'Plaque Bank' launches a new model for noninvasive disease prediction, treatment

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Patient with severe periodontitis improves with microbial treatments and one surgery. Credit: H. Tenenbaum

Scraped from the gums, teeth and tongue in the form of plaque, the researchers behind Canada's first plaque bank are betting that the bacterial content of plaque will open up a new frontier of medicine. By collecting and analyzing plaque samples gathered from the fecund bacterial environment of the mouth, researchers at the newly formed Oral Microbiome and Metagenomics Research Lab (OMMR) at the Faculty of Dentistry argue that plaque can be used can be used to predict, identify and even treat disease.

Bacterial communities in the mouth may tell researchers a great deal about a patient's health - not just whether there are oral diseases, but whether other diseases, such as diabetes, are present.

"We know that the microbiome, or the bacterial environment of the mouth, can be a great predictor of diseases," says OMMR's Co-Director, Assistant Professor Dilani Senadheera. "To a large extent the oral microbiome is an untapped resource for medical research."

Spit samples already form a branch of oral microbiome research. But while bacterial numbers in saliva can ebb and flow over the course of a day, fluctuating based on everything from what you ate for breakfast to your sleep cycles, the bacterial content from plaque remains stable over time. And unlike other bacterial studies that have been making headlines lately, by harvesting bacteria from sites such as the intestines or stomach, the mouth offers a minimally invasive, easily accessible testing ground.

The "gold standard" for bacterial identification

From a plaque sample, researchers hone in on a particular "fingerprint" gene: 16S rRNA. Because this gene is unique to each bacterial type - yet present in all bacteria on the planet - this particular gene analysis is considered the "gold standard for bacterial identification," says Senadheera.

Plaque scraped from gums can be used to analyze disease. Credit: H. Tenenbaum

Researchers can use 16S rRNA as a reference point to identify all the different kinds of bacteria in a sample - and then further distinguish each individual species - of which there are hundreds - present in a mouth sample the size of a pinhead.

By then comparing the composition of bacteria in a plaque sample of healthy people with those with specific diseases, the researchers can distinguish "biomarkers" that correlate with certain states of health - essentially, creating a comprehensive catalogue of health through the kind and number of bacteria located in their plaque.

Plaque analysis is also unique for its speed: a sample can be completely analyzed within just a few hours, making it a form of rapid health surveillance. Researchers can then use the results as a means of analyzing disease risk, or keep virtually "real time" tabs on how a patient is responding to a particular treatment.

"Biomarkers truly are the currency of translational research," argues Senadheera.

"We're providing a bacterial surveillance service to patients," explains Dr. David Lam, Head of Oral and Maxillofacial Surgery in the Faculty of Dentistry, and a Co-Lead in the lab.

"There is no other service like this in Canada right now. We want to go beyond this, to monitor disease progression and responses to therapies."

The Future is Plaque

Other translational components to the OMMR's research are also in the works: the researchers want to create an artificial mouth that mimics the physical and physiological conditions of the human oral cavity to help them carry out their biomarker identification process.

Future research plans also include the development of what they hope will become successful "plaque transplantation" therapies. Patients who undergo radiation therapy for head and neck cancers, for instance, can develop a form of rapid tooth decay brought on by the degradation of the saliva glands, a condition called "hyposalivation."

The hypothesis is that small, carefully selected plaque communities could be transplanted into the mouths these patients. The right "healthy" plaque sample could stabilize the bacterial content of the mouth - effectively saving the teeth of these patients without the use of chemicals, operations or any other invasive procedures.

Still, the researchers don't plan to bank solely on plaque. "Initially [the OMMR] is focused on plaque - which will be used to identify microbiological markers of disease," adds OMMR Director Dr. Howard Tenenbaum (Faculty of Dentistry, Laboratory Medicine and

Pathobiology, Mount Sinai Hospital - Head, Division of Research, Dept. of Dentistry). "But as the program progresses, additional biomarkers for inflammation [such as arthritis], and even pain, will be assessed."

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