

NAME

Exhalomics

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3 SPEAKERS

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Bettina Streckenbach

Renato Zenobi

START OF TRANSCRIPT

[00:00:07] Jennifer Khakshouri

Diagnosing illnesses with only a puff of breath. That's what scientists at ETH are developing at the moment. The idea is simple: I exhale into a tube and the collected breath provides information about my health. This method could change medical diagnostics completely. In this episode of the ETH podcast, two researchers will talk to me about working on the revolution of medical diagnostics. My name is Jennifer Khakshouri, and my two guests will each introduce the other.

[00:00:42] Bettina Streckenbach

So yeah, we've got Renato Zenobi with us. He's a professor of biochemistry analytical chemistry at ETH Zürich.

[00:00:48] Renato Zenobi

Bettina Streckenbach has been a PhD student for a bit more than four years now. She started by doing her master's thesis in my group, and that was a very interesting collaboration between my group and another group in the department. And it was clear that Bettina was motivated and interested. And so I offered her a position which she accepted.

[00:01:12] Bettina Streckenbach

He's an interesting person. So what strike me with him is that he is not only is a professional at his work, but also on his hobbies. So he's very talented in playing the violin. And yeah.

[00:01:28] Renato Zenobi

Bettina is somebody very thorough. She really likes to get things done to the last detail. She's also quite athletic. She does a lot of sports.

[00:01:43] Jennifer Khakshouri

Renato and Bettina, you're here to talk about breathing and breath and breath samples. We're here to talk about Exhalomics. Can you tell us in one sentence what Exhalomics is, Renato?

[00:01:55] Renato Zenobi

Well, Exhalomics is the chemical profiling of breath, because breath is not just some sort of air coming out. Breath is also full of messengers from the body, and we can determine those.

[00:02:11] Jennifer Khakshouri

And how can you determine those? Bettina, you brought something along.

[00:02:15] Bettina Streckenbach

Oh, yeah. I brought a spirometer with us. So this is one way to make use of information that you can gain from breath. But, like, so the spirometer that I brought is only focusing on, like, the volumes of breath that you're inhaling and exhaling.

[00:02:34] Jennifer Khakshouri

And to exhale into the spirometer is called spirometrics. Is that correct?

[00:02:39] Bettina Streckenbach

Yeah, You would call it performing a spirometry or a lung function test. Exactly. And that has been used for a long time now in clinics. So this is especially of use to define any restrictions or abstractions in the respiratory system. But this is specifically only to define volumes of breath.

[00:03:05] Jennifer Khakshouri

Could you please describe it to us? What does it look like?

[00:03:08] Bettina Streckenbach

Yeah. So the one that I brought here today is a portable device. It's rather small, so it's at the size of the hand and you're breathing through kind of like a tube. And the tube is measuring the flow of your exhaled breath and also the pressure difference. By that, you can define volumes that you're exhaling and inhaling. It's like a whole procedure that you have to follow.

[00:03:36] Jennifer Khakshouri

Can you demonstrate it to us, please?

[00:03:39] Bettina Streckenbach

Sure. So I'm putting my nose clips on. So right now I have the nose clips on and put my mouth on the mouthpiece.

[00:04:01] Jennifer Khakshouri

Renato is that Exhalomics?

[00:04:03] Renato Zenobi

No. Spirometry, as Bettina explained, is a purely physical measurement. It measures something like your lung volume, how quickly you can exhale. It's a lung function test. It doesn't give you any kind of metabolic or chemical information. And that's what we try to do with the Exhalomics to get the chemical, the metabolic information.

[00:04:24] Jennifer Khakshouri

So this is only step one in a sense?

[00:04:27] Renato Zenobi

Yes. Moreover, people with severely impaired lung function often cannot perform this maneuver. And small children - forget it. They would just maybe chew on the mouthpiece. But that's about it. They cannot perform a spirometry test, so it's only used for school age children and up.

[00:04:55] Jennifer Khakshouri

For this process of finding ways how to diagnose certain illnesses you don't take breath samples from a spirometer, but from a spectrometer. What's the difference of the two methods?

[00:05:06] Renato Zenobi

So in our laboratory, a test person would deliver the breath sample into a mass spectrometer. A mass spectrometer is nothing else but a fancy balance for molecules. We weigh the molecules, we determine the molecular weight very accurately. And when we know the molecular weight, we already have a very good idea what the compounds could be. And so if you have a certain person giving a breath sample, there is a whole profile of different signals coming from different molecules in the breath. Some of them are extremely low concentration. And we can measure all of these and say something about what this person's breath tells us.

[00:05:54] Jennifer Khakshouri

Bettina, what's the advantage of using breath rather than saliva or blood to detect certain things, to diagnose illnesses?

[00:06:02] Bettina Streckenbach

Yeah. So first of all, from the perspective of the person who gives the sample, it's much more convenient. So I'm breathing every second of every day during my lifetime, so I don't mind to also give a breath sample. However, if I have to give a blood sample, I need to go to the clinics or to a physician, to a doctor to trained personnel, because otherwise I would be at risk for infections. Or I might be really bad at giving a blood sample and might collapse.

[00:06:36] Jennifer Khakshouri

Renato, out of your perspective, what's the advantage?

[00:06:39] Renato Zenobi

Well, if we measure exhaled breath on an instrument that profiles the chemical composition, we actually have the results immediately.

[00:06:50] Jennifer Khakshouri

So it's much quicker than saliva or blood tests, which would have to go to the lab and ...

[00:06:54] Renato Zenobi

Exactly. You have to send those in. And when we do the chemical profiling of exhaled breath, it's very rapid. It's practically in real time.

[00:07:04] Jennifer Khakshouri

So far, I've read that you can detect certain things like sleep apnea and also asthma. How do you find that out? How does the process look like?

[00:07:16] Renato Zenobi

Okay, So first of all, every disease or even if you do exercise or something like that, it leaves a metabolic signature in the body. I mean, men and women are metabolically different. Old people are of different from young people and so on. So that's not surprising. So when we want to pinpoint a disease, we used 20, 30 people with that disease, diagnosed disease and 20/30 age matched and gender matched controls that are healthy. And they all come and give a breath sample. And then we use statistical methods to see which signals are different between the healthy and the diseased group.

[00:08:02] Jennifer Khakshouri

Bettina, you you work with children. And how do you do that? Because before you said it's hard to get breath samples from little kids like from toddlers and before a teenage like just children until they're ten or 11 years old.

[00:08:16] Bettina Streckenbach

Yeah, that's true. And that's especially true for a spirometry test, that's very difficult for children to perform just because it has to be followed in that specific maneuver. However, exhaled breath as we are sampling it with a methodology that we're using in our laboratories, you only need to exhale, preferably in a constant way, but it doesn't have to do anything with add a specific pressure or as long as possible, because the instrument is so sensitive that no matter how you're exhaling in principle, you will detect metabolites that are in the breath.

[00:09:02] Jennifer Khakshouri

Diagnosing diseases with a puff of air, that's the goal of economics. How long will it take till your goals all are reached? Because you're not only researching about sleeping apnea and also asthma, but many other fields?

[00:09:19] Renato Zenobi

Actually, in a sense, we're already pretty close because there is four of these instruments installed in hospital environments, two at the Universitätsspital Zurich, one at the Kinderspital Basel, one at the Kinderspital Zurich. And they measure patients with these instruments every day on a regular basis. And for example, at the USZ they have the goal of measuring 5000 patients over the next couple of years.

[00:09:48] Jennifer Khakshouri

The database that you're building up, is that something that can already help patients or is it still in the doing of building up?

[00:09:56] Renato Zenobi

It's still in the buildup phase, of course, because before you know what all these profiles are, you cannot say for sure, okay, this person has disease A and this person has disease B. What is clear, however, is that every disease leaves some sort of metabolic fingerprint in the body. And so I don't think this is restricted to lung diseases or diseases of the respiratory tract. I think in the future one might be able to diagnose neurodegenerative diseases, maybe early recognition of certain cancers and so on and so forth. It's a rather universal.

[00:10:34] Jennifer Khakshouri

What's in the future? What do you mean by that?

[00:10:37] Renato Zenobi

That's a little bit hard to say. I mean, for sure, when we have a large database, we can already do something. But on the other hand, it also depends on manufacturers of instruments so that these instruments become more affordable and can be installed, for example, at the doctor's office and not just in a big hospital.

[00:11:00] Jennifer Khakshouri

Is this something that you're working on in international groups or is it Switzerland only?

[00:11:04] Renato Zenobi

Zurich Exhalomics is at the moment a little bit larger than Zurich, so kind of Switzerland or parts of Switzerland. But of course, there is international efforts.

[00:11:15] Jennifer Khakshouri

Is there competition on an international level or are you the only ones working on this?

[00:11:19] Renato Zenobi

No, we're not the only ones. I would like to believe that we're among the best. But of course, there is international competition and that's good.

[00:11:26] Jennifer Khakshouri

And exchange also or not yet?

[00:11:29] Renato Zenobi

We have a conference that is called The Breath Summit, where all these people show up.

[00:11:34] Jennifer Khakshouri

Could the medical field, the diagnostic field, be revolutionized by this method of diagnosing illnesses and finding out what's wrong or right with people and how they feel?

[00:11:46] Renato Zenobi

I would say absolutely. I would really like to see that this becomes the standard way of diagnosing whatever disease. But that's really quite a few years down the road.

[00:11:59] Jennifer Khakshouri

Bettina, you're nodding.

[00:12:00] Bettina Streckenbach

Yeah, for sure. So it's something that hasn't been fully used at all. There are a few clinical tests using breath but in that range that we could actually gain insights, systemic insights of the human body there's a lot to still achieve.

[00:12:19] Jennifer Khakshouri

And which field so far have profited the most of your research and of the research of the Exhalomics consortium?

[00:12:25] Renato Zenobi

I would say probably the clinical environment, but not only. So now we have people who are interested in exercise. When do you burn your fat, for example, or people who are interested in the metabolism of animals that goes from lab animals like mice. We recently did a study on bees. The instrument is sensitive enough to get the volatile signature of bees. And another study we did on cows, we had about 100 bags full of cow breath that we measured in the lab.

[00:13:00] Jennifer Khakshouri

How did you get that?

[00:13:02] Renato Zenobi

Well, the cows were in a chamber and the air from the chamber was sampled.

[00:13:07] Jennifer Khakshouri

And what did you find out?

[00:13:08] Renato Zenobi

I don't know yet. We're analyzing the data.

[00:13:11] Jennifer Khakshouri

And bees. I never thought about if bees breathe or not.

[00:13:14] Renato Zenobi

Well, it's not a breath of bees. It's more like their pheromones and their signaling molecules because that's what they do. That's how they communicate to fellow bees. Where to find the nice flowers and so on.

[00:13:28] Jennifer Khakshouri

So Exhalomics wants to spread in all fields and, I don't know, analyze the world in a way?

[00:13:34] Renato Zenobi

I mean, the scariest thing I've come by was people asking: Could we do a breath passport for people? And in principle, I think that should be possible. But if you think about the consequences that every time you pass by somewhere, people measure your breath that's a little bit of scary outlook, isn't it?

[00:13:52] Jennifer Khakshouri

But it's like a fingerprint.

[00:13:54] Renato Zenobi

Exactly. Yeah. Or face recognition.

[00:14:02] Jennifer Khakshouri

Renato, you're a professor here at ETH, you're a researcher, you're the head of Exhalomics, you're a manager in a sense also. How do you keep an overview of the 14 groups working for Exhalomics?

[00:14:13] Renato Zenobi

Well, first of all, we have several projects, usually by PhD student between groups. So for example, I have several PhD students that are employed at ETH Zürich but work somewhere else. I might or might not be the academic supervisor, but I know what's going on. And other than that, I don't interfere with the day to day business. But we meet regularly. We meet in the whole consortium once a year and among the principal investigators every few months. So we really have a very good exchange.

[00:14:48] Jennifer Khakshouri

There's a claim on your website, it says "You exhale, we diagnose": When will this be true for the normal patient?

[00:14:57] Renato Zenobi

It could be in as little as a few years, but it could also be a decade. It's a little bit difficult to say because the market, the diagnostics market, is dominated by large companies like Roche Diagnostics, and I think companies like that should make sure that they get involved, that they don't miss the train, so to speak. And once that happens, then it will be rather quick.

[00:15:22] Bettina Streckenbach

And it's also about finding significant signatures that we can validate. And if we can validate something it might happen rather quickly, then in the in the far future. So it's hard to tell right now, but it looks very promising.

[00:15:37] Jennifer Khakshouri

Both of you are very motivated and full of hope, but supposedly you're not collaborating yet with the big companies.

[00:15:45] Renato Zenobi

Well, we have within the Zurich Exhalomics consortium, we have to startup companies. One company doing sensors, so portable devices for very specific metabolites. The other company doing more data analysis. So kind of big data, artificial intelligence interpretation of these breath prints. What often happens to startup companies is that they get bought up by a gigantic company. And these big companies, they are not interested in doing all the hard work themselves. They want to buy readymade solutions.

[00:16:20] Jennifer Khakshouri

What is your vision? If you think of Exhalomics and everything goes smoothly and goes to the future that we actually just spoke about? What do you see?

[00:16:28] Bettina Streckenbach

I see a future with Exhalomics actually in the daily business of physicians so that taking a breath sample is something not out of the extraordinary, but something that becomes like a clinical tool that can be easily used, especially also for personalized medicine. We haven't talked about that yet today, but that's also a hot topic. I would wish for it to become like a common standardized tool that is part of our health checkup.

[00:17:02] Jennifer Khakshouri

Like day to day health checkup, like taking blood from the finger, like as normal as that?

[00:17:07] Bettina Streckenbach

Even. Yes, as normal as that. Probably not like that you need to take it day by day of course. There might be startups popping up that use it as a fancy tool to do some breath tests at home. But I would rather say, like on the clinician side, that it's like a very common tool to use.

[00:17:28] Jennifer Khakshouri

Renato, what's your vision for the future of Exhalomics?

[00:17:31] Renato Zenobi

Yeah, I largely agree with what Bettina just said. So you could imagine that if you check into a doctor's office sometimes now they take your blood pressure, but maybe in the future they take a breath print and the other side I would see that miniature devices that can be maybe interfaced with a mobile phone, that one can blow into the mobile phone. And then the phone app tells you, well, you better go see a doctor or you forgot your medication today, or you better exercise again. Things like that.

[00:18:10] Jennifer Khakshouri

It was great talking to Renato Zenobi and Bettina Streckenbach. Thanks for listening to the ETH podcast. This Wachter, Lucky Fritz and I, Jennifer Khakshouri, from the Audiobande produced this episode of the ETH podcast.

END OF TRANSCRIPT



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