Clinical Chemistry

Recognition of the Prehospital Preanalytical Phase: Collaborative Efforts between Laboratory Medicine and Emergency Medicine to Ensure Quality Testing

Article:
Octavia M Peck-Palmer, et al.
Recognition of the Prehospital Preanalytical Phase: Collaborative Efforts between Laboratory Medicine and Emergency Medicine to Ensure Quality Testing.
Clin Chem 2020; 66:998-1005 https://doi.org/10.1093/clinchem/hvaa140

Guest: Dr. Octavia Peck-Palmer is an associate professor in the Department of Pathology at the University of Pittsburgh School of Medicine.

Bob Barrett: This is a podcast from *Clinical Chemistry,* sponsored by the Department of Laboratory Medicine at Boston Children's Hospital. I am Bob Barrett.

In the United States, some 145 million patients are seen in hospital emergency departments and a significant percentage of those arrive by ambulance and other modes of emergency medical services. Emergency medical technicians often deliver complex care to patients while enroute to the hospital that includes performing point-of-care testing and administering medications. Such interventions delivered during transport may have a significant impact on the accuracy of in-hospital testing and prompt unnecessary specimen collections that aim to investigate abnormal test results. These added collections may prolong care and lengthen the turnaround time from specimen collection to results for other tests or medically necessary procedures. A Q&A feature appearing in the August 2020 issue of *Clinical Chemistry* examined the pre-hospital phase during emergency medical transport and asked five experts to share their perspectives on how to identify and mitigate pre-hospital challenges and also how to build multidisciplinary relationships to ensure quality testing. The moderator of that feature is Dr. Octavia Peck-Palmer. She is an associate professor in the Department of Pathology at the University of Pittsburgh School of Medicine and she is our guest in this podcast. So doctor, what are pre-analytical factors and how do they impact the accuracy of test results?

Dr. Peck-Palmer: So, there are three phases of the total testing process which include the pre-analytical phase which is the pre-testing phase; the analytical phase, the testing phase; and then the post-analytical, or the post testing or reporting phase. Pre-analytical factors are introduced in the pre-analytical pre-testing phase and there are variables such as test ordering. The physician or the healthcare provider may order the incorrect test. They may order the test repeatedly. There may be some transcription error as to who the patient is. There are also variables such as patient biology, so, ingestion of foods or supplements or medications that may

© 2020 American Association for Clinical Chemistry

interfere with test methods that are used in the clinical laboratory.

The patient may have engaged in strenuous activity that can acutely increase in vivo concentrations of the analyte that you may be trying to measure in the clinical lab. The patient may have diseases that increase analytes that could interfere with other test methods such as high lipids and cholesterol, auto antibodies, heterophile antibodies, and human antibodies to mouth antibodies that are actually employed in the clinical laboratories method. There can be sample collection variables, improper phlebotomy techniques for blood, urine, cerebral spinal fluid, or other standard and nonstandard body fluids. That includes disinfection of the collection site, the time, the tourniquet was used, collection using the wrong device such as a small needle that could lead to the lysis and damage of red blood cells and platelets, blood collection from the wrong patient, blood collected into the wrong collection container, blood collected via an intravenous line that is used to deliver nutrients and medications and thus, it can contaminate the sample.

There are handling and transportation variables such as the healthcare provider or the phlebotomist not mixing the sample properly. And so the anticoagulants in the blood collection tube are not properly mixed with the sample. The sample can be exposed to extreme temperature conditions or vigorous shaking, and then lastly, variables in the sample processing. So appropriate time lapse between sample collection and processing and how those delays can artificially cause in vitro elevations or decrease of the analytes that the clinical laboratory wants to measure. So, many clinical laboratories employ instrumentation that can detect and semi-quantify certain pre-analytical factors.

Free hemoglobin to determine the degree of hemolysis, elevated bilirubin for the status of the icteria and lipids, how lipemic is the sample. So, these pre-analytical factors may acutely increase the analyte of interest or interfere with accurate measurement due to the chemical reaction that's used by the lab. So, it is important that we identify the pre-analytical factors that have a potential to impact patient testing because that ultimately can lead to delayed management or diagnosis or unnecessary additional testing and interventions and have a negative clinical impact on the patient's physical, emotional, and financial state.

Bob Barrett: What specific pre-analytical factors are present in patients being transported via ambulance or air ambulance that may differ from patients arriving at the hospital via their own personal car?

© 2020 American Association for Clinical Chemistry

Dr. Peck-Palmer: There are pre-analytical differences that exist between these patient populations that the clinical laboratory should appreciate and the key difference is that unlike patients who arrive to the emergency department via personal transport or walk-in, patients arriving via EMS transport have a higher tendency to have received interventions via oral, intravenous, intramuscular, or intratracheal tube. And so during transport, these interventions can lead to significant interference on the accuracy of in-hospital testing and prompt unnecessary specimen collections as we start to try to investigate abnormal test results that are obtained by the clinical laboratory.

An example is emergency medical technicians may administer hydroxocobalamin, a hydroxylated form of vitamin B12, to combat the patient's inhalation injury or cyanide toxicity. And so, this agent turns the blood and urine a deep purple color and the hue of the sample causes an interference with colorimetric methods that are employed by the clinical laboratory. Another consideration is that patients transported to the emergency department can be transported between interfacilities such as other outside hospitals or nursing homes. And patients may have received a host or a variety of several medications that can interfere with appropriate and accurate testing. Such agent is propofol. Propofol is a short-acting anesthetic and it has a lipid carrier attached to it. And so, these patients may present to the emergency department having significant lipid contamination and lipids can interfere with accurate testing on certain platforms employed by the laboratory.

Bob Barrett: So, how can the clinical laboratory reduce or eliminate the impact of pre-analytical factors on clinical testing?

Dr. Peck-Palmer: So, the clinical laboratory can reduce or eliminate the impact of pre-analytical factors on clinical testing by developing a working relationship between the clinical laboratory and stakeholders and in this disregard, the stakeholder is the emergency medicine service or the emergency medicine group. Collaboration during the pre-implementation of tests that will be performed in the pre-hospital setting is important. Playing a role in performing a risk assessment of the test menu in the pre-hospital setting is imperative.

Reviewing the point-of-care tests that are going to be offered and the susceptibility risks that occur. So, instrument power considerations that are needed for the point-of-care test. What are the regular instrument maintenance protocols, the appropriate storage or reagents both in the emergency transport vehicle and off the emergency transport vehicles. Defining acceptable test system operation conditions. In the case of the air

© 2020 American Association for Clinical Chemistry

ambulance or the airbus, how does flight, the altitude elevation, impact accurate testing in flight? What are the stable flight and driving conditions? Are they appropriate to still have instruments operating during that time. Additional safety functions such as temperature alerts or quality control failure lockout is important to enhance successful instrument performance.

Bob Barrett: How can laboratorians build relationships outside of the laboratory and educate health providers on the impact of these pre-analytical factors in clinical testing?

Dr. Peck-Palmer: I believe that everyone wants to work with the clinical laboratory. Many times, they are not sure who their contact person is and it is our goal to move outside of those walls and build those relationships. Many times, there is an issue, a problem that has occurred. That is the time that laboratorians should take the opportunity to help solve that problem. It's important that laboratorians and emergency medical services physicians and technicians actually understand each other's testing expectations, the protocols that are being employed and the culture itself of each of these disciplines.

Laboratorians can familiarize themselves with their state emergency medical services guidelines to understand what procedures and interventions emergency medical services technicians actually perform and where there is collective interactions between both laboratorians and the emergency medical services, we can identify key stakeholders, both in the pre-hospital setting and within the emergency department.

We can start building relationships with outpatient transport groups and also with our inpatient groups. We should start to define how our healthcare system actually values patient care. What are the initiatives that align with pre-hospital testing, the quality efforts, the initiatives to minimize blood loss and the main focus of patient comfort. So, I have a couple of steps and a recipe that I like to call, "How to Engage Stakeholders?" One, you're defining the problem. Two, you're engaging the stakeholders to assess their perspective of that problem. Three, you're formally going to develop collectively a method to track this problem and outline the parameters to which you both agree you can capture the issue, you can put a timeframe or a period of which that issue should be captured, and then you can identify how each of the disciplines will contribute to not only the data collection, but the analysis of the data. You're defining expectations together in order to solve a problem.

Four, now, you're going to collect and analyze the data in a collaborative manner. Five, you're going to identify

© 2020 American Association for Clinical Chemistry

methods to address the problem and you agree on the next steps and six, you employ new methods or interventions to reduce or minimize the problem and you assess your outcomes on a regular basis. Many times, this recipe involves the clinical laboratory and the stakeholder. Specifically, the clinical laboratory quality team. Regulatory individuals within the hospital, the medical director of both the pre-hospital settings and the clinical laboratory supervisors, lead medical technicians, technologists, emergency medicine technicians, medical leadership, nursing leadership, and compliance officers, all can work in developing relationships that foster accurate testing.

Bob Barrett: When you said that word "regulatory," what regulatory guidelines or resources can clinical labs use to develop customized protocols to identify and reduce or minimize pre-analytical factors in their healthcare system?

Dr. Peck-Palmer: Although guidelines for the pre-hospital setting are lacking, the clinical laboratory can use several pre-analytical phase resources developed for the in-hospital setting and translating, customize them to their pre-hospital setting. Development of external quality assessments are important in which the laboratory and the stakeholder can identify and establish for their own institution, healthcare system quality indicators. These quality indicators are specific to your pre-analytical phase and you can employ both the clinical laboratory and the emergency medicine services experts in reviewing the individual steps of the pre-analytical phase and allow each of the groups to identify areas that they feel are susceptible that lead to inaccurate testing.

The College of American Pathologists for which the majority of the clinical laboratories in the United States participate, have specific requirements in the CAP checklist concerning pre-analytical expectations from positive patient identification to sample labeling to test menu development to communication with your healthcare providers. Additionally, the International Federation for Clinical Chemistry and Laboratory Medicine Working Group, Laboratory Errors and Patient Safety, have outlined a guideline for quality indicators that are important for the total testing phase. So, identifying quality indicators imported to your pre-analytical phase in your hospital is important.

And lastly, the International Standard 15189, the medical laboratories requirements for quality and competence, is a resource that laboratories can use which allow the laboratory to identify pre-collection activity and collection activity that is specific to the healthcare provider and the users, specific on how the sample was collected. How was it transported and ultimately, how was it processed and stored

© 2020 American Association for Clinical Chemistry

for future testing? All of these are resources that the clinical laboratory can develop for use right now for their pre-hospital settings.

Bob Barrett: Well finally doctor, how can labs ensure continuous success of reducing the negative effects of pre-analytical factors in their healthcare systems?

Dr. Peck-Palmer: Quarterly review with your stakeholders can lead to continuous success in reducing the negative effects of pre-analytical factors.

Quarterly review allows you to be abreast of any changes in test methods that are being used in the pre-hospital setting. It allows you to do comparative studies. It also allows you to look back retrospectively at how your initiatives have had positive impacts on patient outcomes, whether those patient outcomes are turnaround time for results that are obtained on the patient. Whether they include the length of stay in the hospital or various managements that have led to better health or financial savings for the healthcare system as a whole. Quarterly reviews are important.

Another way that the labs can ensure continuous success is through developing electronic identification opportunities in which the laboratory can have real-time alerts as to pre-analytical factors that may negatively impact accurate testing. Our healthcare system and others have developed both manual and electronic processes to identify pre-analytical factors. Deployment of electronic identification of pre-analytical factors can be effective. Once the pre-analytical factor is identified and the electronic health record through either physician or nurse test ordering or pharmacy administration of medication or interventions, the clinical lab can be alerted real time and can prepare how to handle the patient sample.

That preparation can include either having an electronic cancellation of the order with the detailed, but concise comment as to why it's being canceled or by the sample being delayed and collected at a later time in order to minimize the interference that may impact accurate testing. So, the lab can then prepare to either use a different type of specimen, whole blood versus plasma or serum, or a different test method to measure the analyte itself. These are ways to ensure continuous success in reducing the negative effects of pre-analytical factors in your health care systems.

Bob Barrett: That was Dr. Octavia Peck-Palmer from the University of Pittsburgh School of Medicine. She served as moderator for a Q&A feature appearing in the August 2020 issue of *Clinical Chemistry*, on the topic of collaborative efforts between

© 2020 American Association for Clinical Chemistry

laboratory medicine and emergency medical services to ensure quality testing. I'm Bob Barrett. Thanks for listening.

© 2020 American Association for Clinical Chemistry