



Salivary Diagnostics

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High-impact diseases, including cancer, cardiovascular, metabolic and neurological diseases, are challenging to diagnose without supplementing clinical evaluation with laboratory testing. Even with laboratory tools, definitive diagnosis often remains elusive. Three roadblocks hold back the realization of clinical diagnostics' potential: 1) definitive disease-associated protein and genetic markers; 2) easy and inexpensive sampling methods that effect minimal subject discomfort; and 3) an accurate, portable, and easy-to-use diagnostic platform. Saliva, a biofluid, that is totally noninvasive and readily available, has long been recognized to address the second roadblock.¹

Until recently, and with the visionary investment by the National Institute of Dental and Craniofacial Research, saliva biomarker discovery and salivary diagnostic technologies are currently in development that are addressing the first and third roadblocks. It is safe to predict that the use of saliva for disease diagnostics and normal health surveillance is about five years away. This is an exciting time as we are seeing the applications of saliva diagnostics for oral diseases,

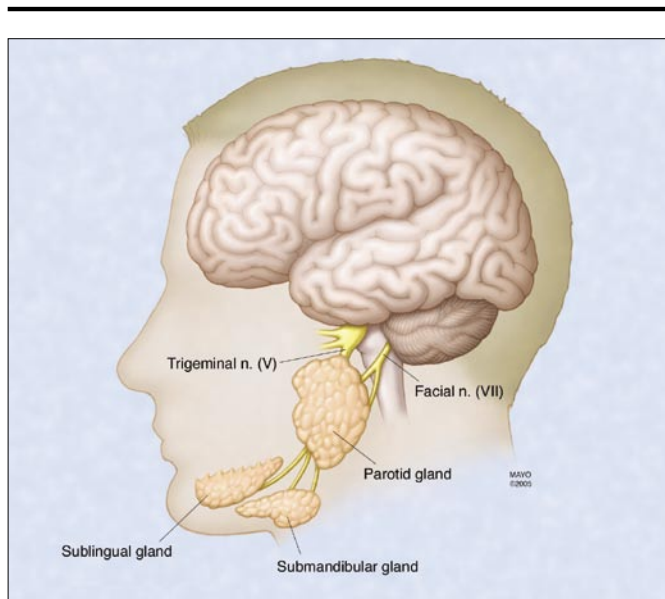


Figure 1. Anatomical locations of the three major salivary glands: parotid, submandibular, and sublingual. *By permission of Mayo Foundation for Medical Education and Research. All rights reserved. Forde MD, Koka S, et al, Systemic assessments utilizing saliva: Part 1 general considerations and current assessments. Int J Prosthodont 19:43-52, 2006.*

which will soon be followed by systemic diseases. This will truly allow the bridging of oral health research into systemic diseases via the biofluid the filters and processes itself from the vasculature that nourishes the salivary glands into the oral cavity (**Figures 1 and 2**). Oral fluid being the “mirror of body” is a perfect medium to be explored for health and disease surveillance. The translational applications and opportunities are enormous.

A growing number of proof-of-principle examples have been estab-

lished for using saliva to monitor systemic diseases and conditions. The barriers to widespread implementation of saliva diagnostics derived from



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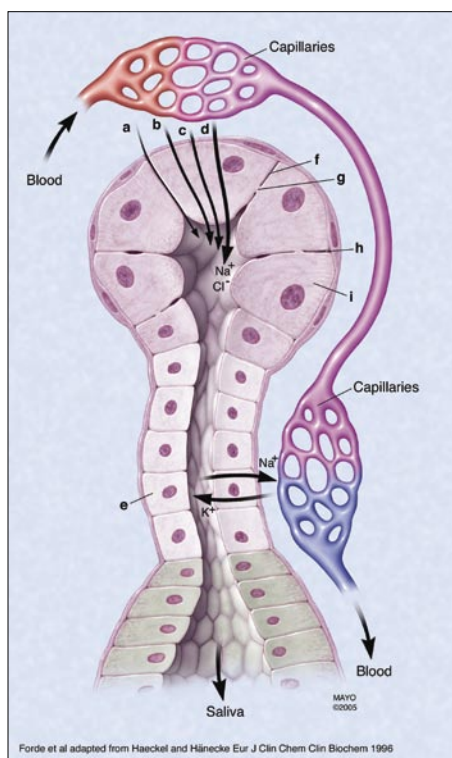


Figure 2. Mechanisms of transport of proteins and ions from serum into salivary gland ducts. By permission of Mayo Foundation for Medical Education and Research. All rights reserved. Forde MD, Koka S, et al, Systemic assessments utilizing saliva: Part 1 general considerations and current assessments. *Int J Prosthodont* 19:43-52, 2006.

technological problems such as sensitivity, miniaturization, high throughput, automation, portability, low cost, high functionality, and speed to enable detection and measurements of multiple disease markers in saliva have largely been overcome. Techniques are emerging from a combination of miniaturization technologies, and discoveries in many different fields of biology, chemistry, physics and engineering are leading to high throughput, automated, portable, low cost,

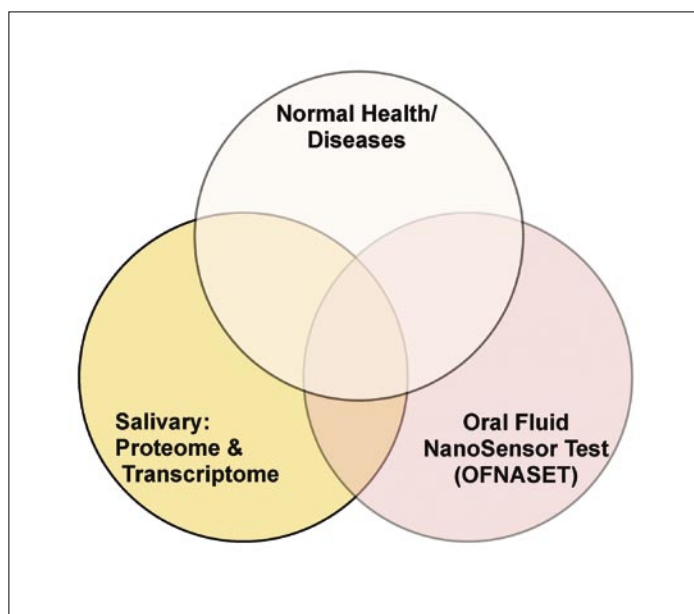


Figure 3. Disease markers manifestation in saliva and their detection by saliva diagnostic biosensors (Oral Fluid NanoSensor Test, OFNASET).

more efficient, and rapid biochemical analyses. Miniaturized diagnostic technologies will be able, with minute amounts of body fluids, to yield critical patient information reflecting health and disease status. These “lab-on-a-chip” platforms will be able to perform multiple operations in parallel in nonlaboratory settings such as the field, factory, hospital clinic, or home. It is envisioned that such technologies will allow the simultaneous assessment of multiple conditions of health and disease and provide clinicians with prevention and therapeutic strategies to meet patient needs.

Vision and Challenges

The postgenomic era provides opportunities for high-throughput approaches to genomics and proteomics. The novel technologies of miniaturization,

coupled with the highly parallel detection, create the possibility of radically new ways to detect and diagnose health and disease states in an individual, even in remote or impoverished settings. These discoveries and technological advances in conjunction with the ability for disease diagnostics in a noninvasive biofluid would offer a revolutionary change in medicine.

There is a great need for convenient and accurate point-of-care disease diagnostic tools in a noninvasive manner. This is of particular relevance in the developing world where many health risks and illnesses remain poorly defined and receive inappropriate treatment. In addition, little information about the burden of disease is available to guide population health decisions.

The vision and challenge of saliva diagnostics is to discover the diagnos-

tic potential and optimize engineering technologies for this biofluid. **Figure 3** is a Venn diagram that illustrates that within the spectrum of total human health and disease states (top circle), it is envisioned that some of these states will reflect themselves diagnostically in saliva via either proteomic or genomic information (lower left circle). How much overlap will the subset remain is to be determined. The lower right circle illustrates the technology development platforms necessary to advance the point-of-care detection capability of saliva.

The challenge to making saliva diagnostics a clinical reality is to establish the scientific foundation and clinical validations necessary to position salivary diagnostics to be novel, highly accurate and feasible technologies to achieve definitive point-of-care assessment of individuals' health and disease status. Inherent in this vision is to establish the science and diagnostic targets in saliva and the development of robust, simple-to-use biosensor technologies for reliable and valid clinical applications.

In this issue of the *Journal of the California Dental Association*, we have

invited a number of scientific, opinion and thought leaders in the field of saliva diagnostics to present their current research to highlight the excitement and promises of saliva diagnostics. **CDA**

References / 1. Mandel ID, Salivary diagnosis: more than a lick and a promise. *J Am Dent Assoc* 124(1):85-7, 1993.