No more STAT testing

Improve critical results management and lab efficiency through automation and data management

By Kenneth E. Blick, PhD, ABCC, NACB

Imagine a medical lab that seemingly ignores physicians’ requests to process tests as STATs, and instead treats the samples as if they were routine, without placing a higher priority on them. What would be the fallout? Masses of injured patients? Outraged physicians? Chaos in the emergency department (ED)?

How about none of the above? Indeed, in the core laboratory at Oklahoma University Medical Center (OUMC), STAT and routine orders are handled in exactly the same manner. Yet, the laboratory better protects patients, and physicians are more satisfied with the overall predictability and reliability of lab services. As for the emergency department, the head physician has recently commented that the lab is no longer a factor in ED wait times.

If any lab professional has had an experience like OUMC’s, he has probably guessed our secret to eliminating the need for STAT orders: lab automation and sophisticated data-management software, along with appropriate attention to process improvement.

Like many labs that have automated, our test turnaround time (TAT) is now so predictably fast that no special treatment is needed for STAT orders. In fact, specimens are handled in real-time in a first-in/first-out process with no queues and, hence, there is no need for special handling of STAT orders. Nevertheless, our physicians still submit such orders; we just put the samples on the automation line along with the routine orders. Essentially, it is as if the automation system was designed specifically for STAT testing and the rapid TAT for routine testing is just a bonus.

The “before” picture

To get a sense of how our experience with automation and data management has gone, consider our situation before we automated our core lab. Like many other labs nationwide, we were squeezed by cost pressures, a shortage of qualified labor, and rapidly rising volumes in the ED. Yet, we were trying to respond with many 30-year-old legacy solutions built around noncomputerized manual decision making, no automated sample handling with people solutions, and stand-alone remote “STAT” laboratories.

For example, we did much of our ED testing STAT in decentralized satellite laboratories while sending the routine testing through the pneumatic tube to the core laboratory for a more traditional and legacy “batch” approach to sample analysis. Unfortunately, batches of samples placed in racks equate to batches of patients in the ED and other critical-care areas in the hospital. In those areas, patients are essentially in queue waiting for some clinical decisions that require these test results. All of this delay in clinical decision-making causes congestion in the free flow of patients through the clinical process. The net effect was a condition equivalent to congestive hospital failure, because a logjam of patients in critical areas like the ED strains the operational capacity of the entire institution.

Batch processing is clearly the enemy, and such legacy solutions doom the laboratory to an excessive number of results with an unsatisfactory level of TAT outlier events, even if overall TAT means appear adequate. For instance, without automation, traditional TAT on a sample can vary from 30 minutes to two hours, depending on many delaying factors, including the sample’s position as it moves from one batch to the next.

Thus, even when our labs appeared to be producing adequate TAT outcomes, they actually were not. For example, in consultation with our physicians, we had set a TAT target of 40 minutes for reporting critical results such as potassium. With this in mind, we looked at our 2003 TAT data — after we consolidated most of our labs into a core lab but before our total automation project was implemented — that showed we had in fact achieved a mean TAT of 40 minutes.

The promise to the physician, however, was for all of the results to be back in 40 minutes. Unfortunately, there were still a number of samples that were taking 70 to 80 minutes or longer. These outlier results led to a cascade of problems.

Continues on page 24
when physicians do not get results within the expected time frame, they call the lab thinking that something in the process has failed. Accordingly, when the lab has to deal with a constantly ringing phone, work gets slowed down that much more — delaying reporting of results even further.

Over time, this became a perpetual problem. Physicians who were not getting results in the expected and timely manner tended to order more tests as STATs just to pressure the lab to perform better for their patients. In fact, we reached the point in our lab where a ridiculous proportion of our tests — 50% — were ordered STAT. We even came up with five subcategories of STATs, from “life-threatening” down, in a failed attempt to adjust to the justifiable need for critical-care testing in our hospital.

How does a laboratory deal with these issues? By hiring more people to do the work, including staff whose main job is just to answer the phone. Applying management solutions like Six Sigma or LEAN to increase the lab’s effectiveness is also a frequently considered option.

But in our hospitals and region, hiring more staff is no cure-all — not only because it consumes scarce hospital resources, but also because of the enduring shortage of lab technologists. Furthermore, applying Six Sigma to old, outdated, problem-atic legacy solutions and technology is feel-good, cosmetic-only — or, essentially, putting lipstick on a pig. While our efforts to apply old, outdated solutions were perhaps well intended, our successful implementation of new automation solutions has clearly shown that our old approach used resources poorly, was inefficient, and was ultimately doomed to failure. To use a well-worn but still relevant analogy, it was as if a secretarial pool was worn but still relevant analogy, it was as if a secretarial pool was trying to increase output by hiring more administrative assistants and using more manual typewriters, instead of investing in up-to-date computers and word-processing software.

The “after” picture

When our staff closely analyzed our situation, the solution became obvious. It made no sense in an automation era to try to get by with legacy instruments and processes that were not only costly and slow, but also error-prone. Indeed, total automation had already demonstrated its efficiency, reliability, and cost-effectiveness in numerous other labs worldwide, many of which handled much smaller test volumes than did OUMC. There was no reason to expect anything less at our institution.

Once we did commit to automation, we settled on a vendor that was not only experienced with many worldwide total automation installs but also one that would assist us in the updating and redesigning of our many legacy, out-of-date processes. We also recognized that in a technology-driven business like the clinical laboratory, we needed to select a partner with a solid view of the laboratory of the future.

Our overall approach was that, rather than automate inefficient processes, it made more sense to optimize processes and workflow first, then implement an automation system. This way, the lab makes better use of the capital it is investing in new technology and software. We feel the success of our project in terms of measurable outcomes validates this concept.

Initially, and as part of the automation project, we either eliminated or automated 48 existing legacy workstations and human-processing steps. Much of our redesign occurred on the front end of the testing process. We went from manual test ordering, phlebotomy teams making rounds, runners and transporters bringing specimens to the core lab in batches, STAT labs, and so forth. By going with computers for electronic orders and having bar-code labels printed at the nursing stations, we were able to have nurses and house staff collect specimens, then deliver them to the central core lab from all over campus via a pneumatic tube located at each nursing station and outpatient area. Hence, we eliminated the batch processes at the front-end order, collection, and delivery-to-core-lab stages.

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In the lab, we had the automation track and computers take over the real-time processing of all specimens instead of having techs and staff handling specimens. The most dramatic takeover of manual processes included (1) autocentrifugation; (2) automated tube-cap removal; (3) autoloader balancing; (4) autodelivery of specimens on instruments and routing of specimens to instruments performing unique tests (tropin-1); (5) specimen tracking from start to finish; (6) elimination of pour-offs; (7) refrigerated storage and automation of add-on tests; (8) autovalidation; (9) identification of problem specimens; (10) specimen adequacy, clots, hemolysis, icterus, and lipemia; and (11) labeling problems. Without POC testing, these core laboratory changes would not be enough to handle the TAT requirements for critical care. Add-on testing automation via a refrigerated specimen-storage stockyard and the automation track took stress off the staff and markedly improved operations.

These changes not only sped up our TAT tremendously but also made our results and reporting more reliable by eliminating many sources of human error. By automating the preanalytic phase of testing, in which nearly 40% of laboratory errors occur, we eliminated many of the most error-prone processes in the lab, including such major threats to patient safety as sample-identification errors and process-delay events.

From the standpoint of TAT outliers for STAT orders, perhaps the most important aspect of our automation project was the near-total elimination of batch processing, except for a few of our outreach testing activities. Among the essential requirements were laboratory order entry by nurses and physicians in inpatient and outpatient areas with local bar-code labeling, along with real-time transport of specimens to the central core laboratory via the pneumatic tube system. We then placed received samples directly on the automation track. Hematology, chemistry, and immunoassay testing (including add-on tests) were then performed in real time as well.

Our data-management software also contributes greatly to the more predictable and faster TAT in several ways:

(1) By mediating an interaction between the automated instruments and the laboratory information system, the software enhances our ability to focus on critical patient specimens; and
(2) Using an instant message window, the software automatically alerts the operator to problems with critical test requests.

Continues on page 26
This allows the laboratory to deliver more timely information about critical samples to clinicians, helping them to perform diagnosis more quickly and to make management decisions regarding their patients. It also helps us meet the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requirements for standardization of critical results reporting directly to the physician.

Data-management software permits normal results — roughly three-fourths of our volume — to be validated and reported automatically at speeds no technologist could match. The task is performed according to rules that laboratory management has programmed into the software, so accuracy is not an issue. Plus, the software minimizes human variability, making the actions from the lab to the physician more consistent and more operator-independent on a 24/7 basis. It also makes a host of other decisions, such as those pertaining to specimen integrity — again according to user-defined rules — at speeds far beyond what even a senior technologist could replicate.

The resulting numbers underline the rationale for our decision to process routine and STAT samples the same way. Before automating and implementing expert software, we met our potassium TAT target of 40 minutes only about 82% of the time. The troponin TAT target of 60 minutes was met about 85% of the time before automation and data-management software were implemented. By comparison, we now meet both of those targets nearly 97% of the time. These TAT outlier percentages include all test results and even those from problem samples. Moreover, we expect further improvements as we continue to enhance processes with new vendor releases of software and hardware.

Our pre- and post-automation data also focused on in-laboratory cardiac marker testing, where timely and predictable TATs are essential aspects of lifesaving, evidence-based clinical decision making. Clearly, a more predictable TAT is not just a matter of a laboratory’s pride; rather, TAT outliers are a matter of patient safety. Indeed, in recognition of the key role that the laboratory plays, meeting TAT cardiac marker targets is also required for JCAHO accreditation nowadays. Accreditation teams recognize that nearly 80% of the information physicians rely upon for diagnosis and treatment decisions comes from the lab, so the imperative for optimizing TAT outliers and overall lab reliability is clear.

Another area where our lab’s use of automation and data-management software has made a large impact is with add-on testing. In the pre-automation days, a physician would call the add-on order to the lab for troponin-I or potassium, for example, leaving the laboratory staff with the obligation to hunt down the sample. Since our lab processes thousands of specimens daily, we might have had to sort through 1,500 or more samples before we were able to locate the correct one — hardly an ideal scenario for an add-on STAT troponin-I or potassium order. Also, in some cases, upon retrieval of the sample, we would find that too little sample remained to perform the requested test. By then, such delays in this manual process may have made it impossible to perform a suitable lifesaving intervention on the patient.

Today, when an order is generated at the terminal, it is passed to the laboratory information system and to the automation line and data manager. The software automatically sees a new test request and finds the sample in our specimen-storage stockyard. Software and robotics then handle placing the sample back on the track, routing the sample to the proper instrument, and finally autovalidating and autoreporting the result. In most cases, this process is handled entirely without technologist intervention. Clearly, this new, potentially lifesaving process allows the physician to receive the add-on laboratory tests from already collected specimens in the shortest possible time period.

Cost can never be completely separated from clinical value, but it can be financially shortsighted today for hospitals to decide against an automation solution for their TAT problems. It is well established that automation is a sound financial investment for many labs even at the community hospital level, not to mention larger institutions. Our experience helps demonstrate why:

■ Our improved TAT and handling of STAT orders enabled us to close a satellite STAT lab that we were operating for one of our EDs. This has saved OUMC roughly $1.5 million per year.

■ We have reduced FTEs in our core lab from 70 to 59. This includes 1.5 FTEs for telephone support, because we no longer need to dedicate staff to answer doctors’ calls about delayed results.

■ We have increased our productivity — total tests per month divided by total paid hours — by about 25%.

■ With the technologists’ time freed up by our system, we have been able to bring in-house 15 tests we had previously referred out, saving OUMC about $20,000 per month.

■ Because of the increased capacity created by automation, we have been able to grow our testing volume by about 6% without adding technical staff or overtime pay. Without automation, it would take about 4.2 additional FTEs (cost: about $244,000) to handle the same volume increase.

■ With the increased capacity, we are able to take in more deferred testing. In one month alone, we took in an additional $80,000 of referred volume, without adding staff or overtime.

Given the obvious clinical and financial advantages we have observed, we have decided to totally automate our hematology testing and, consequently, we expect significant positive patient-care and economic outcomes in hematology. To those consumers outside of healthcare, it may not seem revelatory that software and robotics are producing these kinds of potential benefits. But the revelation is that the technology described herein is available today and is reliable enough to be applied to the practice of laboratory medicine. In fact, technology appears to be more reliable in many cases than even our best technologists. And indeed, this new era of real-time testing for the clinical laboratory may signal the welcome end of the need for STAT priority testing altogether.

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