Interview

Dr Wayne Nishio Ayre FHEA BEng (Hons) PhD FHEA

by Gayathri Kannan, Year 3, Cardiff University BDS

Dr Nishio Ayre is the lead for the Biomaterials Research Group at Cardiff University and taught me the topic of biomaterials in dentistry as part of the BDS Year 2 programme. As an extremely engaging lecturer who clearly possessed a passion for the topics he was involved in, I thought he would be a perfect fit to explore deeper into the application of biomaterials in dentistry and the concept of research as a part of your career.

What are you currently working on/please describe your latest research in biomaterials relating to dentistry?

I'm currently working on three different projects, all of them are looking at how we can exploit lipids for medical applications. The first project involves developing a metal implant coating made of lipids that responds to bacteria to release an antimicrobial and prevent implant-related infections. The second project is focussed on using lipid nanoparticles to prevent secondary caries by simultaneously releasing antimicrobials and encouraging remineralisation. The third project is a bit different; I'm working with researchers in chemistry, physics and medicine to develop a nanoscale infrared spectroscopy tool that identifies lipids in small cell derived vesicles so we can diagnose diseases in patient blood much earlier.

Picking a specific line of research, please briefly describe more about your project 'Exploiting bacterial virulence for triggered antimicrobial release from orthopaedic implants' and where else you feel exploiting bacterial virulence might come in handy.

Around 200,000 hip and knee replacement surgeries are performed each year in the UK and unfortunately around 3000 of these will experience an infection. This is a major problem as infections are much harder and more costly to treat, and in severe cases can result in amputation or even death. Existing ways of preventing these infections are not very effective and only provide short-term protection. Our research is coating implant surfaces with lipids that encapsulate antimicrobials. What's exciting about this approach is that the lipids can be tailored to release the antimicrobial only in the presence of proteins and enzymes produced by specific bacteria. This means the coating will always have a reservoir of antimicrobial stored and will only use it when needed. Our initial research also shows that the amount of antimicrobial released depends on the level of infection. This will hopefully help prevent any antimicrobial toxicity issues associated with very high antimicrobial concentrations and will also help prevent antimicrobial resistance by ensuring the amount of antimicrobial released is proportional to the amount of bacteria present.

What has been the most rewarding part of being a researcher in your field?

As cheesy as it sounds, I think I found supporting the next generation of biomaterials researchers the most rewarding. As you progress through academia, you realise you no longer have the time to do the exciting experiments in the lab. It's great to come up with interesting ideas and get the funding to pursue them, but it's even more rewarding to see early career researchers get excited about the research and see their reaction when things go well in the lab (which believe me is not often!).

What is the most exciting discovery/thought you have come across?

I think it was the discovery that we can incorporate lipid nanoparticles into any type of material. We found that using lipid nanoparticles to release antibiotics from bone cement resulted in much more prolonged levels of release and unexpectedly also improved the mechanical and fatigue properties of the material (something which had not been achieved before). The discovery was patented and also copied by a biotech start-up and we're now exploring how this approach can be used in dental materials.

What novel thing do you hope/expect to see in the future that you believe might be integral in dentistry?

I think the obvious one would be artificial intelligence (AI). In the past, biomaterials development was an iterative, trial and error process that involved making a material, testing it and hoping it would be better than the existing material. Unfortunately, this approach is really slow and expensive (it can take more than 10 years and millions of pounds for a technology to even get tested in a patient!). This results in thousands of exciting new materials being developed but never actually helping any patients. I'm hoping AI will be able to help design new materials, predict properties and also predict how they will behave in the body without the need to physically make and test all the materials one-by-one. This will reduce the time to develop and test materials and hopefully will help accelerate new biomaterials into the clinic.

Anything else you would like to add?

I've really enjoyed being a biomaterials scientist and also teaching undergraduate and postgraduate students about it. I think the one thing that keeps me engaged is that it's a very interdisciplinary field, which means I get to work with lots of interesting people from diverse academic backgrounds on really cool and exciting projects. I hope one day some of my research will benefit patients or at the very least, someone else will use my research for something interesting.

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