EARLY ONLINE RELEASE

Note: This article was posted on the Archives Web site as an Early Online Release. Early Online Release articles have been peer reviewed, copyedited, and reviewed by the authors. Additional changes or corrections may appear in these articles when they appear in a future print issue of the Archives. Early Online Release articles are citable by using the Digital Object Identifier (DOI), a unique number given to every article. The DOI will typically appear at the end of the abstract.

The DOI for this manuscript is doi: 10.5858/arpa.2020-0729-OA

The final published version of this manuscript will replace the Early Online Release version at the above DOI once it is available.
A Daily Operational Huddle and a Real-Time Communication Application Improve Efficiency of Laboratory Processes

Jing Cao, PhD; Michael Dowlin, BA; Aaron West, MS, MT(ASCP); Clarah Mutandiro, MSHS, MT(ASCP)CM; Marcus Mpwo, MS, MT (ASCP); Ila R. Singh, MD, PhD

Context.—Clinical laboratory processes that require cooperation among geographically distinct sections often face challenges. We describe these challenges as related to the Gram staining of cerebrospinal fluid, a key test in the management of patients with suspected central nervous system infections, and our attempts to improve quality outcomes.

Objective.—To evaluate multiple tools and strategies for their effectiveness in optimizing the turnaround time of tests sharing a specimen or workflow.

Design.—Over the course of 5 years, the turnaround time of cerebrospinal fluid Gram stain was studied at one of the largest children’s health systems in the US. Baseline data showed suboptimal compliance to targeted turnaround times. A conventional approach to process standardization, and 2 innovative tools that facilitate horizontal integration were applied to the main campus laboratory as follows: a daily huddle and a novel electronic communication application that was interfaced with the laboratory information system. Turnaround time and its variation were assessed. Two other hospital laboratories within the health system that did not undergo these quality interventions served as controls.

Results.—Standardization of processes reduced the variability of turnaround time but only minimally shortened it. In contrast, an interteam daily huddle that monitored key quality metrics together with the communication application, improved turnaround time significantly and sustainably.

Conclusions.—Communication strategies involving a physical or virtual gathering of laboratory representatives encourage horizontal communication and improve turnaround times. These tools are generally applicable and could be used to improve other processes in healthcare, especially those where a workflow is shared between 2 geographically distinct areas of a health system.

(Arch Pathol Lab Med. doi: 10.5858/arpa.2020-0729-OA)

Sharing specimens or workflows is a common occurrence among different sections of a clinical laboratory. Processes that require cooperation among geographically distinct sections in a clinical laboratory pose challenges, which include splitting limited specimen amounts, lack of awareness of the other section’s needs, and an overall delay in turnaround time (TAT).

Laboratories deal with physical distancing of their sections by transporting original specimen tubes or aliquots from one area to another. With tests that need a quick TAT for best patient outcomes, such sharing and transport of specimens can lead to noticeable delays. We describe our experience with one such test, Gram stain of cerebrospinal fluid (CSF), where physical separation of 2 laboratory sections led to a delayed TAT. We elaborate on our attempts, using a variety of conventional and innovative strategies over a 5-year period, to correct these delays in a sustainable manner.

Gram stain of CSF is a key test in the diagnosis of bacterial meningitis, an infectious disease with high morbidity and mortality. Acute bacterial meningitis is associated with a mortality of 15% to 37%. Rapid detection and initiation of appropriate antimicrobial treatment are critical to reducing adverse outcomes. Diagnosis of bacterial meningitis is dependent on CSF examination after lumbar puncture and is typically associated with an elevated white blood cell count, elevated protein concentration, and low glucose concentration in the CSF. Although CSF culture is considered the reference diagnostic method for bacterial meningitis, it usually takes 24 hours to 48 hours to result. In practice, the patient may have received antibiotics before lumbar puncture (eg, in an outpatient setting), which may lead to lack of growth in culture. Thus, the sensitivity of CSF culture for diagnosing bacterial meningitis is limited, typically ranging from 70% to 90%.

Gram staining, on the other hand, is widely available, and offers an inexpensive and rapid method for bacterial
meningitis diagnosis. Its actual analytical performance is difficult to assess given an imperfect reference standard, but the reported sensitivities of CSF Gram staining for bacterial meningitis range from 60% to 90% in community-acquired meningitis and 18% to 60% in nosocomial meningitis, with specificities as high as 97%. The high accuracy, combined with rapid turnaround, low cost, and minimal training requirement, all emphasize the value of Gram stains in the workup of suspected meningitis. Guidelines from the Infectious Diseases Society of America® state that Gram stain examination of CSF is recommended for all patients in whom meningitis is suspected. It is fast, inexpensive, and accurate in 60% to 90% of patients, although misinterpretation or contamination could cause false-positive results.

Laboratory policies defining the procedures and quality control standards of CSF Gram staining are included in the College of American Pathologists microbiology inspection checklist. Because the rapid availability of CSF Gram staining is one of the key features that guide clinical management, its TAT is deemed a critical quality metric of a clinical laboratory. However, the sample receiving, accessioning, processing, aliquoting, and testing processes often involve staff located in nonadjacent areas of the clinical laboratories and thus pose a challenge to successfully meeting the desirable TAT.

At our institution, one of the largest pediatric health systems in the United States, we faced challenges in meeting our target TAT for CSF Gram staining (which was set at 60 minutes) when the microbiology laboratory moved to a different floor in another building, situating it approximately 400 feet away from central receiving and other sections of the laboratory. We report here the application of conventional and innovative strategies to improve the TAT of CSF Gram staining following this move. While conventional strategies of process standardization were associated with a modest success, more novel interventions, including a daily operational huddle and an internally developed electronic communication application, Electronic Quality for Laboratories (EQL) and bench-side display, starting November 2017. All changes were cumulative.

Figure 1. Percent time that the turnaround time (TAT) for cerebrospinal fluid (CSF) Gram stain met the target of 60 minutes each month from July 2014 to June 2018. Data collected from main campus laboratories. (Section A) Standardization of specimen handling process, baseline—January 1, 2015 to March 15, 2015. Phase 1—assigning a maximum number of specimen collections to a phlebotomist, starting March 16, 2015. Phase 2—distributing short TATs across multiple specimen processing lines, starting April 15, 2015. Phase 3—removing specimen drop-off bin outside the receiving room to allow direct hand-over of specimens, starting August 10, 2015. Phase 4—removing the “To be Clock-in” bin, and staffing the pneumatic tube station with a full-time employee to facilitate immediate triage of specimens, starting August 26, 2015. (Section B) Implementation of division-wide daily huddle, starting March 2016. (Section C) Implementation of system “Electronic Quality for Labs” (EQL) and bench-side display, starting November 2017. All changes were cumulative.

healthcare, contributing to improvements in quality and clinical outcomes.

METHODS

Scope of the Study

The TAT of CSF Gram staining at the main campus was monitored during a 5-year period from July 2014 to November 2019. Each CSF specimen collected by the clinical team was transported to the central receiving section of the clinical laboratory by couriers. After the specimen was received, it was entered into the laboratory system. Aliquots were made as needed. Specimens were then hand-carried to the microbiology laboratory, which was situated on a different floor, in another building. Slides were generated and stained with Gram stain, and read under the microscope. The test result was also entered into the laboratory information system, from where it was electronically interfaced into the electronic medical record. Test TAT was measured from time of sample arrival in the central receiving section of the laboratory to time of result reporting in the electronic medical record. The target TAT was 60 minutes at the main campus. CSF Gram Stain TAT was reported as a metric at the main campus laboratory and 2 other laboratories (Lab 2 and 3) within the same health system, and this metric was compared in the preintervention and postintervention phases.

Quality Improvement Tools—Process Standardization

Our attempts to improve the CSF Gram stain TAT started with the implementation of 4 specific process improvement strategies as follows: (1) assigning a maximum number of specimen collections to a single phlebotomist and assigning additional staff to phlebotomy if volumes of draws increased, thus recruiting additional staff to process specimens in the lab, (2) distributing short TAT requests to all specimen processing lines, instead of a single short TAT line, (3) eliminating the process of specimen drop-offs in spots that were not constantly attended, and (4) stationing a laboratory employee next to the pneumatic tube station for immediate receipt and triage of the specimen after arrival in the laboratory. These changes were cumulative in nature, as in, when process 2 was put in place, process 1 was still active.

Quality Improvement Tools—Daily Operational Huddle

In March 2017, the Laboratory Medicine Division of our health system implemented a daily huddle at main campus. Initially held adjacent to the clinical laboratory, the huddle became a virtual
event since January 2019. It is intended to be a 6-minute to 10-minute meeting, and is attended by medical directors, lab administrative directors, quality and other managers, supervisors, fellows, and residents on rotation, the goal of the huddle is to make key laboratory personnel, and by extension all other staff, aware of important events in the laboratory and hospital that might impact testing quality and patient safety. The team provides very rapid reports on hospital census, personnel availability, operational issues, reagent shortages, maintenance issues, infectious disease testing, new workflows, and significant feedback from clinicians and patients. Notes are made on the huddle board, which evolved from a whiteboard at the huddle’s inception, to a formatted Excel spreadsheet upon transition to virtual meetings.

Quality Improvement Tools—Electronic Quality for Laboratories

EQL, a web-based application, was created in house to address the communication, coordination, and documentation needs of the clinical laboratories. Existing resources, 1 programmer, and existing servers, were leveraged for the creation of the application, and required no additional capital. EQL links workbenches, sections, shifts, laboratories, and campuses across the health system to provide near real-time information sharing (screen refresh rate of 1 minute). EQL provides a checklist format for shift-to-shift hand-off and supports task management in a way that is customized to address different functions. The application is organized along several interrelated hierarchies, including operational structure and staff roles. Technical, administrative, and professional roles are all logically linked in the workflow and information sharing functionality. EQL also accommodates campus and discipline-specific (eg, General Laboratory, Histology, Blood Bank) operational integration. Much of the data captured in EQL are available in a structured form for analysis and reporting to affect operational and quality improvement.

RESULTS

Our target for CSF Gram Stain was to meet the TAT of 60 minutes at least 95% of the time. At the beginning of our 5-year study, we met the TAT target for CSF Gram Stain approximately 83% of the time. We used the following 3 main strategies to improve this TAT: (1) a traditional quality improvement approach that involved a laboratory-wide project to standardize key steps in sample receiving and processing, (2) a daily operational huddle with members of the Laboratory Medicine division, where key laboratory-area representatives exchanged important operational information, and (3) EQL, an electronic intralaboratory, real-time communication application. The timing of these interventions and the resulting monthly percentages of TATs that met the target of 60 minutes from July 2014 to June 2018 are shown in Figure 1.

Standardization of Laboratory Processes

Initial attempts to improve the CSF Gram stain TAT began with the implementation of 4 process improvement strategies described in detail in the Methods section. These changes were cumulative in nature, when process 2 was put in place, process 1 was still active. After 4 phases of cumulative interventions, there was a significant reduction in the variation of TAT; the interquartile range decreased from 18 minutes to 14 minutes, and standard deviation decreased from 23 minutes to 18 minutes. However, the decrease in TAT was modest, as the median TAT stayed unchanged at 47 minutes from baseline to phase 1, and slightly decreased from phase 1 to phase 2 and 3, without any statistically significant difference. The TAT dropped from 44 minutes to 43 minutes from phase 3 to phase 4 (Figure 2. A) while the percentage of TAT on target (60
Figure 3. A. Example of the daily huddle tracking board. Daily inpatient census, number of outpatient appointments and expected laboratory visits, positive cases of respiratory viruses, status of quality documents, potential testing delays, and special patients that may needed additional laboratory support. The panel on the right shows reports from each weekday: Monday—review of weekend issues; Tuesday—changes in laboratory methods or workflows; Wednesday—updates on long term projects; Thursday—quality-related and safety-related incidents; and Friday—acknowledgement of laboratory staff by patients or clinicians. B, Report from each laboratory section (on left) on key quality metrics, staffing status, issues with instruments and special conditions.
minutes) remained below 90% (Figure 1). Other laboratories within the health system that did not implement these and other process improvement protocols (further details below) did not see changes in TATs (Figure 2, B). In summary, standardization had the greatest impact on ensuring process consistency, while the lag in sample transfer prevailed.

**Division-Wide Daily Operational Huddle**

We next implemented the nontraditional approach of a daily operational huddle to improve the TAT. Figure 3, A and B show the components of laboratory quality metrics that were monitored and reported at the daily huddle. A total of 20 to 30 people, from various laboratory sections, participated daily. Metrics related to hospital census, personnel availability, operational issues, reagent shortages, maintenance issues, infectious disease testing, new workflows, test recalls, feedback from clinicians and patients, as well as acknowledgement of laboratory staff from within and outside the division were rapidly shared and briefly discussed. Key points from the huddle were shared at the daily health system–wide operation briefing.

The TAT of CSF Gram stain was chosen to be a metric for the Microbiology lab, and was reported at the huddle from its inception. Each time the TAT exceeded the target of 60 minutes, it was announced at the huddle and marked on the huddle board. All representatives from central receiving, chemistry, and microbiology sections who were stakeholders in the CSF Gram stain test noted these outliers and participated in identifying the potential root cause of the delays. TAT of CSF Gram stain improved after the huddle was introduced (Figure 2, A). A lack of prompt alert and delivery from the specimen management section to the microbiology section (silo), horizontal integration enabled by the division-wide huddle addressed gaps in a process shared between sections, with potential delays in patient testing. To overcome the boundaries between silos, robust communication tools, preferably real time, are needed. The 2 tools we describe here, the daily huddle and EQL, provided horizontal integration of spatially distinct laboratory sections, and the ability to manage clinical service parameters in real time or close to real time, contributing to significant reduction in TAT for our test analyte, CSF Gram Stain.

The huddle is a commonly used format for meetings in many fields. In more recent years, the huddle has been increasingly practiced and reported in the medical setting. Its features generally include a short duration, the reporting of safety and quality events, enumeration of critical metrics of operation, and close communication among attendees for immediate feedback. Our laboratory medicine division huddle, structured on common elements in a laboratory huddle, was helpful in encouraging interteam interactions and monitoring key quality metrics. We confirmed that continuous monitoring and reporting on specific quality metrics had a positive impact on quality improvement and sustainability. Of note, the implementation of the huddle outperformed conventional process standardization methods, by significantly and sustainably reducing the TAT. This finding suggests that while process standardization may have enhanced function within each section (silo), horizontal integration enabled by the division-wide huddle addressed gaps in a process shared between multiple sections. Huddles have been proposed to improve efficiencies and quality of information sharing, increase levels of accountability, empowerment, and sense of

**Impact of Interventions on TAT and Variation**

The 4 phases of cumulative process standardization reduced the variation of TAT and phase 3 to 4 transition showed significant reduction in TAT (Figure 2, A). The median TAT decreased from 47 at baseline to 43 minutes at phase 4 and further to 40 after the huddle and EQL phases. Notably, standardization had the greatest impact on ensuring process consistency and reducing variation, while the lag in sample transfer improved after the huddle and EQL implementation.

We compared TAT compliance in the main campus laboratory with 2 other laboratories within the same health system (Lab 2 and 3, Figure 2, B). These laboratories did not have the challenge of geographically separated laboratory sections. They did not use CSF gram stain TAT as a key performance metric. They did not use the same process improvement methods as the main laboratory and over the period of time of these interventions, did not show a change in TAT. Thus, the performance improvement seen in the main laboratories was likely due to the quality improvement approaches we describe here.

**DISCUSSION**

As clinical laboratories grow in size, areas once adjacent to each other could become distant, disrupting what were once efficient workflows. When growth dictates physical separation of a single laboratory unit, an unintended consequence is the creation of silos. These silos affect efficiencies across sections, with potential delays in patient testing. To overcome the boundaries between silos, robust communication tools, preferably real time, are needed. The 2 tools we describe here, the daily huddle and EQL, provided horizontal integration of spatially distinct laboratory sections, and the ability to manage clinical service parameters in real time or close to real time, contributing to significant reduction in TAT for our test analyte, CSF Gram Stain.
community, which together create a culture of collaboration that increases the staff’s quality of collective awareness and enhances capacity for eliminating patient harm. We found our huddle accomplished many of these proposed goals. Some accomplishments (eg, increased empowerment and sense of community) could not be easily measured. However, the general idea of information sharing and our specific practice of publicly acknowledging laboratory staff when they had accomplished something unusual, added to the group’s perception of better cohesion and higher morale.

Informatics tools have greatly enhanced the ability of a laboratory to process, result, and report test orders. Our use of EQL to allow real-time communication among sections was another example of a novel communication tool that improved immediate outcomes and provided documentation for quality assurance and regulatory review. An ongoing systematic evaluation of events and outcomes in EQL provided a means of simplifying the quality review process and also enabled efficient and effective analysis before quality improvement measures were put in place. It is likely that in the future, EQL will be linked to a dashboard that monitors operations and quality measures, allowing the laboratory to move beyond simple discovery of poor outcomes to real-time understanding of potential causes. Communication tools may also be interfaced with data analysis applications in order to group and rank encounters that commonly occur in a laboratory setting.

In summary, our experience in the continuous effort to optimize a laboratory process demonstrated that while conventional strategies of process standardization were associated with success, the more novel tools consisting of
a daily operational huddle and an electronic communication application led to a significant and sustained decrease in TAT. These strategies promoted horizontal integration, sharing of key pieces of data, and facilitating electronic communication between various laboratory sections. It is helpful if the process for implementing these tools is planned with the involvement of the laboratory staff that performs these tasks, to create ownership of these processes. If implemented well, a laboratory can achieve and maintain quality metrics and lead to staff goodwill and higher morale. Our tools are widely applicable to other clinical settings for improvements in healthcare.

The authors thank Greg Buffone, PhD whose inspiration and support led to the in-house development of the EQL application, Hanna Uhrova, MBA, for her support of process improvement in her role as quality manager, and Emily Garnett, PhD for her comments on the manuscript. We are grateful to Joe Rutledge, MD, and Mike Astion, MD, PhD, for helping us learn about huddling.

References