communicated to phlebotomy managers by team leaders and phlebotomists), so this presented a challenge. To make the transition as smooth as possible, we worked closely with human resources; explained the benefits of the change for the staff, patients, and clinicians; and gave the staff advance notice. Although institutional policy required a 30-day notice for changes to an employee’s scheduled hours, we provided 5 weeks of notice prior to implementing the change. We judged this amount of time to be adequate but not excessive, considering the potential personal impact of changing employee schedules. Importantly, because of previous improvement initiatives, staff were already initiated into the department goal of continuous improvement and optimization of patient care. We communicated that new shift positions would initially be offered on a volunteer basis, with first priority given to senior staff whose shifts were impacted by the new model. Junior staff would be required to fill the remaining new shifts. We were also able to use existing staff vacancies to hire new staff directly into the newly created shifts. Using these strategies, we retained all but one phlebotomist after the staffing changes, and staff morale improved quickly in conjunction with the increased timeliness of rounds, as highlighted in feedback from team leaders and phlebotomists. Phlebotomy managers also noted a decrease in the number of absences and call-outs in the postimplementation phase. Continuous and consistent communication to all staff members, including clear expectations and goals, was key throughout the implementation and postimplementation phases.

Limitations

On inspection, Figure 5 reveals a reduction in safety reports pertaining to phlebotomy delays during the preimplementation period. Our institution conducts Kaizen events on a regular basis to apply Lean principles to our phlebotomy service. In August 2009, a Kaizen event was held to standardize phlebotomy carts and emphasize prompt arrival to the first inpatient care unit of the morning shift. Phlebotomy management considered the impact of this event to be positive and likely complementary to that of the subsequent staffing reorganization. Although the number of safety reports declined after the new staffing model was implemented, more analysis is needed to better assess the statistical significance of the observed difference.

Although we did not formally assess the downstream effect of our improvement initiative on the time that results became available, we conducted a preliminary assessment of result availability times for those inpatient morning samples (approximately 70%) for which potassium tests were performed. The median time that potassium levels became available was 15 minutes earlier after the intervention. This is similar to the 17-minute shift we observed in collection times. We also saw an approximate 50% drop in safety reports filed for delayed processing and reporting of laboratory tests in the postimplementation period, less than the 80% drop in safety reports for delayed collections we observed in this study. Further assessment is necessary to determine if results are more consistently available for physicians during their rounds.

Future Process Improvement Initiatives

We have identified additional opportunities to use these methods to optimize staffing, such as fine-tuning assignments to match the pattern of demand specific to each inpatient care area. Our institution is preparing to implement a closed-loop order communication system, whereby electronic orders will be downloaded directly to the handheld electronic PPID devices and also communicate directly with the LIS. Closed-loop order communication will enable the phlebotomy service to record the exact volume and completion time for each phlebotomy round, and for each inpatient care area. Such a system would capture the actual number of phlebotomy requests at each hour of the day, allowing us to match staffing to true workload.

We also aim to apply the key Lean principle of continuous flow to our testing process, an application that has been highlighted by other institutions. An assessment of the factors contributing to the turnaround times of specimens from collection to result reporting has revealed a considerable wait time before specimens are received by the laboratory. Strategies to increase the flow of specimens through our system include minimizing batching of specimens by phlebotomists and improving use of the pneumatic tube system. In addition, the success of this first initiative provides a rationale for attempting a similar review and appropriate allocation of laboratory staffing to match the incoming flow of specimens at the point of laboratory receipt.

Conclusion

This study demonstrates a strategy for evaluating an existing staffing model, identifying areas of waste, and reallocating staff to match clinical demand. Such a strategy can use existing resources to improve productivity and efficiency of an inpatient phlebotomy service.

We extend our appreciation to Andrea Shellman, MHSA, for her work in assembling data for this study.
References