Shining a light on disease: better diagnoses for coeliacs and cancer

Dodd-Walls Centre Postdoctoral Fellow Sara Miller is developing a faster, cheaper and more effective technique for diagnosing coeliac disease with the aim to then apply the same technology to a range of other gastrointestinal illnesses. Working at the University of Otago and alongside Dodd-Walls Centre Principal investigator Keith Gordon, the team plans to incorporate the new techniques into a device that could be used in standard medical procedures. Collaborating with laser specialists and industry advisers in the Dodd-Walls Centre and a gastroenterologist from the Dunedin School of Medicine they have a dream team of experts to realise the idea.

Nowadays, diagnosis of gastrointestinal illness is an uncomfortable, time consuming and expensive process. Firstly the patient undergoes an endoscopy; a camera on a fibre optic cable is passed down their gastrointestinal tract allowing the doctor to visually detect signs of disease. After this, biopsies are often required to confirm a preliminary diagnosis. These small samples of tissue, collected from the affected area, need to be individually prepared and analysed by a pathologist in the lab which takes time and money.

The multi-disciplinary team working together to impact the health of thousands of New Zealanders using laser light: Dodd-Walls Centre Ph.D. student Sara Miller *(centre)*, Dodd-Walls Centre Principal Investigator Keith Gordon *(right)* and Michael Schultz, Head of the Department of Medicine at the Dunedin School of Medicine.

Sara and Keith's idea is to provide an on-the-spot diagnosis by incorporating a range of laser spectroscopy techniques into the endoscope. Laser light will travel down the fibre-optic cable, bounce off the affected tissue, travel up the fibre and be analysed in a portable detection device. By building a database of the characteristic responses of different diseases they hope to provide reliable data for the diagnosis of a range of diseases and disorders including coeliac disease, cancer and irritable bowel diseases. In many cases this will remove the need for biopsies altogether. But if a biopsy is still required, the new instrument will help pinpoint the most at risk areas which will improve the accuracy of the result.

"One of the illnesses this would be really useful for is known as Barrett's oesophagus," Sara explains. "Currently doctors take blind biopsies in four quadrants every two centimetres over the area affected to monitor for cancerous and pre-cancerous changes. That can mean lots and lots of biopsies and it's completely blind as to whether its diseased tissue or not."

To begin with Sara and the team are focusing on coeliac disease. This is partly because of its prevalence. It is currently estimated that 60,000 to 70,000 New Zealanders have coeliac disease (one in seventy), however up to 80% of those are unaware they have the condition. Both Sara and Keith know people with the disease and they wanted to help. The other reason they chose coeliac disease is that it presents a really interesting and complex scientific challenge. Unlike cancer cells which are dramatically different to healthy ones, coeliac disease affects tissue in a more subtle way.

"We reckoned that if we could get the technique to work for coeliac, which is much more subtle, then it would work for any disease," says Keith.

One of the big advantages of this project has been the group's close collaboration with medical experts. When Sara first had the idea to study gastrointestinal diseases she had no idea whether it would be practically viable. A search for gastroenterologists at the Dunedin Medical School led them to Associate Professor Michael Schultz.

"I emailed him saying that we had a research idea and asked if he'd be willing to meet with us," Sara recalls. "He was very receptive so we were very lucky."

"Michael has been really useful in explaining to us what are good ideas and which ones won't work," says Keith. "It's very important to have someone like him who actually does biopsies and has real expertise in the problem we're trying to solve."

The support of the Dodd-Walls Centre has also been essential throughout the project. In the past, Keith and Sara have mainly focused on analysing the quality of products such as milk powder, wool, meat and plastic. They are experts at using laser light to understand complex materials. However this project involves some new and unfamiliar challenges.

"One of the critical issues is getting the light down and then back up the fibre," Keith explains. "These endoscopes are long and they twist quite a bit so you've got to be able to get the light up and down in a reliable way."

In this area Dodd-Walls Centre Principal Investigator Frédérique Vanholsbeeck from The University of Auckland has been an invaluable support. She understands how laser light behaves in fibre optic cables and has experience building small portable devices like the one Sara and Keith hope to create. The team has also received support and advice from Luke Taylor who works in instrumental prototype development for the Dodd-Walls Development Centre at the University of Otago.

"This means that we can deliberately target techniques and methodologies that can realistically be deployed in a fibre optic cable when someone is having an endoscopy," says Keith. "…we would have never taken on the project without having this supporting expertise."

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