Breath to diagnose liver disease

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Intro VO: *Welcome to the Ideas Lab Predictor Podcast from the University of Birmingham. In each edition we hear from an expert in a different field, who gives us insider information on key trends, upcoming events, and what they think the near future holds*.

Sam: So we're here today with Dr Margaret O'Hara who's a Medical Physicist and Daphne Jackson Trust Research Fellow, here at the University of Birmingham. Hello Margaret.

Margaret: Hello.

Sam: Can you tell us a bit about what you do here at the university?

Margaret: Yes, I'm a Medical Physicist, which means that I've done the first stage training in Medical Physics in the NHS but what we're doing now here is pure research and it's in breath analysis which is a slightly different branch of medical physics. What we're trying to do is investigate the proposal that we can use breath as a diagnostic medium. So instead of taking blood samples or tissue samples or something like that, we can take actually just a sample of breath and measure compounds which are contained in the breath at very small concentrations using very very sensitive mass-spectrometry and then trying to find things which are related to disease.

Sam: So your current project is focusing on volatile organic compounds in breath for the diagnostic of liver disease. What is it in our breath that tells us what's going on with the state of our liver?

Margaret: Yeah, this is an interesting question and actually it has quite a long history because it's been known for centuries actually that people with advanced liver disease have a particular smell on their breath. It's called 'fetor hepaticus' and it's been described as a sort of fishy smell and actually it's due to the presence of sulphur compounds. So sulphur compounds, organic compounds, are the kind of thing that make eggs smell and volatile organic compounds are little molecules which contain carbon, which is why they're called organic, and they're volatile which means that they evaporate at room temperature. That means you can smell them, so aroma compounds are kind of things that make perfume smell, that make foods smell, petrol even. Those kind of things contain volatile organic compounds and generally when they're at a high enough concentration you can smell them. But by that time in the case of disease, the liver disease is quite advanced and what we're trying to do is to use very sensitive mass-spectrometry. This can sense things way, way before the nose can. So the machine can, if you like, smell it before a person can smell it. So it's at a much lower concentration and the idea there is that we measure this before the patient becomes very ill, before the disease is very very advanced, so we pick it up in an early stage, hopefully at a point where some intervention can be used and perhaps not all the damage has been done.

Sam: So how much does this technology improve the existing diagnostic process for liver disease?

Margaret: You generally start off with a blood test but the trouble with a blood test is the things they measure in them are not all that specific for liver disease. There are other things that can cause them to be high so what you find is that about 90% of people who have an abnormal liver blood count have absolutely nothing wrong with their liver. So you end up following up a lot of people who've got nothing wrong with them and then also once you have been confirmed to have liver disease, the blood tests are not really fantastic at monitoring progress. There are other tests like ultrasounds but ultrasounds aren't very good in overweight or elderly people and that comprises quite a lot of people with liver disease because of fatty liver disease and because it can be a disease of age. So they're also not great, so the definitive way to diagnose liver disease is by biopsy and a biopsy is invasive, expensive and obviously you don't want to be having a biopsy if you can help it. But at the moment for cirrhosis that's really, you're really got to end up having a biopsy done. We wouldn't expect a new diagnostic technique to replace others, it's to add more information and it's to assist. So we will be looking at breath as a diagnostic sample instead of blood or using ultrasound or whatever and the idea there is that there is information contained within the breath, these volatiles, and we know there must be something in it because of this fetor hepaticus and if we can identify what they are, if you could identify those molecules and then work with bio-chemists, then you would have a chance of looking back into the bio-chemical processes in the body to see what it is that's going wrong. So not only would it help diagnosis, if you find levels of some volatiles which are high for certain diseases then obviously that's got diagnostic value. But it's not just that, it's the fact that you can then trace back, use the bio-chemistry and try and work out what it is that's going on in the body and that would give clues as to processes, and once you've got clues as to the processes that are occurring, then you've got a way to start thinking about ways to prevent it or ways to treat it.

Sam: Will this technology just be within the diagnostics or is there scope for treatment?

Margaret: There's kind of always scope for treatment from diagnostics. If you can figure out what's happening and you can figure out bio-chemically what's going on and trace back to processes that are occurring within the body and then you can come back up-line to see whether you can intervene to prevent that process occurring, or to treat to prevent the effects of that process. It may be that a volatile is a by-product of something that's happening that's causing other damage which can be prevented. So there is hope. It would obviously be in the long run, that once you've identified a molecule you can start to think how this will affect the patient and then also with the early diagnosis there is scope with the liver for repairing of damage by change of lifestyle. The liver is a really amazing organ. It can continue to work even when quite a large part of it is damaged and it can put up with a lot of abuse, a lot more than the other organs and if you stop the abuse, ie drinking alcohol, taking drugs and so on, your liver has a chance to recover up to a point, but you've got to get it before that point and most patients, because the liver compensates, you might feel a little bit rundown, a bit under the weather, but you wouldn't necessarily go to your doctor. You'd think oh, I'm not getting enough sleep or I've got flu or whatever and you just carry on and carry on. Your liver just compensates and keeps kind of soldiering on so by the time you see your doctor, for most patients actually the damage is done and there's no reversing it. So if you could have a test which was so non-invasive that you could do it, the GPs could just do it time and again. You don't want to be doing blood tests for no reason but with a breath test you could just do these every week if you wanted to and just keep a monitor, if a doctor's got a patient who drinks a lot of alcohol or who has a history of drug abuse or whatever and who thinks is maybe at risk of liver disease then they would be able to monitor them and then maybe be able to say 'OK, things are starting to happen so you have to change your lifestyle'.

Sam: Ideally years down the line how will this diagnostic process be implemented? Will it be through GPs, will it be through hospitals or even something that people can buy themselves?

Margaret: I think all of those things. We would start in hospitals. We're working with hepatologists at the Queen Elizabeth Hospital and if this has diagnostic potential, they would start to use it in clinic. But then if it does, if it is able to diagnose liver disease at an early stage, if we are able to see these early markers of change in the liver, then you could move it out to GPs. GPs might find that level for their high risk patients. There's a big obesity problem at the moment and fatty liver is one of the growing causes of liver disease and about 30% of people with a fatty liver will progress to cirrhosis. But the other 70% don't. So the other 70%, they just have a fatty liver and then it doesn't get any worse. I mean it would be very useful for the NHS actually to be able to monitor people, just to see who's progressing to liver disease and who isn't. At the moment these people are followed up in liver clinics, in hospitals. They have expensive tests done on them, biopsies and so on, and actually for 70% of them you don't need to. So this would be the kind of thing that GPs could do and then the kind of technology that we're using, it can be miniaturised. In the future it would be possible to have hand-held sensors for the volatiles of interest if we find these VOC's and we identify what they are. You could have an instrument which is just dedicated to those – it's very small and it will just measure them on its own. These are the kind of things which could potentially you could have at home and patients could do their own testing, you know, if you are worried about your alcohol intake or you've got a family history of the disease or so on, you have some other risk factor. It's so non-invasive, so quick, so easy, you could just be testing yourself on a regular basis to monitor your own health.

Sam: Fantastic. And the implications of that seem phenomenal so best of luck with all your research in the future and Dr Margaret O'Hara, thanks for joining us today.

Margaret: It's been a pleasure. Thank you.

Outro VO : *This podcast and others in the series are available on the Ideas Lab website:* ***www.ideaslabuk.com (http://www.ideaslabuk.com)*** *. There's also information on the free support Ideas Lab has to offer to TV and radio producers, new media producers and journalists. The interviewer and producer for the Ideas Lab Predictor Podcast was Sam Walter.*