How would you explain your research to a high-school student?

Point of Care Biosensing using Luminescent Nanoparticles

Siobhán O'Connor [1]

1. Bernal Institute, Biomaterials Cluster, siobhan.m.oconnor@ul.ie

Summary

Concurrently with the debate of rapid antigen versus PCR testing for Covid-19, the focus of my PhD project is developing rapid, Point of Care biosensors for various biomarkers. Point of care biosensors are designed for use at the patient's side and while there is some surrender of accuracy, they are cost-effective, user friendly and time-saving making them highly effective in developing countries and emergency rooms. In my project, I use nanoparticles that light up in the presence of different biomarkers to design biosensors that can be used quickly and easily at the patient's side.

Main

Right now, there is a raging battle between super sensitive PCR tests for Covid-19 and rough and ready rapid antigen tests that Tony Holohan reckons give the same accuracy as a "coin-toss".[1] We are desperate for these antigen tests to be widely adopted to let us back into concerts, restaurants and pubs, especially for you, the younger cohort, for whom vaccinations haven't been offered yet. With advantages such as speed and simplicity, we have to wonder what's the story with these antigen tests and where do they fit into the healthcare world?

These antigen tests are a type of Point of Care biosensing, where the test is performed right beside the patient and are normally quick and cheap, similar to pregnancy tests where you get a result right away. My research focuses on designing tests like these, not to replace the heavy-duty lab testing (like PCR) but to work alongside it. This could be especially important in places like emergency rooms where you want to do a quick screen and get a result in a few minutes or even in developing or remote regions that don't have easy access to a hospital. Easy to use tests for illnesses like malaria already exist which can save time and money compared to sending samples to a lab to get analysed and ensure that people get the medicine that they need when they need it. While lab tests might be more accurate, if we can continually and quickly screen lots of people, we are much more likely to catch an irregular result or a problem showing up which is how the antigen tests are being used in other countries to prevent outbreaks of Covid-19.[2]

My biosensors are based on nanoparticles, which are just tiny particles only about 3 nm big, that can light up when I pass electricity through them. I prime them in such a way that they will only light up when a certain chemical is present – whichever biomarker of the illness that I'm looking for. So in a previous project, I primed them to light up when serotonin was present which is involved in many things in the body including mental health and the nervous system.[3] Similarly, they could be primed to light up when Covid-19 or another virus molecule was present and the amount of light that they give off is proportional to the amount of the biomarker present.

In the image above, you can see in (A) how a biosensor might look from my research where a drop of blood would fall on the sensor with nanoparticles on it, but I am very much in the proof of concept phase just yet. In (B) you can see a picture of the actual nanoparticles taken on a very high power microscope and in (C) you can see nanoparticles with different colours that give off light in these colours.

By the end of my project, I hope to have a good system with these nanoparticles that is able to sensitively and accurately detect different biomarkers for different illnesses. I hope that the system would be able to be modified for different uses and be cheap and easy to make. Most of all, I hope that we will be able to rely on the rapid antigen testing already there and be back in society, having fun!

References

Times New Roman Font 12 1.15 Spacing 800 words

(1) Meskill, T. Holohan Warns Antigen Tests "Not a Green Light." *RTE*. June 16, 2021.

(2) Santacatterina, F. EU Commission's Recommendation on Rapid Antigen Tests | Obelis Group https://www.obelis.net/news/rapid-antigen-tests-use-across-europe-the-eu-commissions-recommendation/ (accessed Jul 5, 2021).

(3) Baranwal, A.; Chandra, P. Clinical Implications and Electrochemical Biosensing of Monoamine Neurotransmitters in Body Fluids, in Vitro, in Vivo, and Ex Vivo Models. *Biosensors and Bioelectronics*. Elsevier Ltd December 15, 2018, pp 137–152. https://doi.org/10.1016/j.bios.2018.09.002.