Opinion

Point of Care Diagnostics in Oral Diseases

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Oral and dental diseases constitute one of the common ailments affecting the human being. Approximately 90% of the world population experiences dental diseases at least once in their lifetime [1]. Early and accurate diagnosis is of prime concern for appropriate therapeutic planning and improved prognosis. Technological advancements in the recent past has helped the clinicians and researchers to detect the presence of various endogenous and exogenous compounds in the body fluids to aid in disease diagnosis and thereby improve post treatment quality of life. These compounds collectively referred to as biomarkers are being significantly isolated and characterized as specific markers for various oral diseases [2]. The role of saliva as an important diagnostic fluid has gained widespread attention owing to its non-invasive and ease of collection, its proximity to the lesion and improved sensitivity and specificity for isolating a range of disease specific biomarkers [3]. A range of inflammatory biomarkers, tumor related biomarkers, genomic and metabolomic markers have been detected in saliva thus making it an ideal diagnostic tool [4].

Most of the diagnostic tests employs a robust laboratory equipment which remains the mainstay of analytical processes to determine the biomarker of interest [5]. These laboratory tests are still not foolproof and have the disadvantage of being time consuming, costly, and technical difficulties related to the analyte sample. To overcome some of the difficulties associated with the routine laboratory techniques, efforts are made to identify the biomarkers as a clinical chair-side technique. These initiatives have led to the development of a newer and versatile technique known as point-of care (POC) diagnostics.

POC testing is defined as medical testing conducted outside of a laboratory at or near the site of patient care, including the patient's bedside, the doctor's office, and the patient's home [6]. Developing a chairside/PoC-based disease-specific biomarkers is of great interest as it would make life easier for clinicians and researchers as well as for patients. The ability to utilize POC diagnostics to screen and quantify biomarkers associated with disease prognosis and predictive therapeutic response would assist dentists/ physicians in their treatment selection [7]. POC testing is advantageous over standard laboratory procedures by providing timely information to medical teams, facilitating rational, time critical decisions and has been demonstrated to improve patient outcomes in critical care settings.

It avoids some of the cost associated with sample handling, packaging, tracking and shipping to centralized labs and reduces the likelihood of samples being contaminated, mixed up, lost and/or degraded [8]. Point of care devices are categorized based on the technology employed into those based on lateral flow assays and those based on microfluidics or lab-on-a-chip technique. Lab-on-a-chip approaches integrate processing steps such as sampling, sample preparation, detection and data analysis into one small device [9]. POC testing can be employed to detect diagnostic targets such as nucleic acids, proteins, metabolites and other small molecules in body fluids such as blood, urine and saliva [10].

Molecular biomarker detection using point of care diagnostics are being continuously assessed in various oral diseases including periodontitis, microbial infections and oral cancers. Much of these devices have attempted to use saliva as an important tool for biomarker detection. Emerging POC technologies include biosensors, fluorescent biosensors, biological Micro-electro-mechanical systems, microfluidics/paper-based technology, electric field-induced release and measurement (EFIRM) and smartphone-based biosensors [5].

A few POC devices have been developed for the detection of oral cancer and periodontitis. In 2002, the NIDCR funded seven projects namely electrochemical sensing, on chip PCR/RTPCR, microsphere based nano-biochip, microsphere based optical fiber assay, high throughput DNA microarray, surface plasmon resonance optical system and microchip electrophoretic immunoassay that explored different point of care systems to detect salivary analytes and provide an overall profile that correlated with a disease states [11]. Oral fluid nanosensor test (OFNASET) is a handheld, automated, easy to use integrated system that will enable simultaneous and rapid detection of multiple salivary proteins and nucleic acids [12]. PerioSafe and ImplantSafe are two PoC tests based on an active MMP-8 (aMMP-8) immunoassay for measuring the inflammatory burden of periodontitis and peri-implantitis [4]. Microelectromechanical technology (MEMS), optical fluorescent system followed by electrophoresis, oral rinse indicator are other salivary based single platform POC diagnostics which measures the salivary MMp-8 levels in periodontal diseases [5]. Chromatography test strips for HIV, HCV and influenza; hand-held devices for detection of cortisol and amylase are other point of care devices in

use. Other devices to detect interleukins, mRNA, DNA, metabolites are constantly being developed.

To summarize, the convergence of microfluidics and oral-based diagnostics has made it possible to detect diseases and monitor other conditions at the point of testing. The combination of novel use of microparticles isolated from saliva with microfluidic technologies hold promise for diagnosing disease, monitoring disease progression and facilitate intelligent, individualized treatments, and improve peoples' standard of living and safety. By using saliva as the diagnostic medium, POC technologies will be able to provide rapid, simple, inexpensive, and accurate measurements directly from saliva. Rapid progress in technology has enabled the identification of wide range of saliva-based biomarkers which could play a pivotal role in diagnosis of various oral diseases. Despite these advancements, the field is still in infancy and further research must be directed towards discovery of chair-side diagnostic aids to enable the clinician in early diagnosis and implementation of prompt therapy.

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