Patients are demanding that healthcare institutions do a better job at reducing errors. Medicare says they will no longer reimburse hospitals for medical errors, and third party payors and state hospital associations have begun to follow suit. Finding new ways to mistake-proof clinical laboratories is becoming crucial. The mistake-proofing system developed by Toyota may be one that is worthy of our attention.

Why Do Errors Occur in the Laboratory?

Countless newspaper articles and television news programs constantly remind us that at times, mistakes occur in the laboratory. Why do these errors happen? Studies conducted by the Institute of Medicine in 1999 (To Err is Human)¹, 2001 (Crossing the Chasm)² and 2006 (Preventing Medication Errors)³ all arrived at the same conclusion regarding laboratory errors. The good news is that these events are not the result of employees who work in the laboratory. Healthcare seems to attract some of the brightest, most dedicated, and most hard-working individuals in any industry. Instead, it is the system.

“The good news is that these events are not the result of employees who work in the laboratory.”

continued on page 2

Letter from the editor

As today’s healthcare institutions seek to maximize productivity and increase quality and throughput, one area that must be addressed is the incidence of laboratory errors. In this issue of LabNotes, our feature article presents some of the possible root causes of these errors, including an examination of the Toyota system for “best practices” to eliminate waste and inefficiency in the lab.

In addition, efficiency practices play a role in processing urine specimens as well as blood, as spillage of samples may compromise other specimens and expose lab personnel to potential pathogens. Using a closed system for urine specimen collection provides an effective way to help maintain specimen integrity—from collection to diagnosis.

Expand your knowledge of coding and documenting patients’ conditions with our new web-based seminar, “Deciphering Coding’s Role in Reporting Never Events.” If you are unable to attend the live event in late September, please visit our BD Vacutainer® website for a complete listing of our online learning library offerings.

We’ve also included an easy-reference tube guide to post in your lab. As always, we welcome your comments and suggestions for future issues of LabNotes.

Regards,

Dr. Ana K. Stankovic, Editor

MD, PhD, MSPH
Worldwide Vice President, Medical and Scientific Affairs and Clinical Operation
BD Diagnostics – Preanalytical Systems
Email: Ana_Stankovic@bd.com

Associate Editor, Leslie S. Magee, MBA, MT(ASCP)
Production Coordinator, Marion Plumley

The Vacutainer® Brand and Trademark

Trademarks were developed to protect the consumer from confusion as to the source of products and services available in the marketplace. Trademarks identify and distinguish the source of goods or services of one party from those of another. Trademarks, otherwise known as brands, are intellectual property and are part of the assets or “good will” of a company.

On LabNotes, and many other pieces of information you receive from BD and on our Web site, you see the Vacutainer® Brand represented with the registered trademark symbol ®. Vacutainer is a registered trademark of Becton, Dickinson and Company. This brand name is officially registered with the US Trademark office and many other local trademark authorities worldwide, and is legally owned by BD.

Address all correspondence to: Leslie Magee, Associate Editor, LabNotes, BD Diagnostics – Preanalytical Systems, 1 Becton Drive MC325, Franklin Lakes, NJ USA 07417-1885.

Error-Proofing the Laboratory

Possible Root Causes

In my view, the system upon which we have relied to avoid making errors in the laboratory is based on benchmarking. We define measurable indicators of quality, collect data on the indicators and analyze the data statistically to determine targets, or benchmarks of performance. At the same time, we survey the practices by which services are provided and then stratify the benchmarks by those practices to determine which practices we believe to be the “best.”

To some degree, this approach seems to work. For instance, participants enrolled in the College of American Pathologists’ benchmarking programs Q-Probes” and Q-Tracks” claim that benchmarking data helps them determine the weak spots in their laboratories as well as how and where to spend money to reduce errors4. Participants who track quality indicators over the course of several years do indeed show continuous improvement. Chasing benchmarks as a strategy by which to reduce errors does seem to offer some benefit, but critics cite some serious flaws:

• Misplaced Targets. Medical errors in the clinical laboratory—at least serious errors—are, for the most part, rare enough to require years of study in order to accrue enough data from which to draw conclusions. Interventions designed to make those events even rarer can require lifetimes to see whether or not they’ve made improvements. What we are often forced to measure instead, are operational processes—the frequencies with which people perform the tasks.

• Choosing Benchmarks. In general, performance achieved by the top five or 10 percent (95th or 90th percentiles) of participants is designated as the “benchmark.” This is not necessarily the best performance possible, only what the top five or 10 percent were able to achieve. Sometimes, sights are set even lower, perhaps the 75th percentile, rather than settling for nothing less than perfect performance.

• Reacting instead of Preventing. We tend to question our performance only when it dips below a certain threshold or is triggered by some catastrophe, rather than to brainstorm ways to prevent errors before they occur.

continued on page 3
• **Slow to Change.** While we often enter cycles of monitoring and intervening, at times, these cycles may go on forever, allowing whatever flawed environments that precipitated the error to continue. Ideally, systems could detect and correct errors immediately before they can cause harm.

• **One-Size-Fits-All Approach.** Just because “best practices” seemed to work in somebody else’s laboratory does not necessarily mean that they will work in yours. In fact, Q-Probes™ studies have shown that some of the “best practices” employed in the top performing laboratories were also employed in the bottom performing laboratories. It is not always clear why some laboratories do or do not function well. Therefore, we need to devise and customize systems that work in our own environments.

**Another Option: The Toyota Pyramid**

Given the shortcomings of relying solely on a benchmarking system to avoid trouble, it may be worthwhile to investigate other systems of service delivery. The most copied production system on the planet, copied not just by manufacturing companies but by service providers as well, is the one developed by the Toyota Motor Corporation.

Applying industrial techniques to the delivery of health care services does not mean turning healthcare workers into robots and patients into engine blocks. Activities involving people (i.e., hematology technologists identifying leukemic cells on peripheral smears) must be differentiated from activities involving systems (i.e., ensuring that the peripheral blood slides are labeled properly). It is the system, not the people, which requires fixing.

Pickup trucks or peripheral smears, the goals of production systems are the same. Every laboratory’s goal is to deliver their services at low cost, at high quality, and safely. Toyota’s approach is worth reviewing since they have achieved these goals so well. Their vehicles are among the top rated in quality, safety, and reliability. Why are they successful and what ideas can be borrowed from them?

Toyota’s system has been viewed as a pyramid constructed of four blocks: a sound business philosophy operationalized by Toyota’s unique production system, driven by people, instilled with a culture of continuously improving the system. The supporting base of the pyramid is the commitment of top management to sacrifice short-term profitability in order to achieve long-term growth. This business philosophy, as simple as it may sound, is essential for driving the other components of the system.

The philosophy is operationalized by the Toyota Production System (TPS), also known generically as the *lean* production system. Lean is not a Toyota word, however, it was coined by Womack, Jones and Roos in their book *The Machine that Changed the World* to describe what they believed the TPS was trying to accomplish. Of its many components and techniques, two principles stand out with regard to reducing errors: eliminating all waste directly into products.

**Eliminating Waste Eliminates Errors**

Toyota describes seven cardinal wastes in industrial production, to which Jeffery Liker, author of the thoughtful study of Toyota, *The Toyota Way* has added an eighth:

1. **Overproduction.** More inventory is presented to a work station than can be processed efficiently. For instance, at 6 AM, buckets of specimens from patient care units throughout the hospital arrive in our laboratories. Upstream, work backs up as technologists labor furiously to generate test results. Downstream, doctors and nurses are idle, waiting for the test results needed to advance the care of their patients.

2. **Unnecessary movement.** As an experiment, try diagramming the flow of work and traffic in your laboratory—from the arrival of specimens to the release of reports. It won’t take a lean expert to convince you of the unnecessary movement that this drawing represents.

3. **Overprocessing.** Overprocessing is the half dozen or more admitting notes written by the emergency room doctor, house officer, hospitalist, specialist, etc, all of which say the same thing that the pathologist has to read before commencing the autopsy.

4. **Overstocking.** Stocking an entire shelf of large-size gloves in a laboratory in which there are no large-sized hands is wasteful and contributes to excess inventory.

5. **Unnecessary transport.** Routes by which specimens journey from the bedides to patient to the laboratory may not be optimal due to facility constraints, resulting in testing delays and creating opportunities for errors to occur.

6. **Unnecessary waiting.** Waiting for a patient to return from X-ray in order to draw blood may not be the best use of a phlebotomist’s time.

7. **Defects.** Erroneous laboratory reports require repeating tests and investigating the origin of the errors.

8. **Unused employee creativity.** Failing to solicit ideas on how to improve operations from those who are in the best position to provide that information is, in my opinion, the most egregious waste in any industry.

*continued on page 4*
In most industries, waste is dealt with by either hiding it or working around it. In the long run, this requires more effort, more resources and more capital than what may be required to eliminate the waste altogether.

The following are dots that Toyota-style production engineers might connect to deal with waste:

- **Remove the silos.** Silos—phlebotomy, receiving, processing—serve only to increase the distance between operations and make communication among operators more difficult.

- **Plot the flow.** With the silos removed, diagram the steps of production from the time specimens enter the laboratory to the time reports are released.

- **Identify the value.** For each step, determine which ones do and do not provide value to patients. For instance, drawing blood and examining peripheral smears provide value. Transporting specimens and waiting for instruments to become available do not.

- **Eliminate the waste.** Finally, eliminate as many non-value steps as possible. Don’t touch the value-producing steps. In fact, consider spending more time providing value, more time examining blood smears.

Every wasted step removed from the process takes with it another opportunity to make an error and generate a defect.

For instance, a CAP Q-Probes™ study⁷ of transfusion practices demonstrated that removing wasted steps—transporting blood directly to patients’ bedside rather than allowing couriers to make several stops along the way, and having only one person handle the products rather than allowing units to pass through multiple sets of hands—was associated with fewer process errors.

Investigators at the University of Michigan⁸ were able to remove wasted steps from the process of installing percutaneous intravenous catheters (PICC lines) into patients. The entire process, from time of physician’s order to the actual PICC insertion procedure, was reduced from an average of 4 days to 7-10 hours. Errors, measured as First Time Quality (the number of times the procedure was performed without a hitch), went from getting it right one out of three times to performing flawless procedures almost 9 out of 10 times. The amount of time spent on value (the one-on-one time that doctors and technicians spend with their patients) increased by 10 percent.

**Building a Safety Net to Catch Defects**

Building quality into the product directly as it rolls down the assembly line is a matter of making errors visible as soon as they occur. Defects that are identified can be corrected before they are passed on to consumers. In manufacturing, making errors visible is achieved through standardization and redundancy.

**Standardization** is doing the same job, the same way, every single time. **Redundancy** is catching defects that sneak past standardization, since no matter how tightly we standardize our procedures, something is bound to go wrong.

In both the factory and laboratory, standardization means parts that are color-coded and that fit together in only one possible way. It also means developing protocols that describe every movement and operation. Idiosyncratic improvisation is to be eliminated, since it presents opportunity for errors.

Redundancy in operations is aimed at decreasing the intervals between the occurrence, detection and repair of errors. The goal is to eliminate defects before they can be passed onto patients.

Building redundancy into the system is a matter of inspection: how often we take a step back and look at what we’ve done. One method of inspection that has been shown to reduce manufacturing defects by as much as 90% is termed successive checks. Successive checks require workers to inspect another’s work before they start turning wrenches themselves. In the laboratory, Q-Probes™ studies have shown that having one transfusionist read patient identification information to another before starting transfusions is associated with fewer process errors. Several studies have demonstrated that having one pathologist check the work of another before tissue diagnoses are released to clinicians results in fewer diagnostic errors.

The goal of inspection in lean production is the source inspection. Source inspections represent standardization that is so complete, inspection itself becomes unnecessary. For instance, a radio frequency device (RFD) placed into a machine part will alert assemblers that parts have not been installed correctly. In the laboratory, RFDs are finding their way into wristbands.

**From the Factory to the Laboratory**

At Toyota, workers correct defects before they can be passed on to customers. If a worker spots a defect and cannot correct it immediately, he/she pulls a cord, which stops the line and summons a supervisor. If the two cannot solve the problem, engineers are brought to the floor to perform the necessary root cause analysis. This root cause analysis is accomplished on a problem that occurred five minutes ago, not five weeks ago. As inventory is exhausted up and down stream, additional conveyor segments come to a halt. Any assembler is empowered with the ability to shut down the entire line; this is not just a matter of salvaging one part. The engineers want to diagnose the cause of the problem to avoid more surprises later in the day.

If any front-line assembly worker is allowed to shut down the line, how does the factory get any work done?
Anyone who has ever worked the night shift in a busy laboratory probably knows the answer to this. Problems encountered but ignored at 2 AM do not disappear by themselves. They often reappear at 8 AM, only to become more disruptive. Any supervisor who has had to discuss a “lost” specimen with an irate doctor knows that it is a lot easier to track down and repair the damage if the incident occurred 10 minutes ago than 10 weeks ago.

**Completing the Pyramid: People and Culture**

The system works because the people Toyota employs make it happen. Toyota goes to great lengths to maximize the effort of its number one resource—its people. They start by getting the right people on board; applicants are not hired indiscriminately simply to fill holes in schedules. Applicants undergo months of interviews and testing. Toyota endeavors to hire only those individuals whom they believe will be committed to the ethic and culture of the company.

In turn, Toyota makes a commitment to their employees. No one is fired as a result of economic downturns or automation. In addition, workers are cross trained, as necessary. Technology is used to support workers, not replace them. Candidates are not passed up for promotion, instead, Toyota grows leaders from within the company rather than bring in managers from the outside. Once the best people are hired, they are empowered to initiate improvements in the jobs they do every day. In this way, management does not need to instill a culture of continuous improvement in them; the employees instill the culture themselves.

Hypertherm, a company in New England that has adopted the Toyota system, provides an example of this. Hypertherm manufactures arc welders. They employ 900 people, manufacture their products in the United States, and command three quarters of the world market for the type of welder they make. For several hours every month, workers are pulled from the line and given time to brainstorm ways to improve the operation. They design experiments to improve safety, reduce errors, be more efficient, reduce overhead, and develop outcome metrics to test their hypotheses. They need not convince top management to allow them to perform the experiments, only the people sitting around the table. This is a culture of error reduction that is proactive, blameless, and self perpetuating.

The results have been impressive. In 2005, these 900 employees offered 2,500 suggestions to improve production, 1800 of which were incorporated into factory operations. In 2004, the numbers were about the same, as they also were in 2003. This presents the question: how many of your laboratory’s employees were given the opportunity to come forward with suggestions on improving workplace safety or reducing errors?

Perhaps the biggest challenge that hospital and laboratory managers face in implementing Toyota-inspired production principles is the assumption that these improvement projects are one-time events. As dramatic as some improvements may be, there is always room to improve further. There is always room to encompass other areas of the laboratory and then move beyond the laboratory walls to other departments in the hospital. Continuous improvement must be built into the job description of every employee. ♦

Dr. David Novis has practiced laboratory medicine and pathology for 25 years and is a recognized expert in practice management, clinical quality, patient safety, and service delivery. He serves as a content resource and advisor for a wide range of laboratory, pathology, and general medical consulting firms.

“How many of your laboratory’s employees were given the opportunity to come forward with suggestions on improving workplace safety or reducing errors?”

**References**


LabNotes a newsletter from BD Diagnostics – Preanalytical Systems, Volume 18, No.1, 2008 [www.bd.com/vacutainer](http://www.bd.com/vacutainer)
Conemaugh Memorial Medical Center is a nationally recognized facility for cardiac, orthopedic, neonatal intensive care and home healthcare programs. The Center’s focus on total quality management has driven continuous improvement efforts for the laboratory. A comprehensive urinalysis solution was implemented that consisted of workflow and process enhancement initiatives, incorporation of automation, and a closed urine collection system.

### The Challenges

In a typical day, the laboratory manages more than 145 urinalysis tests and about 70 cultures from their outpatient clinics, nursing floors, and physician offices. Opportunities for improvement in several aspects of the testing process were identified:

- Efficiently managing increase in urinalysis workload
- Inability of the existing testing processes and workflow to handle specimen demand (particularly during peak hours)
- Improve turnaround time for specimens from the Emergency Department (67% of urinalysis workload)
- Decrease number of false positive urine cultures
- Improve Receive to Verify times (Laboratory ranked in the 9th percentile versus a similar peer group)
- Decrease staff movement when obtaining urine cultures
- Prepare for CMS’ upcoming reimbursement changes due to be implemented in October 2008

### The Solution

A joint effort between BD, Iris, and the Medical Center was designed to maximize the testing efficiency and workflow in the laboratory. This endeavor incorporated Lean Sigma process improvement services, installation of an Iris Diagnostic iQ® 200 ELITE™ Urinalysis Workcell (automation), and the BD Vacutainer® Urine Collection System (closed system). The process included:

- Identifying segments of the process that demonstrated inadequate performance as well as those that warranted a detailed examination
- Assessing productivity based on hands-on operator time using cycle time measurements
- Measuring one of the fundamental goals of Lean process improvement—reduction in the length of time from order to delivery
- Quantifying defects (e.g., leaking specimens, outliers) as a means of eliminating waste
- Training Urinalysis Department staff on Lean principles (e.g., single piece flow, standardization of processes)
- Replacing existing manual microscopy and urine chemistry equipment with a complete automation system; relocate equipment for more convenient access to the point of specimen entry to the laboratory
- Implementing a closed urine collection system to safely transport urine, decrease false positives, and eliminate re-testing

### The Results

The laboratory experienced significant qualitative and quantitative progress including:

- Ability to handle total urinalysis workload—at any time of the day or night—without delay.
- Overall turnaround time decreased by 26% in all areas, with ED turnaround times decreased by 21%.
- Reduced inquiries from nursing staff on specimen status and recalls—possible labor savings of $100,000 per year.
- Technical staff requirement decreased by 50%, translating into a productivity and capacity gain of 0.5 FTE, allowing redeployment of staff to perform other functions.
- As a result of the Lean layout and automated urinalysis, staff movement was reduced by 61%.
- Lower proportion of outliers—specimens with turnaround time above 2 hours dramatically decreased in the ED and inpatient locations.
- Improvement in specimen quality with a 28% decrease in poor quality urine culture specimens—mixed growth.
- 4.1% reduction in total cost-in-use for urinalysis and urine culture processes (which are related to the initial urine collection process).
BD Vacutainer® Urine Collection System

BD Urine Collection Products offer all the advantages of a closed system, for both patients and healthcare workers alike. Patients receive more reliable results, due to decreased preanalytical variability. Healthcare workers derive more safety on the job because they don’t need to pour potentially contaminated urine into tubes, while the efficiency of the closed system eliminates the need for re-testing and re-labeling and reduces the potential for preanalytical errors. The preservatives in the BD Urinalysis Tube and the C&S Tube allow for delayed testing and are in compliance with CLSI guidelines.

<table>
<thead>
<tr>
<th>Reference Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>364957</td>
<td>Complete Kit: Sterile Screw-Cap Collection Cup with Integrated Transfer Device and 8.0 mL, 16 x 100 mm Plus Plastic Conical Tube with Preservative for Urinalysis and 4.0 mL, 13 x 75 mm Plus Plastic C&amp;S Preservative Tube and Castile Soap Towelettes</td>
</tr>
<tr>
<td>364956</td>
<td>Complete Kit: Sterile Screw-Cap Collection Cup with Integrated Transfer Device and 8.0 mL, 16 x 100 mm Plus Plastic Conical Tube for Urinalysis and 4.0 mL, 13 x 75 mm Plus Plastic C&amp;S Preservative Tube and Castile Soap Towelettes</td>
</tr>
<tr>
<td>364954</td>
<td>C&amp;S Cup Kit: Sterile Screw-Cap Collection Cup with Integrated Transfer Device, 4.0 mL, 13 x 75 mm Plus Plastic C&amp;S Preservative Tube and Castile Soap Towelettes</td>
</tr>
<tr>
<td>364953</td>
<td>C&amp;S Transfer Straw Kit: Transfer Straw and 4.0 mL, 13 x 75 mm Plus Plastic C&amp;S Preservative Tube</td>
</tr>
<tr>
<td>364909</td>
<td>BD Vacutainer® Urine Foley Catheter Collection Kit: BD Vacutainer® Luer-Lok™ Access Device, 4.0 mL, 13 x 75 mm Plus Plastic C&amp;S Preservative Tube, 8.0 mL, 16 x 100 mm Plus Plastic Conical Tube for Urinalysis</td>
</tr>
<tr>
<td>364946</td>
<td>Urinalysis Cup Kit: Sterile Screw-Cap Collection Cup with Integrated Transfer Device and 8.0 mL, 16 x 100 mm Plus Plastic Conical Tube with Preservative for Urinalysis</td>
</tr>
<tr>
<td>364981</td>
<td>Urinalysis Cup Kit: Sterile Screw-Cap Collection Cup with Integrated Transfer Device and 10.0 mL, 16 x 100 mm Plus Plastic Round Bottom Tube for Urinalysis</td>
</tr>
<tr>
<td>364989</td>
<td>Urinalysis Cup Kit: Sterile Screw-Cap Collection Cup with Integrated Transfer Device and 8.0 mL, 16 x 100 mm Plus Plastic Conical Tube for Urinalysis</td>
</tr>
<tr>
<td>✔ 364951</td>
<td>Bulk Tube: 4.0 mL, 13 x 75 mm Plus Plastic C&amp;S Preservative Tube</td>
</tr>
<tr>
<td>✔ 364979</td>
<td>Bulk Tube: 10.0 mL, 16 x 100 mm Plus Plastic Round Bottom Tube for Urinalysis</td>
</tr>
<tr>
<td>✔ 364980</td>
<td>Bulk Tube: 8.0 mL, 16 x 100 mm Plus Plastic Conical Tube for Urinalysis</td>
</tr>
<tr>
<td>✔ 364992</td>
<td>Bulk Tube: 8.0 mL, 16 x 100 mm Plus Plastic Conical Bottom Tube with Preservative for Urinalysis</td>
</tr>
<tr>
<td>✔ 364909</td>
<td>Bulk Tube: 8.0 mL, 16 x 100 mm Plus Plastic Conical Tube with Preservative for Urinalysis</td>
</tr>
<tr>
<td>✔ 364979</td>
<td>Bulk Tube: 6.0 mL, 13 x 100 mm Plus Plastic No Additive (Z) Tube</td>
</tr>
</tbody>
</table>

Best Practice Formulary

NEW!

BD Vacutainer® Urine Foley Catheter Collection Kit

Designed with your convenience and safety in mind

Consider using the BD Vacutainer® Luer-Lok™ Access Device instead of a syringe

- achieve proper sample/additive ratio in the tube
- reduce the need to manipulate samples
- eliminate the use of a cup since samples are transferred directly to the tube
- utilize pneumatic tube transportation of specimen

To learn more:
1.800.631.0174
vacutainer_techservices@bd.com
<table>
<thead>
<tr>
<th>Inversions at Blood Collection</th>
<th>Laboratory Use</th>
<th>Additive</th>
<th>Your Lab's Draw Volume/Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>For serum determinations in chemistry. May be used for routine blood donor screening and diagnostic testing of serum for infectious disease. Tube inversions ensure mixing of clot activator with blood. Blood clotting time: 30 minutes.</td>
<td>Lithium heparin and gel for serum separation</td>
<td>For plasma determinations in chemistry. Tube inversions ensure mixing of anticoagulant (heparin) with blood to prevent clotting.</td>
</tr>
<tr>
<td>8</td>
<td>For serum determinations in chemistry. May be used for routine blood donor screening and diagnostic testing of serum for infectious disease. Tube inversions ensure mixing of clot activator with blood. Blood clotting time: 60 minutes.</td>
<td>Silicone coated (glass) clot activator, Silicone coated (plastic) clot activator, Thrombin</td>
<td>Special stopper formulation provides low levels of trace elements to minimize the risk of interferences and false results. Tube inversions ensure mixing of anticoagulant (EDTA) with blood.</td>
</tr>
<tr>
<td>0</td>
<td>For serum determinations in chemistry. Tube inversions ensure mixing of clot activator (thrombin) with blood to activate clotting.</td>
<td>Lithium heparin</td>
<td>For plasma determinations in chemistry. Tube inversions ensure mixing of anticoagulant (EDTA) with blood.</td>
</tr>
<tr>
<td>8</td>
<td>For serum determinations in chemistry. Tube inversions ensure mixing of anticoagulant (heparin) with blood to prevent clotting.</td>
<td>Sodium heparin</td>
<td>For plasma determinations in chemistry. Tube inversions ensure mixing of anticoagulant (EDTA) with blood.</td>
</tr>
<tr>
<td>8</td>
<td>For coagulation determinations. CTAD for selected platelet function assays and routine hematologic testing. CTAD for whole blood hematologic testing.</td>
<td>Sodium citrate, K3EDTA</td>
<td>For glucose determinations. Oxalate and K2EDTA anticoagulants will give plasma samples. Sodium fluoride is the anticoagulant of choice for nutritional-chemistry determinations. Tube inversions ensure proper mixing of additive with blood.</td>
</tr>
<tr>
<td>8</td>
<td>For glucose determinations. Oxalate and K2EDTA anticoagulants will give plasma samples. Sodium fluoride is the anticoagulant of choice for nutritional-chemistry determinations. Tube inversions ensure proper mixing of additive with blood.</td>
<td>Oxalate, Sodium fluoride</td>
<td>For glucose determinations. Oxalate and K2EDTA anticoagulants will give plasma samples. Sodium fluoride is the anticoagulant of choice for nutritional-chemistry determinations. Tube inversions ensure proper mixing of additive with blood.</td>
</tr>
<tr>
<td>8</td>
<td>For glucose determinations. Oxalate and K2EDTA anticoagulants will give plasma samples. Sodium fluoride is the anticoagulant of choice for nutritional-chemistry determinations. Tube inversions ensure proper mixing of additive with blood.</td>
<td>Sodium fluoride (serum tube)</td>
<td>For glucose determinations. Oxalate and K2EDTA anticoagulants will give plasma samples. Sodium fluoride is the anticoagulant of choice for nutritional-chemistry determinations. Tube inversions ensure proper mixing of additive with blood.</td>
</tr>
<tr>
<td>8</td>
<td>For glucose determinations. Oxalate and K2EDTA anticoagulants will give plasma samples. Sodium fluoride is the anticoagulant of choice for nutritional-chemistry determinations. Tube inversions ensure proper mixing of additive with blood.</td>
<td>Sodium fluoride (plastic)</td>
<td>For glucose determinations. Oxalate and K2EDTA anticoagulants will give plasma samples. Sodium fluoride is the anticoagulant of choice for nutritional-chemistry determinations. Tube inversions ensure proper mixing of additive with blood.</td>
</tr>
</tbody>
</table>

* Invert gently, do not shake.
* The performance characteristics of these tubes have not been established for infectious disease testing in general; therefore, users must validate the use of these tubes for their specific assay-instrument/reagent system combinations and specimen storage conditions.
* The performance characteristics of these tubes have not been established for immunohematology testing in general; therefore, users must validate the use of these tubes for their specific assay-instrument/reagent system combinations and specimen storage conditions.
<table>
<thead>
<tr>
<th>Color</th>
<th>Code</th>
<th>Additives</th>
<th>Inversions</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tan</td>
<td>#LOTACTIVATORANDGEL</td>
<td>For serum determinations in chemistry.</td>
<td>Tube inversions ensure mixing of anticoagulant with blood to prevent clotting.</td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>#LOTACTIVATORANDGEL</td>
<td>For serum determinations in chemistry.</td>
<td>Tube inversions ensure mixing of anticoagulant with blood to prevent clotting.</td>
<td></td>
</tr>
<tr>
<td>Lavender</td>
<td>Green/Gray</td>
<td>For serum determinations in chemistry.</td>
<td>Tube inversions ensure mixing of clot activator with blood.</td>
<td>Blood clotting time: 30 minutes.</td>
</tr>
<tr>
<td>Pink</td>
<td>Lavender</td>
<td>For serum determinations in chemistry.</td>
<td>Tube inversions ensure mixing of clot activator with blood.</td>
<td></td>
</tr>
<tr>
<td>Light Blue</td>
<td>Pink</td>
<td>For whole blood hematology determinations.</td>
<td>Tube inversions ensure mixing of anticoagulant (EDTA) with blood to prevent clotting.</td>
<td>For coagulation determinations. CTAD for selected platelet function assays and routine coagulation determination. Tube inversions ensure mixing of anticoagulant (citrate) to prevent clotting.</td>
</tr>
<tr>
<td>Clear</td>
<td>Clear</td>
<td>For use as a discard tube or secondary specimen tube.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** BD Vacutainer® Tubes for pediatric and partial draw applications can be found on our website.
Deciphering Coding’s Role in Reporting Never Events

Facing the Ever-Changing CMS Landscape

September 24, 2008 • 1:00 p.m. Eastern Time
Presented by - Mary Meysenburg, MPA, RHIA, CCS

Proper coding and documentation of a patient’s condition upon admission is a critical factor in the reimbursement process. This webinar provides an overview of the Health Information Management (HIM) department’s role in collecting and reporting of diseases and procedures, as documented in the medical record, through claims to private and governmental payers with an emphasis on healthcare associated infections. ICD-9 diagnosis coding, definitions used in reporting POAs and the billing process will also be explained.

Can’t attend the live event? Visit our BD Vacutainer® website and register for the recorded version, available soon.

Register today at www.bd.com/vacutainer

Accreditation: This webinar is eligible for 1 contact hour of P.A.C.E.® Continuing Education Credit.

BD is an approved provider of continuing education programs in the clinical laboratory sciences by the ASCLS P.A.C.E.® Program. P.A.C.E. is a registered trademark of American Society for Clinical Laboratory Science.