Clinical Chemistry

Preanalytical Errors Introduced by Sample-Transportation Systems: A Means to Assess Them

Bob Barrett: This is the podcast from *'Clinical Chemistry'*. I am Bob Barrett. One of the major factors contributing to delays in returning laboratory results to patients is sample transportation. Sample quality can be compromised if exposed to extreme temperature and physical forces during transportation.

These uncontrolled temperature induced errors are often prevented with environmentally controlled transportation containers. However, the effects of excessive physical forces applied to medical samples are poorly understood.

Pneumatic tubes, which are in widespread use for transporting medical samples to the laboratory, substantially reduce turnaround times and are a less expensive alternative to constructing satellite laboratories. Yet, during transit in pneumatic tubes, samples endure rapid accelerations, radial gravitational forces, and sudden decelerations.

These harsh physical forces have long been thought to contribute to preanalytical errors, owing to stress to or even rupture of plasma membranes of erythrocytes and lymphocytes.

Recent technological advancements have made it possible to measure the environmental factors that influence medical samples while on route to the laboratory in a pneumatic tube carrier.

And a paper published in the October issue of *'Clinical Chemistry'* from Streichert and colleagues detailed the utilization of small recording accelerometers to capture temporal environmental data and correlate it with laboratory reported values for pediatric blood samples.

Dr. Robin Felder of the Department of Pathology at the University of Virginia wrote an editorial on the Streichert paper and noted the concrete evidence for a causative link between physical forces and changes in serum parameters. Dr. Felder is out guest in this podcast.

Dr., as automation becomes more prevalent in the delivery of laboratory services, what kinds of issues do you need to be on the lookout for in terms of automation induced errors?

Dr. Robin Felder: Well, automation is simply going to do exactly as programmed, and there's also the issues that -- like even your dishwasher and your refrigerator, it fails occasionally. So automation related issues are, one, is it programmed to do the right thing at the right time? -- and we all know about the complexities of a clinical lab -- and two, is there a plan for a failure? Like anything; like your dishwasher and

refrigerator, you depend on them, so if it goes down all of a sudden, there is back up of unmentionable proportions in the laboratory.

Bob Barrett: Well, in the specific example of automated specimen delivery via pneumatic tube, what kinds of physical forces were shown to affect specimen quality?

Dr. Robin Felder: Well, unbeknownst to the people using pneumatic tubes, I mean it's kind of out of sight, out of mind. So you put the sample in at one end and it shows up in the lab and you aren't even the person who loaded it, two different people. So there's a process that's completely dissociated from the people using it.

And behind the walls, the specimen is going through a wild roller coaster ride till it gets to the final destination, and usually the laboratory.

So in that wild roller coaster ride, in fact, unlike roller coaster rides, those samples are subjected to extreme turns, rapid decelerations in the switching stations, and then the final bump when it arrives in the laboratory. All those issues, those forces can cause damage to the specimen in various ways.

Bob Barrett: What kind of steps can be taken from laboratories that rely on pneumatic tubes to prevent these issues?

Dr. Robin Felder: Well, pneumatic tube systems are generally a fairly old technology and have not been tweaked or fine-tuned often in many years.

I was just visiting a large medical center in the Midwest just yesterday and they have some tube systems that go over a quarter mile and yet they haven't checked them in 15 years.

So the article in *'Clinical Chemistry'* about what's going on with specimens and the issues of tube systems have got them thinking about, oh, maybe we will call our tube manufacturer and we will adjust the speeds. We can slow them down. Especially if you are going from pediatrics to the lab, that may be a good place to look at how fast your tube is moving, and maybe it really doesn't need to get there in 15 seconds, and an extra 30 seconds might preserve the specimen.

Bob Barrett: Are there other automated systems that can potentially lead to specimen error?

Dr. Robin Felder: Certainly the issues of sampling, getting the sample out of the tube and into aliquots, those can lead to errors at times. There are the issues of tube sorters that can be stirring the

specimens up inappropriately. There are places specimens can rest where you may bring them to the laboratory and refrigerate it. But in an automated system they may be holding up for various reasons and they can be getting warmer than you anticipate.

So there are many places in the process, if you don't understand your process and document your process, where errors may be introduced.

Bob Barrett: Well, outside of errors, what other negative influences can automation have on laboratory operations?

Dr. Robin Felder: Well, I don't want to focus on the negatives. Automation is really a tremendous benefit to the laboratory. But I would say other areas that you might be cautious about, one is post-analytical errors, once the sample has been sampled by your automation system and then it's going to be stored somewhere, exactly how is that storage happening? Are the aliquots you are saving adequate for the job at hand?

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If something is marginally hemolyzed, there's not as many people handling specimens, and so the sample quality issues can sometimes get passed right through the system, and it may be just suboptimal for some detection systems and analyzers, but a problem in other places, especially if you are going to store it and reuse it in the future, those are things you need to look at in addition.

Now, to the rescue are coming technologies that will actually examine specimen quality at various steps along the entire processing chain, and that will assist and prevent those kinds of issues.

Bob Barrett: Well, do you think that laboratory should employ and train certified automation experts to deal with this highly complex area? And is there a certification program in automation?

Dr. Robin Felder: Absolutely! This is a place where it's a big gap in our current knowledge base and our current certification area. And one, people learn automation just by doing, but they often learn automation on one kind of system, and there are many basic principles that transcend all of the systems out there.

So people should be trained in a modest amount of engineering, particularly systems engineering. They should -- and I am actually personally working on developing a Board Certification process so that somebody could be Board Certified in Medical Automation.

We have completed the publication of three textbooks that lay the foundation for the field. And so I anticipate within the year that there would a course material you could take and a test that you could pass and then you would be essentially a Board Certified -- first you are going to be a Laboratory Automation Specialist and then you could actually get your Medical Automation Board Certification, which will allow you to put your fingers into other interesting areas like nursing, pharmacy, sterile supply, which could be of use to an entire medical system.

Bob Barrett: Dr. Robin Felder is from the Department of Pathology at the University of Virginia and has been our guest in this podcast from *'Clinical Chemistry'*.

I am Bob Barrett. Thanks for listening.

Total Duration: 7 Minutes