By Molly V. Strzelecki

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Not a Flight of Fancy, Drones are Put to Use in Sample Transport

A Q&A with Dr. Timothy Amukele

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Serving resource-limited countries to ensure they have proper medical care is a challenge. Add to that fact transporting laboratory samples to obtain diagnoses over terrain that has low-quality or no roads at all, and improving the health of people in need becomes an even greater challenge.

As new technologies emerge, getting samples safely and unharmed to a laboratory when there is not one nearby is one of the issues being tackled by one of the latest pieces of machinery to make headlines: the drone.

Timothy Amukele, MD, PhD, is the lab director for Johns Hopkins Bayview Hospital and an assistant professor of pathology at Johns Hopkins Medicine. He also serves as the medical director for Makerere University-Johns Hopkins University Research Collaboration Core Laboratory in Uganda. Dr. Amukele is the lead author on a paper published in the November issue of *AJCP*, "Drone Transport of Chemistry and Hematology Samples over Long Distances," which looks at this new method of transportation for medical purposes and assesses its value to the laboratory. *Critical Values* spoke with Dr. Amukele to discuss the findings and what drones could mean for laboratory services in resource-limited and remote areas.

Critical Values (CV): Tell us about the study. What did it entail?

Timothy Amukele (TA): The idea of this study was to validate conditions for using drones [to transport samples] when there are no roads. Although this often applies to poor countries, it can also apply to remote areas of [other] countries. It's not just a low-resource challenge; anywhere you have a bay, and the bridge is two hours away, while the other shore is only 10 minutes by drone, it's a challenge, a need. There are lots of places like this, even in the US.

So the idea was pretty straightforward: find another way to move things around. The challenge with biological samples is that they're pretty fragile. Our focus has been figuring out the range of acceptable transport conditions. How hot? How cold? How far? How long? What kind of drone? We had done previous studies that looked at drone usage for the most common tests done in a lab, then moved on to micro, then to blood units. Initially we looked at 30 minutes [of flight time], but we extended it to three hours because of a really practical reason—someone had contacted us about setting up a drone network, but they wanted to cover 100 kilometers one way, which means 200 kilometers round trip, and we hadn't tested that. We had originally thought that 30 miles would be the maximum distance most people would want to fly, but [now] we thought, "Let's do something to test the range people are actually interested in."


Dr. Amukele

CV: What did you discover?

TA: In three prior studies we conducted, we found essentially no difference in the samples that were flown vs. the samples that were not flown. And that's what you want to see if you're using drone transportation. But with this study, we saw some effects of the flights. [One] effect was in the glucose and potassium, which are known to be finicky in lab testing anyway, so that part wasn't surprising. So now we know for those labs that are as far away as three hours or in hot places, either we should not use drone-transported samples for glucose, or we have to be really careful about controlling the climate on the drone.

All the other analytes were pretty stable. We did 19 tests, and of the 19, only two had an issue. The reasons for publishing our findings were twofold. One was to share what we found. The other, to my mind, was to share how anyone should approach these kinds of validations on drones.

Because eventually drones are going to be everywhere, we can't just adopt this technology assuming it's okay for everything. If you look at pneumatic tubes that they use in hospitals to move things around, 99% of the time they're great, but there are some specimen types or analytes that

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Photos courtesy of *AJCP*. Clockwise from left: A custom-built cooler was used to transport samples. The authors built a custom box under the drone's fuselage to transport the custom-built cooler. Sleeved vacutainers were placed in two biohazard bags in the custom cooler.

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don't do well in pneumatic tubes, and those you have to walk down to the lab. With drones, it's the same kind of thing: figuring out what the parameters are, which is what we're doing for this new technology.

CV: Were there any surprises about this study?

TA: One thing that was surprising was the samples on the drone were in a custom-built cooler. We couldn't buy one, so we had to build it. And what was surprising was that the samples in that cooler did better than the samples that were just sitting in the car for three hours with the air conditioning on, because we tried to control the climate in the car.

It tells you a lot about what we assume are okay processes. If someone showed up at our clinic, having driven samples in a car for a couple hours to get them to us, we wouldn't necessarily ask if that's okay. It underscored some of the really basic things that we all know, but forget: transport conditions matter—otherwise your sample is essentially of no value.

CV: What are some of the concerns with using drones to transport samples?

TA: One concern is the amount of customization it takes to work with drones currently. The drone we used was built for things like inspecting railway lines. It was not built to carry medical cargo. We had to design a bay underneath the fuselage to hold the sample and then build the custom cooler. I'm not an engineer; as a medical person trying to answer a medical question, we really had to grow our engineering expertise because it became very clear that the field is not quite yet set up to address [certain] medical needs. We've had to build these things from the ground up.

The second is that although people are getting more comfortable with drones, there are still some concerns around how safe they are. We don't know as much about drone safety as we do airline safety. We can look at airplane data and say planes flew 10 million miles last year, and there were ten near misses and one accident. But for drones that data just doesn't exist. Currently a lot of drones are owned by hobbyists. It's hard to get the data, but the indications that we have suggest they are quite safe, and safer than cars. And that's interesting because, while drones are replacing cars, they're not replacing airplanes. When we think about drone safety, it's better to look at it as one less car on the road. So the risk to pedestrians is reduced by drone flying.

CV: What does your study mean for the future of samples being transported by drones?

TA: I think it's pretty positive. The fact that most of the different test batches were not affected is great. And even [for] those that were affected, our data showed that that if the environment is really well controlled, they're not affected. It shows that drone transfer is a real possibility.

It's like any other lab process that requires validation and the same kind of careful monitoring. And that's a really important message right now because what I see in the drone world is a lot of hospitals and health systems are thinking of drones, and thinking of them only as an engineering problem. It's not simply, "Let's go hire a drone company to do this." It's an engineering problem, but it's also a medical problem, because engineers can build the drones, but they cannot ensure the stability of the cargo. As laboratory professionals, what we care about is the sample, the cargo.

Drones are exciting now, but in 10 years they will be common, and we will still care about the cargo. So the cargo is our focus, and you're incrementally learning about this new form of transportation that's out there; it's coming, but it requires the same kind of rigor that we bring to other kinds of validation in the laboratory.

CV: Are more validation studies needed?

TA: I think so, because drones are not yet standard in the way cars are. Drones today are kind of like how cars were in the 1920s. Each car was its own thing, and what you did on one was not transferable to the other, so you had to learn each car that came out. Drones are still in that kind of space; they haven't yet become the same kind of reproducible vehicle. So these validation studies are needed, at least for the near future.

To read the full paper, visit www.ajcp.com.

Ms. Strzelecki is Senior Editor of *Critical Values* magazine.

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