Microbiology Trainer: from high school to high containment

Suzanna Hawkey, Senior Microbiology Trainer, Novel & Dangerous Pathogens Training, Public Health England

Thank you for the opportunity to come here today and share my career with you. Hopefully I will be able to pass on some of the top tips I've learnt for getting a career in Biological Sciences, and give you an insight into what my job is all about.

So how did I get where I am? Apparently, when I was about five I said that I wanted to work with blood and bones and my grandmother, who was a nurse, showed me her nursing books and I reportedly said "this is what I wanted to do". I carried on through school, quite liked art, but went the science route. Came here and did my Biological Sciences degree. My module combination meant I ended up with a Zoology specialism, so I thought I'd really quite like to work in the jungle studying orangutans and things like that. But then I realised as a poor student that this maybe wasn't the best career choice. So I stayed on at Leicester for another year and did a PGCE in Secondary Science and then did teaching for a while back where I used to live. I then moved to Cornwall, did a bit of supply teaching and then in the summer holidays there wasn't any work, so I ended up at a job fair for the NHS and that's where I found Clinical Microbiology.

After doing a few weeks in the summer holidays volunteering at the haematology department, they said "there's a job coming up in Microbiology, why don't you go for that?" Then I found out my degree wasn't actually accepted by the Institute of Biomedical Science to be a state registered Biomedical Scientist. I then had to top up my degree, distance learning with Ulster University for several years. That then turned into a Masters in Biomedical Science, and I ended up in research at Porton, which I will describe a little in a second. After doing some research I went back into being a Biomedical Scientist and I was the senior Biomedical Scientist in our reference laboratory called the Rare and Imported Pathogens Laboratory. I'm now in the Novel and Dangerous Pathogens training team, so I've gone full circle back into education and training, because of all of the experiences I've been through. I never really thought I would end up working in a centre for world excellence in high containment microbiology when I left University, so one of my tips for you would be that you sometimes just have to go with the flow and see where you end up.

Public Health England, was established in 2013 and it bought together 70 organisations in to a single public health service. We aim to protect and improve the nation's health and I obviously work in the National infectious service part of Public Health England, but we've got about 5000 staff, mainly scientists and researchers, but we've got all the fields now into one organisation to cover infectious diseases, diabetes, smoking, obesity, all of the different health problems.

Public Health England Porton (PHE) supports in preparation and response to health threats by providing high containment microbiological research and reference capabilities. We have an international reputation in this area of expertise. The site was actually first started in 1916 because of the use of gas as a chemical weapon in World War I. So the

Royal Engineers set up a station, then for quite a long period of time the UK Military ran the site. There were threats of biological weapons in World War II as well, and in 1952 they built the current site where I am working. As I said, it was originally part of the military site, but in 1979 the site was split into the public health Centre for Applied Microbiology Research and, across the fence, the military Defence Science Technology Laboratories (DSTL). We have really good communication with them, and we also get contracted to do some work for them because of our long history in working with the same kind of pathogens and the containment required for them.

In 2003 we joined the Health Protection Agency and the site was then called the Centre for Emergency Preparedness Response. Later in 2013 we were put into Public Health England. Recently, because we have pharmaceutical vaccine production facilities on site, they have now split off into an independent company called Porton Biopharma. They produce the UK anthrax vaccination, also a treatment called Erwinase and also we still get royalties for a product called Dysport, which is basically the same as Botox using *Clostridium botulinum* toxin. That is where we are now and it is a great site to work on because you've got lovely fields and countryside around you.

We get involved in emergency response and have to respond and help with things such as Ebola. In the last year we have trained over 350 people that have volunteered to go out to Sierra Leone to help diagnose Ebola in the laboratories there. Zika is really prominent in the news at the moment. One of my colleagues in the Rare and Imported Pathogens Laboratory actually developed the diagnostic test used in the UK. We've actually had the test for it for years and now obviously it is coming to good use. A particular bacteria I have worked on quite a lot over the years is *Bacillus anthracis* which causes anthrax. It keeps popping up every couple of years, In 2006 there was a bongo drumming incident where the person got inhalation anthrax, then in 2008 another bongo drummer also got inhalation anthrax. In 2009 whilst I was working in the Rare and Imported Pathogens Lab, we had an outbreak of anthrax amongst injecting drug users. We had to provide 24 hours, 7 day service for all of the labs across the country to send us samples which they thought might contain *Bacillus anthracis.* Then just before Christmas, we had a cow crop up in a Wiltshire village not far from us that had anthrax. Even though these things are quite rare, they do keep popping up every now and again.

Moving on to my current department, we provide biosafety and applied microbiology training to a huge range of customers. We can provide live agent training for NHS staff, so they can come and have a look at these rare bacteria. We do a lot of hands on practical training. Sometimes we have to provide scenarios. I don't know why but they keep asking me to be an ill person in a scenario to throw up onto a doctor! We are also developing e-learning, so that we can provide a blended approach to training laboratory staff.

To give you an idea about what containment actually means. Laboratory workers are at higher risk of infection than anybody else, because they are actually handling biological material with unknown pathogens potentially in there. In the UK we put huge emphasis on using practices and equipment to protect our laboratory workers, because this protects everybody in the laboratory. So, if you have an organism that is infectious by the aerosol route, you want to put that into containment equipment, so that it protects everybody.

After emphasise on these areas, then personal protective equipment, PPE, is the last physical barrier between you and what you're working with. Elsewhere in the world they put greater emphasis on PPE, so lots of other places they will be wearing respiratory protection, respiratory PPE, to protect them from aerosols, where as we would rather put it into a piece of equipment to get rid of the aerosol, so it protects everyone.

If these control measures fail then obviously people can be vaccinated for pathogens where there is a vaccine available, but this doesn't prevent them from becoming infected, it just reduces the severity of that infection and then obviously prompt prophylactic treatment will prevent the severity of that infection. Really, the emphasis needs to be on good laboratory practice to break the chain of infection.

All of the work is covered by risk assessments and this includes categorising the pathogens we work into four groups, category 1-4, based on their ability to cause infection in humans, how transmissible they are to other people and if there is treatment available for them. Examples of hazardous group 4 would be Ebola, Lassa and Marburg, all of those types of haemorrhagic fevers. In category 3, we have things like *Bacillus anthracis* and *Yersinia pestis*, the cause of plague, and lots of other pathogens as well. In category group 2 these are the general things you will find in clinical microbiology labs, organisms like *E.coli* and *Staph aureus*, common causes of infection.

To go with the different categorisation of pathogens, we have different levels of containment laboratories. Containment level 2 lab is the most common time type of laboratory across the country, where you are just working on the bench. Obviously, you have controls in place for storage of biological material and how you handle them, but also you've got basic PPE and if you're working with liquids and other things you will be wearing eye protection as well. In containment level 3, you then use a variety of different containment equipment to protect you from the infectious aerosols that you might generate during your processing.

Commonly in a hospital lab in a CL3 they will have a microbiology safety cabinet and it's called a class one. Class two cabinets are generally used for cell culture, tissue culture and things like that. Then we've got the flexible-film isolator and the class three cabinet, which are basically a sealed box and you work in big rubber gloves, so you've got a complete physical barrier between you and whatever you're working with. The hazard group is a guide to the containment level and there are circumstances under which organisms can move up a level or require use of a particular piece of equipment. For example *Neisseria meningitidis*, which causes meningitis, would be cultured in a containment level 2 lab in a hospital, but then once you've got that culture, you'll put it into a class 1 cabinet in a CL3 lab, because you've now got a lot of it there and when you manipulate it you can generate an infectious aerosol.

We can always bump things up and at PHE Porton we have about 70 containment level 3 laboratories, so we've got the most in the country and we work a lot in these class 3 cabinets because we are doing research on known hazard group 3 pathogens at high volume and titre that we are researching, so we are going to put it in a box, so we know we are going to be fine to work with it. Then containment level 4 laboratories, they have

combined class 3 cabinets, so the sample goes in one end, you've got microscopes, incubators, centrifuges, everything you need in there to process the sample and its killed before the waste ever comes out of that cabinet.

We have scientists come into the agency for training, or if we are providing it for other agencies, then it is important to bear in mind that they don't know what they don't know. That's a very dangerous situation in a laboratory because they might do something and then have an accident, so we need to quickly move them to knowing they don't know something! Then through training and experience, we can say they are consciously competent, they know that they know. That's a great place to be. But after a while you get complacent and you do things without even knowing it, so it's like driving from A to B and not knowing how you got there, even though you did it safely. The only situation when this is a good idea in microbiology is in emergency response. If you want someone to know what to do if there's an accident, you just want them to respond without having to think about it. But most of the time when they are working in a laboratory we want them to be conscious of what they are doing.

There's no such thing as a typical day as a microbiology trainer, it all depends on the type of course that we are running throughout the year, or you are preparing for the next course. We've had to do some things at short notice because they will say "we need to respond to the Ebola outbreak in Sierra Leone, we need you to train volunteers to go out there". All of last year was basically training volunteers to go out to Sierra Leone. Before that it was the Olympic Preparedness. We are always delivering courses, but I'm also a containment level 3 laboratory supervisor and have to do lab work as well as all of the paperwork that goes along with it. We also get to do a lot of international travel. I've done training in Azerbaijan about six or seven times. I've done training in lots of other places too. Then there are a lot of conferences in Europe, because we go to the European Biosafety Association Conferences. Then there are events coming up this year in Thailand, India and China.

Our courses entail both theory and practical sessions and a whole wide range of different areas. It's really good to train laboratory scientists and make scenarios and deal with: what we do if you have that spill; how we can remove PPE safely so you don't contaminate yourself. Getting the trainees doing it and experiencing it is the best way to learn because, as scientists, we are hands on, we need to do stuff. But there is always an amount of theory we have to cover as well.

In the lab, my project for my Professional Doctorate in Biomedical Science was on *Bacillus anthracis* in blood cultures. Unlike a standard PhD it's a professional Doctorate, which was really good for me as I could study part time. It took about 7 years. The outcomes weren't fundamental research, so my outcomes had to be professional based. I looked at training for front line lab staff to identify anthrax, also the biosafety of the actual processing of samples, is it going to generate an aerosol and also some diagnostic techniques using molecular and general bacteriological methods.

We get to go in field as well. So I got to go to Italy and sample known sites for anthrax associated with dead cows, which was quite interesting because we were wearing all sorts

of protective equipment and the farmer was just washing his hand in the pool of water we'd just sampled for anthrax. Dealing with Ebola has taken over our life for the past year. The workers who are actually dealing with patients have to reply on PPE, because the patients are bleeding and vomiting. Coping with all of these bodily fluids, they need all of that equipment to protect them, whereas in the laboratory we can work with the samples inside the flexible-film isolators, so we have a physical barrier between us. As a result our lab PPE is quite general. If we are using extra PPE it's most likely because there's loads of bleach everywhere and really strong fumes; you don't want to splash that on yourself, so all of the extra stuff is because of bleach. I got to go out to West Africa quite early, on over Christmas last year, and did a five week deployment in our diagnostic labs there. One of my reasons for doing that, other than obviously I had the skills and capability and wanting to help the country, was to enable me to bring back real-life experiences to our training for the next people we were then going to sending out. Everyone that went out also got a medal from the Queen for our services to the outbreak.

Finally we also do a lot of work with the local community, so I do get back into the school environment, though it is a bit scary now. We have done a lot of work with our local University Technical College including sessions on rapid Ebola diagnostics, to try and bring science, real what's happening now, in to the class room.

So to summarise my career to date. It's been a long time. I've been through teaching, into the hospital and ended up where I am. I don't know about the future, I will see what happens.

I've got some top tips for you:

- **Don't be afraid you're not always going in the direction you expect**. It's not always a straight line. There's always going to be different ways to go.
- **You don't know unless you ask, so always ask**. There is no harm in asking.
- **If you get a chance to go on some lab visits, or volunteer, it's great because you get to understand what the environment is like**. Most of the time you might actually be doing very mundane science in lab work and you've got to repeat experiments loads of time, but often it's the people in that environment that can make it a really good experience for you.
- **Be prepared for your interviews**. Find out about the organisation. You might have found that out because you've already gone for a lab visit.
- **Sometimes it's *what* you know that opens doors, but a lot of the time it's *who* you know as well**. I have met people randomly throughout time and it's those contact that then led me on to the next step in my career.
- **Read scientific literature**. There are loads of critical appraisal tools out there online, so if you look at a scientific paper use a tool to understand how that research was designed. Then you can pick out some really good important things from it and normally the abstract has to be as clear as possible to summarise the whole thing.

- **Health and Safety is always important**. Most of us think it's a really boring subject, but having been immersed in it over the years, then I know you're always going to come across it in a Biological Sciences career.
- **Team work is very important**. Again, it's not what you know, it's how you are with other people as well - you are always going to have to work in a team when you work in a lab.
- **Knowledge, skills and experience**. You are getting knowledge from university, but you will get your experience and skills from actually working in a laboratory, so don't go straight into the lab thinking "I know it all" and then get frustrated when you can't actually do it. It's going to take time to develop your skills and experience and that's what you do in the work place.
- **Relate what you learn to the real world**. A lot of the stuff I learned here at University didn't all make sense at the time, but then working in the real world it started to click.

Finally, when you know a subject well it can become funny watching TV programmes and films that get their microbiological procedures badly wrong. You spot the drama about anthrax in which the scientist is holding a vial of Bacillus anthracis – you'd NEVER just hold a vial, there would always have several layers around it. Also, in America, they use a suited system for their containment level 4, you might have seen it in films like *Outbreak*. So they rely mainly on their PPE and the rest of the lab is potentially quite dirty. But in some scenes in the film they've actually got a class 3 cabinet in the background, which is what we do in the UK, so you'd put the sample in the box and not have to be so reliant on PPE. Finally, you get examples where someone is looking down a standard light microscope but apparently seeing an electron microscopic image of what he is looking at. When you go throughout your career you will see things like that in the media and on films and you'll think 'Really, you haven't done your research'.

Thank you. Any questions?

Q: How did you come across your job in Public Health England?
A: If you go onto the NHS jobs website, you will see lots of jobs for labs in NHS, but also for Public Health England as well. PHE are also now classified as civil servants, so you can go on the Civil Service jobs website as well [PHE is one of the options in the "organisation" drop down menu]. I was just looking around randomly and found it. Once you are in the door, then you can move between departments quite easily.

Q: What is the most dangerous pathogen you have worked with?
A: Definitely Ebola, in Africa. The labs are very basic. We've got our pieces of equipment, isolators, that we know how to use and contain the samples, but the other side of a couple of layers of gloves is blood which is hooching with Ebola.

Q: From what you were saying, it sounds like imported drum skins are a bit of an issue for anthrax infection then?
A: There are regulations and guidelines on the importation and use of skins, including the need for decontamination. In the recent examples it was illegally imported skins being made into drums that caused the problems. If you've got a drumming workshop booked you ought to be fine!

Q: Have there been any kind of disasters or big mistakes that have happened since you have been working there?
A: I've dropped a couple of things inside one of the class 3 cabinets, but because it's all in a sealed box the spill was contained and I cleaned it all up.