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Smartphones Can Monitor Medical Center Pneumatic Tube Systems

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Guest:
Dr. Garrett Mullins is currently a clinical chemistry fellow at the University of Virginia specializing in pre-analytical variation mass spectrometry and toxicology.

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

Pneumatic tube systems have become a primary way of automating the transport of clinical specimens in medical centers. These may travel within the floors of a building and also between buildings. Although this provides convenience and speed of transport, the excessive acceleration forces and the prolonged time and distance travelled have been linked to pre-analytical variation including hemolysis of blood specimens. As a result, it has been suggested that users regularly assess the forces encountered in a pneumatic tube system.

A letter to the editor in the June 2016 issue of *Clinical Chemistry* offers a relatively low cost widely available solution for how to do this using a smartphone equipped with an application for logging data. The letter is supplemented with a video captured during an experiment showing the tubes experience a wild ride while in transport within the pneumatic tube system. And we're joined by one of the authors of that letter, Dr. Garrett Mullins, currently a clinical chemistry fellow at the University of Virginia, specializing in pre-analytical variation, mass spectrometry and toxicology.

So Dr. Mullins, how did this project get started?

Garrett Mullins: Well, the idea of using smartphones to monitor the pneumatic tube system all started with some various student nurses that are actually in a particular location of our hospital system. And what happened is they noticed some lactate dehydrogenase results that were unexpectedly high. These results didn't really fit their clinical picture and so they contacted the lab and we began to look into why in this one location, we were getting high lactate dehydrogenase measurements. So we started to look at how we transported the samples from that location to our testing facility which is done by pneumatic tube system and

after some investigation, we found that this particular pneumatic tube system route was causing sample hemolysis. All the other routes that we checked throughout the hospital, and throughout the medical center really, didn't cause that hemolysis to happen.

So the big question then became, what's so different about this one route, and that's when we started sending smartphones through to assess what was happening in each of these routes.

Bob Barrett: And why is this important in the hospital setting?

Garrett Mullins: It's a good question. I mean as we all know, getting a reliable result is important for managing patient care. And I think in a lot of cases, we set up this pneumatic tube systems, they are very common. It's a popular way to transport patient samples from the patient care facility to the testing facility. So once we set up these tube systems in a lot of cases, we don't do much to ensure that they're not causing any problems in the future. So I think this is an essential thing that many medical centers can really benefit from, which is to monitor the pneumatic tube systems very frequently and I think it can prevent pre-analytical errors and in this case caused by hemolysis. And I think what's really fun and interesting is that the smartphone method really was so simple and cost-effective and really hopefully can become a very common way to do this.

Bob Barrett: Well what makes this method especially useful? What are the benefits of using a smartphone to monitor the tube systems?

Garrett Mullins: We actually looked around and we tried to get our hands on a data logger that is equipped with an accelerometer but it's designed to give you kind of some readouts when you send it through pneumatic tube system. And you know, at least for us, it was very hard to get our hands on one of these. So as you're thinking about it and realizing that pretty much any smartphone nowadays is equipped with the same type of accelerometer, we search for some apps and we're really -- I think it cost a $1.99 to download an app--and as long as there's someone that has an old smartphone laying around which nowadays most everyone does, it really became this almost free, very inexpensive and convenient way that we can just send the phone through and have that data readily available immediately to tell us what was different about this one tube system route that wasn't happening in all the other tube system routes in the hospital.

Bob Barrett: Do the phones survive?

Garrett Mullins: Yeah, that's a good question. We're using two old phones, one was mine and one is my attending, Dr. Bruns's. So I used mine first to make sure it wasn't going to break. We just wrapped in a little bit of bubble wrap. And pretty surprisingly, there are a lot of impacts going on as you can see from the video that came with the paper, but the phones did okay. One of the screens got a little bit scratched but we don't mind because they're just old phones that were just sitting in our drawer anyways. But yeah, especially with a screen protector, I think even without bubble wrap, it will probably be okay.

Bob Barrett: Apple, Android or does it matter?

Garrett Mullins: We have only done it with Apple. We've done it with two iPhone 5s and that's just because that's what we had available. There wasn't any real logic going into that choice. The apps that we used are available for both Android and for Apple. And so it all just depends on the quality of the accelerometer and I'm sure with both companies, they are very comparable. So I had assumed that it would work with Androids as well but it would be something to check on in going forward.

Bob Barrett: What do you hope will come of this work?

Garrett Mullins: Hopefully, this can really be a solution for a lot of medical centers that use pneumatic tube systems that, because there's not an easy way to monitor them, maybe they're not monitored very often. So hopefully, this is a convenient, reliable, cost-effective way for these hospital systems to ensure sample integrity is preserved while transporting those samples through the pneumatic tube systems.

Bob Barrett: Where do you go from here? What are the next steps now that this technique has been introduced?

Garrett Mullins: I think there are a lot of applications of this method of using a smartphone, and I think one nice things is that because it's so easy, it can be tailored to the needs of each medical center that uses it. As far as the next steps for us here in the University of Virginia, our plan is to use this extensively in our system to monitor our sample transport through the tube system, and we're also really interested in developing an app that is designed specifically to assess the risk of hemolysis during transport through the pneumatic tube system. And I think that's a pretty cool application that you can assess the risk of hemolysis just using a smartphone app without ever having to draw blood and send it through and do a bunch of experiments to see if you actually get hemolysis.

Bob Barrett: Dr. Garrett Mullins is currently a clinical chemistry fellow at the University of Virginia specializing in pre-analytical variation mass spectrometry and toxicology. He's been our guest in this podcast from *Clinical Chemistry*. And be sure to head over to the *Clinical Chemistry* website where you can see a supplemental video showing what happens to a blood tube while it's in a pneumatic tube system.

I'm Bob Barrett. Thanks for listening!