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One Bad Apple Can Spoil the Bunch: The Impact of Contamination in the Clinical Laboratory

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Guests: Dr. Hannah Brown is a Clinical Chemistry Fellow at Washington University in St. Louis. Dr. Chris Farnsworth is an Associate Professor of Pathology & Immunology at Washington University in St. Louis and Medical Director of clinical chemistry and point-of-care testing at Barnes Jewish Hospital in St. Louis, MO.

Bob Barrett: This is the latest podcast from *Clinical Chemistry*. I'm Bob Barrett. Contamination in the clinical laboratory is an often-overlooked topic that can negatively impact laboratory staff and hospital patients.

In one sense, contamination can be defined as the presence of infectious agents in a patient's sample that present a risk of infection for laboratory staff.

In another sense, contamination can mean the introduction of a foreign substance into a patient's sample or laboratory instrument that affects the accuracy of reported results. Although, clinical laboratories have robust quality control procedures and many other performance indicators, contamination events are generally not tracked or reported.

As a result, there is relatively little published information regarding best practices for effective detection and decontamination. A Q&A feature appearing in the January 2023 issue of *Clinical Chemistry* examines this very problem. Clinical laboratorians with expertise in clinical chemistry, microbiology, molecular genetic pathology, and infectious disease weigh in with specific emphasis on the impact of clinical laboratory contamination on the safety of laboratory staff and accuracy of reported test results, methods to identify contamination, and measures to prevent contamination in the first place.

In this podcast, we're excited to talk with the two moderators of the Q&A feature. Dr. Hannah Brown is a Clinical Chemistry Fellow at Washington University in St. Louis. She is joined by Dr. Chris Farnsworth, Associate Professor of Pathology and Immunology at Washington University and Medical Director of Clinical Chemistry and Point-of-Care Testing at Barnes Jewish Hospital in St. Louis.

And Dr. Brown, let's start with you. Many of our listeners may be surprised to hear the contamination can occur in the

clinical laboratory. Before we dive into further discussion, how do you define laboratory contamination?

Hannah Brown: I think it's important to first acknowledge that laboratory contamination is a relatively broad, diverse, and often overlooked topic. Simply speaking, laboratory contamination is something that shouldn't be there, whether that's environmental--so like foreign particles such as fiber particles or hair, chemical--so, non-living substances such as fluids or interfering drugs, or biological, such as bacterial, viral, molds, or yeast contamination.

Contamination can occur at any point in the testing process including sample collection, processing, storage, transporting, and analysis. It can have serious and widespread negative impacts on diagnostic testing, such as rendering a sample unsuitable for testing or yielding incorrect results, and on laboratory staff such as exposure to infectious agents, radioactive materials, or other hazardous agents that can be inhaled or absorbed.

Despite quality control procedures designed to detect contamination events, the number and types of contamination in the clinical laboratory are generally unknown and rarely reported. Furthermore, there is limited data in the available literature detailing procedures for effective decontamination. So, in a real sense, contamination is the dirty laundry no one wants to talk about but couldn't be more important.

Bob Barrett: Well, that dirty laundry contamination might not mean the same thing for different types of clinical labs. Dr. Farnsworth, can you share some of the unique perspectives of the experts that you interviewed?

Chris Farnsworth: Yeah, this was a really fun question to ask these panelists since they provided such unique viewpoints from their various clinical perspectives. So, a couple of the experts really discuss contamination in terms of how we as laboratorians will contaminate the specimens or even the environment around us leading to inappropriate or wrong test results for our patient specimens.

So, for example Dr. Jonathan Genzen, who's done some really interesting research regarding the use of topical ointments and creams and how they interfere with lab results, really kind of spoke through this lens. Dr. Melanie Yarbrough, who is a microbiologist, shows her own perspectives in contamination, specifically with how we might contaminate blood culture plates. Introducing organisms that weren't previously there and ultimately giving bad results for our patients. And then similarly, Dr. Andrew Bryan also discussed

the potential for contamination of molecular tests, particularly in core labs opposed to the specialized molecular testing labs.

So, again these are all areas where we as laboratorians are introducing some type of contamination to the specimen leading to inappropriate lab results but the other side of this coin is how specimens are tested in the clinical lab and how they may actually impact our staff. So, several of our experts actually weighed in on the possibility of laboratory acquired infections from specimens, hardware, and blood-born viruses such as HIV or hepatitis-C.

However, a lot of the work actually in this area has been more recent and a lot of it was born out of laboratorians having to deal with Ebola and the potential impact to lab staff when you get instrumentation for example that's contaminated with patient blood. So, kind of along the same vein, Dr. Ann Gronowski really discussed the potential of non-infectious outcomes from laboratory contamination. So, she's done some really interesting research on dealing with radioactive substances that are given to patients on various types of chemotherapies and how they are still circulating in the blood at times when they arrive in our laboratories. Just perspectives that we don't often think about.

And then, the final perspective though is given to us from Jamie Philips Deeter, who works for Roche Diagnostics, and she really interesting said the importance of both systems, to reduce likely contamination from the lab to the laboratory and also from the laboratorian to the lab, which as a hospital laboratory director, I find very encouraging to know that our corporate and industry partners are really thinking of this in terms of both lenses because that's how the experts really seem to think about it too.

Bob Barrett: Dr. Brown, how did these experts say that laboratories should identify contamination?

Hannah Brown: So, I think recognition of contamination varies across laboratory discipline, as do the tools and techniques used to identify and monitor it. So, the experts provided perspectives of how labs should identify contamination, from perspectives in fields of clinical chemistry, microbiology, molecular genetic pathology, and infectious disease. So, while each expert provided unique recommendations, there were several overarching themes that emerged.

Generally speaking, established protocols such as those suggest by the College of American Pathologists are widely used to monitor contamination and the analytical process. Routine evaluation of QC, delta checks, negative controls, and environmental monitoring can be critical to early detection of contamination.

Several of the authors also mentioned their use of wipe or swab tests to monitor contamination and mitigate concerns. Further, unexpected results should be further investigated to determine validity of the results in question. However, monitoring contamination of laboratory personnel is more difficult. Risk contamination for handling infectious specimens is critical to ensure proper protocols are taken to minimize risk of contamination and ensure the safety of laboratory personnel.

And while the safety of laboratory personnel is typically overseen by occupational health, true lab acquired infectious rates, like radioactive exposure, are not monitored, which is something that was mentioned by many of our experts. The experts also stressed the importance of standardizing this process for investigating and reporting these events in the future and hopefully that'll help mitigate contamination.

Bob Barrett: So, how can labs reduce the chances of contamination occurring in the first place?

Hannah Brown: This is a really good question. As the most effective way of handling contamination in the clinical lab is to reduce the chances of contamination occurring in the first place. The most practical measures include monitoring for contamination, using PPE, establishing decontamination strategies before a contamination event occurs, and utilizing equipment that's been designed to reduce contamination and enable optimal result integrity, such as biosafety cabinets and closed automation systems, which is something that was struck by multiple of the experts.

However, the best policies are meaningless without the buy-in from laboratory personnel, especially laboratory leaders who are critical to promoting a culture of cleaning, holding others accountable, and ensuring mitigation procedures to ensure continued compliance.

Chris Farnsworth: I think what I would add to this particular question is that from the perspective of most laboratory staff, areas in this arena are often secondary to lack of knowledge about the topic. So, sometimes the staff do relatively innocuous things that increase the likelihood of contamination. For example, they may open the specimen for molecular testing, not under a biosafety cabinet like they should, but near the molecular instrumentation, potentially contaminating the environment and leading to false results.

Now, most likely these things are protocolized but if they haven't read the protocol, they've forgotten it, or they just don't realized the importance, that really-really kind of contributes to the contamination rates. I think further when

we think about the potential risks of the specimens to laboratorians, they might not actually know the risk that blood-borne pathogens actually pose to them. They know they should wear gloves because someone told them somewhere along the line they should wear gloves but they don't necessarily understand the "why" or that a large proportion of our patients have infectious diseases that are blood-borne viruses circulating in the blood.

So, as a result, because they just don't know, they don't necessarily do anything with that or they don't pay as close attention to that advice as they should. I think this is somewhere where we, as leaders in the lab, are really called to step-in and provide training and feedback to our staff to help reinforce why these procedures and rules exist.

The second thing that I occasionally see in my lab is that staff sometimes skirt these rules because they're actually trying their best to help the patients. So, the example I see occasionally are grossly contaminated specimens that are in specimen bags often from a syringe or tube that's broken open and blood has leaked out. In our lab, I have actually asked my staff to please redraw these samples. So, I think there's a real risk to them handling the specimens. So, I would rather wait 10 minutes to get a new sample than potentially put them at risk, and there's a lot of apprehension with this at first because they want to do right by the patient. They felt bad thinking there could be a patient that's critically ill and we're asking for a new specimen.

While I think it's a really incredible thing for a staff member to have that attitude, it's also important we help them find that balance to make sure they maintain their safety as well.

Bob Barrett: Well, finally what lessons have we learned from dealing with lab contamination in the context of the pandemic, and looking ahead how can we apply this information to be better prepared for similar events in the future?

Chris Farnsworth: I think one of the greatest outcomes of the pandemic from the perspective of contamination in the laboratory is that we didn't see this meteoric rise in illness to laboratory staff even though we're handling countless numbers of respiratory specimens from a ridiculously contagious virus. A lot of measures that we have from mitigating risks to our staff are working. I think this is a huge win. However, when I think what we've learned from both COVID and even Ebola within a laboratory community is that we do not fully grasped the need for disaster preparedness.

And what I mean by this, the policies, procedures, and even instrumentation, we haven't fully thought through what are those things and we have them in place to allow us to respond

to emergencies in a way that keeps the lab protected while providing accurate patient results. I think in both Ebola and COVID, we've had to be reactionary and develop these things kind of by the seat of our pants as we've gone.

I'm hoping that we as a laboratory community have started to recognize that this is very likely not the last time we're going to be called on to react in a chaotic time and hopefully now we can begin planning accordingly so it's slightly less reactionary. One example from my own hospital system has been the context of Ebola. We've actually kept a satellite lab up and running with procedures, policies, on-call staffing, they practice donning and doffing special PPE, call-down lists, et cetera, all in the case that a highly virulent and deadly pathogen starts circulating in the U.S. again. That way we can respond rapidly as opposed to having to take months to get these things up and running.

So, this is a labor-intensive program and when I think the easiest route would be just to shut it down, save money, resume normal operations. Because there's currently not really a pathogen that meets the needs for this laboratory but once again in an emergency, now we are prepared to be able to react far more quickly than we would otherwise.

I think another example that we think about maybe a little bit here locally in St. Louis is preparedness with regards to natural disasters. So we reside pretty close to a huge fault line, which thankfully hasn't slipped in a long time, but if there was a massive earthquake and we lost power or water, how would we as a lab be able to respond? Which instruments would we use? How will we supply results? What would happen if we didn't have power? Electronic medical records?

I think these are conversations that are just starting to happen now in our system and hopefully across the U.S. as a result of COVID-19. I think this is something that'll be a great benefit if we see something like COVID or another disaster in the future.

Bob Barrett: That was Dr. Chris Farnsworth and Dr. Hannan Brown from the Department of Pathology and Immunology at Washington University in St. Louis. They served as moderators for the Q&A feature on contamination in the clinical laboratory in the January 2023 issue of *Clinical Chemistry*. And they've been our guests in this podcast on that topic. I'm Bob Barrett. Thanks for listening.