Educational commentary is provided through our affiliation with the American Society for Clinical Pathology (ASCP). To obtain FREE CME/CMLE credits, click on Earn CE Credits under Continuing Education on the left side of the screen.

**Florida licensees, please note: This exercise is NOT intended to fulfill your state education requirement for Medical Errors. It will fulfill requirements for Supervision / Administration.**

**Learning Objectives**

On completion of this exercise, the participant should be able to:

- explain the importance of positive patient identification (PPID) in preventing patient harm;
- identify preanalytic errors that can be reduced or eliminated by using an electronic positive patient identification (EPPID) system; and
- recognize the two primary technologies used for EPPID systems.

**Commentary**

In 1999, the Institute of Medicine’s (IOM’s) *To Err is Human* stunned the public with the finding that preventable medical errors kill patients.¹ In 2001, the IOM released *Crossing the Quality Chasm*, which highlighted information technology as a key mechanism for improving patient identification.² In the laboratory, it galvanized a focus on patient identification during specimen collection processes that continues today. Electronic positive patient identification systems have become increasingly sophisticated and can contribute significantly to decreasing preanalytic errors and improving operational efficiency in the laboratory.

**Preanalytic Errors**

The majority of lab errors occur during the preanalytic phase.³⁴⁵ Examples of preanalytic error include patient misidentification, incorrect collection method, and inappropriate methods of specimen transport and storage.²⁴⁵ These errors can increase turnaround time, which in turn delays diagnosis and/or treatment. Such delays can extend emergency department visits, compromise other testing such as imaging, and unnecessarily complicate patient care. Additional blood draws can contribute to hospital-acquired anemia, an increasing concern in critically ill patients. Other consequences of errors in patient identification can be more grave, such as transfusion of a blood product to the wrong patient, unneeded surgery or other procedure, a missed diagnosis, or delays in treatment or diagnosis that alter the patient’s outcome.
In addition to identifying the correct patient, electronic patient identification systems can provide collection information that can prevent rejected specimens and redraws. Tube types, special collection or transport instructions, complete legible information on labels, and the correct number of labels for the ordered tests can greatly reduce the number of redraws. Another benefit is that real-time tracking for collections can prevent duplicate draws and better manage timed draws.

Table. Common preanalytic errors and associated impacts.

<table>
<thead>
<tr>
<th>Error</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Misidentified patient (wrong blood in tube)</td>
<td>Wrong/delayed treatment or diagnosis, incorrectly transfused, risk of transfusion reaction, medical record incorrect, cost and/or suffering based on outcome, reject and recollect specimen</td>
</tr>
<tr>
<td>Duplicate draw</td>
<td>Unnecessary blood draws on already ill patients</td>
</tr>
<tr>
<td>Mislabeled specimen</td>
<td>Reject and recollect specimen</td>
</tr>
<tr>
<td>Wrong specimen</td>
<td>Delayed testing</td>
</tr>
<tr>
<td>Unlabeled specimen</td>
<td>Unnecessary blood draws on already ill patients</td>
</tr>
<tr>
<td>No specimen received</td>
<td></td>
</tr>
<tr>
<td>Misc. - transport instructions not followed, wrong collection time, etc.</td>
<td></td>
</tr>
</tbody>
</table>

The laboratory and healthcare organization also feel the impact of collection errors. The impact to workflow is costly and can negatively affect the culture of the facility. Calculating the cost to the laboratory is fairly straightforward and includes staff time and reagents/supplies. It is harder to determine the cost impact on the organization as a whole, because multiple providers and departments are involved in the care of the patient.

An economic analysis of redraws in the emergency department of a 225-bed hospital put the cost per redraw at $300. Because the hospital emergency department needed to redraw patients 10,013 times per year, this error cost the hospital $3 million annually. Other organizations report financial savings after implementing barcode systems of varying sizes and complexity.

Positive patient identification systems can significantly reduce preanalytic error. The impact of errors to the patient will be decreased quality of care and possible injury, as well as added cost. There is a significant financial impact to the healthcare system. It is likely that most organizations under estimate the financial impact of preanalytic errors.

American Proficiency Institute – 2017 1st Test Event
EDUCATIONAL COMMENTARY – HANDHELD SCANNERS, BARCODES, AND POSITIVE PATIENT IDENTIFICATION: HOW TECHNOLOGY CAN IMPROVE PATIENT SAFETY AND IMPACT LABORATORY OPERATIONS (cont.)

EPPID Technology

Correct initial identification of the patient and the absolute linking of all specimens to that patient throughout the entire testing process, including collection, analysis, and reporting, is the goal of PPID.9 Two major technologies are currently used in patient armbands for EPPID, barcoding and radio frequency identification (RFID), with barcoded bands being more common in the United States.

Barcodes

Initially, barcodes provided a more reliable method of identifying patients, simply by removing the inherent risk associated with verbal confirmation or reading and recording a name/number. As information technology evolves, barcodes also link the patient quickly and efficiently to clinical information, providing a complete look at the patient's healthcare record.12

Graphic 1-dimensional (1D) codes were the first wave of identification code and are still used in laboratories for specimen identification. These barcodes store a number that links to a specific patient, account, test, or specimen. They are quickly scanned and have a very low error rate in the capture and decoding of data and immediate integration of the decoded data into the database. This makes them a fast, reliable method of identification in a relatively low-cost product. Their main disadvantage compared to alternatives such as 2D codes and RFID, is that they have a relatively low storage capacity of approximately 20 to 30 digits.

Because 2-dimensional (2D) barcodes are much denser than the 1D version, they use approximately one-tenth of the area required to store the same information. They are capable of storing alphanumeric characters including letters, numbers, and punctuation. The increased volume and complexity of the data require a longer processing time. Advanced multimedia capabilities are being incorporated into camera-equipped mobile smart phones and personal digital assistants (PDAs), enabling these relatively inexpensive devices to replace the otherwise costly dedicated 2D code readers/decoders.

The main advantage of 2D codes is the simple technology. 2D codes can be very easily generated and printed on a variety of paper or plastic labels or on any other surface without the use of specialized equipment. Users can also use a smart phone to read and decode barcodes. The camera-based optical capture of 2D code-based readers requires close proximity to the patient’s bracelet to capture the code, adding an additional element of mistake-proofing to the process.13
A typical wireless barcode-based EPPID system consists of barcoded patient wristbands, handheld computers onto which orders are downloaded, barcode scanners used to confirm patient identity before blood specimen collection, and portable printers to generate labels at the bedside.

**RFID**

Radio frequency identification is an alternative to barcodes. Data is encoded on a chip embedded in a label or tag. RFID may be active (allows continuous monitoring) or passive (requires close proximity but no direct contact). Typically, RFID chips are able to hold more information than a barcode and can be read automatically with no requirement for user action. Unlike barcodes, direct line of sight is not required to read an RFID.

Although more expensive to implement than barcode technology, active RFID technology has some unexpected benefits in identifying workflow patterns and limiting exposure to infectious patients. A pilot study in Hong Kong was motivated by an outbreak of severe acute respiratory syndrome (SARS). RFID can be scanned from an extended range, eliminating unnecessary direct contact with infected patients. Patient encounters are tracked and recorded to assist with infectious disease tracking and management. Transport and treatment of patients is more efficient as the patient’s location can be clearly identified at any time. The same tracking technology can be used to map traffic patterns for staff and equipment directly into spaghetti diagrams for ongoing lean assessment of the workflow. Further, these records of activity can help determine actual equipment use, support redesign, or supply financial validation for new equipment or staff.

Because it can be read from a longer range, RFID technology in the healthcare environment has some limitations. There is the potential for the wireless reader to connect with the wrong patient if multiple patients are in a small area. Graphic barcodes avoid that ambiguity because of the close proximity required between the barcode and the scanner/reader. RFID also carries the risk for electromagnetic interference with other medical devices.

An application called SurgiChip was implemented at The Orthopaedic Institute in Florida, where RFID is used to help prevent surgical errors. At the time of admission, a smart tag is generated containing patient data, site of surgery, and specific surgical information and instructions. The RFID tag is read by a dedicated scanner, and before surgery it is placed at the location on the patient’s body where the surgical procedure is to be performed. The information obtained from the label is communicated to and corroborated by the patient before he or she is sedated. The tag is read again in the operating room and
the surgeon verifies that the information corresponds to the ID number and to the clinical data printed on the patient’s wristband. Only when all the information matches does the surgery proceed.17

**Biometric ID**

Biometric identification uses a unique physiologic marker to provide PPID. Eye and hand vein scans are the two most commonly used markers. They are highly effective, but more expensive and complex to implement, making them less common than barcodes or RFID.

**PPID and Regulatory Guidelines**

Using a barcoded armband or other PPID allows a laboratory or healthcare system to meet regulatory guidelines and accreditation standards.

The Joint Commission first made patient identification a Patient Safety Goal in 2003 and it remains Goal 1 in 2017.4,18 The goal is simply to improve the accuracy of patient identification. Specific elements apply to the laboratory:

- Use at least two patient identifiers when administering medications, blood, or blood components; and when collecting blood samples and other specimens for clinical testing.
- Label containers used for blood and other specimens in the presence of the patient.18

The College of American Pathologists (CAP) also states that their number one patient safety goal is to improve patient and sample identification.19

In a 2004 Final Rule, the US Food and Drug Administration (FDA) proposed barcoding at the point of care for medications and blood product delivery.20 In addition, the rule requires the use of machine-readable information on container labels of blood and blood components intended for transfusion.21

**EPPID Studies**

Patient identification is the first category of errors addressed when implementing an electronic positive patient identification (EPPID) system. Errors generated by patient misidentification have the potential to negatively impact patient outcomes and can be significantly decreased by the use of technology. A review of 17 studies evaluating specimen barcoding practices found that barcoding is effective in reducing errors in patient specimen and laboratory testing identification in diverse hospital settings. Snyder et al. concluded that barcoding can be recommended as an evidence-based best practice.22
Hospitals across the United States have implemented EPPID programs. Brigham and Women’s Hospital in Boston (a 777-bed facility) implemented an EPPID system, and labeling errors fell from 5.45 to 3.2 per 10,000 specimens. Patients reported higher rates of wristband verification before phlebotomy and scored the phlebotomists higher in professionalism during the collection process. To improve non-phlebotomy collections, the hospital implemented a new collection module that allowed non-phlebotomists to scan the patient’s wristband and the specimen label to link them at the bedside. Average monthly preanalytic errors decreased significantly, from 7.95 to 1.45 per 1000 specimens in the emergency department and from 11.75 to 3.25 per 1000 in inpatient nursing. The rate of decrease was similar for mislabeled, unlabeled, wrong-specimen-received, and no-specimen-received errors. Most residual errors (80% in the emergency department and 67% in inpatient nursing) occurred when clinicians and other staff did not use the new system as designed.

Valley Hospital in Ridgewood, New Jersey implemented an EPPID system and reported an 82% decrease in the rate of incorrect or incomplete labels, from 0.017% to 0.003%. In Memphis, Tennessee, St. Jude Children’s Research Hospital reported an 84% decrease in the incidence of mislabeled specimens, from 0.032% to 0.005%. A study at Howard County General Hospital in Maryland, which implemented a blood product administration process that linked all phases of the process, found that the wireless barcoded system was 30 times more likely to catch errors than the previous manual method. Specimen rejection rates dropped from 1.82% of collections to 0.17%.

Another study found that an electronic system that included collection instructions on the label resulted in a two-fold to three-fold decrease in all measured preanalytic errors in primary care. A 10-year retrospective study found that a restrictive specimen-acceptance policy, computer-generated PPID systems, and interdisciplinary cooperation significantly reduced patient identification errors.

In all these institutions, patient satisfaction increased as PPID errors decreased. Implementing a barcode system has a strong, evidence-based track record for preanalytic error reduction and improved patient experience. The error reduction can be attributed to the electronic positive patient identification (EPPID) system and increased access to order and collection information.

Conclusion

Barcoded armbands as part of an EPPID system have a strong, evidence-based track record for reducing preanalytic error, improving patient identification, and generating operational efficiencies, and are recommended as a best practice. The error reduction can be attributed to both decrease in patient identification errors and increased access to order and collection information. Reducing or eliminating
identification and other preanalytic errors through EPPID is associated with an overall cost reduction and improved patient outcomes.

References and Suggested Reading


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