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Review Article

eDiagnostics in Pregnancy in Covid 19 Pandemic

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Abstract

Background: eHealth being a secure and cost-effective mode of use of information communication technologies (ICT) in healthcare services, and conducting surveillance, literature, and education in healthcare for gaining knowledge for conducting further research.

Objective: The technology for point of care and point of care medical testing is still in infancy, requiring further research for producing various eHealth diagnostic devices to support eHealth systems. This is important that such e- devices (eDiagnostics) should have minimal involvement of user for analyzing direct biological samples and should be affordable to general population.

Methods: This prospective article explores technological advances in remote monitoring of pregnant women.

Results: Technology is allowing pregnant women to stay away from hospitals, and it's improving care—for those who can get access, and ediagnostics will be promising for them during covid 19 pandemic.

Conclusion: The technology for point of care and point of care medical testing is still in infancy, requiring further research for producing various eHealth diagnostic devices to support eHealth systems.

Keywords: eDiagnostics; Telehealth; Telemedicine; Paper Strips; Point-of-care; Wearable eHealth Solutions

Introduction

eHealth is a mode of use of information communication technologies (ICT) in healthcare services, and conducting surveillance, literature, and education in healthcare for gaining knowledge for conducting further research. The technology for point of care medical testing is still in infancy, requiring further research for producing various eHealth diagnostic devices to support eHealth systems. This is important that such e- devices (eDiagnostics) should have minimal involvement of user for analyzing direct biological samples and should be affordable to general population. Technology is allowing pregnant women to stay away from hospitals, and it's improving care—for those who can get access, and ediagnostics will be promising for them during covid 19 pandemic.

eDiagnostics

Main components of eHealth systems are

- Electronic health record, medical records with easy access to medical history of patient, e-prescription, and e-booking [1,2];
- Telehealth or telemedicine to allow virtual appointments of patients with physicians and the health monitoring of patients remotely (even in their homes); and
- mHealth (or mobile Health): Communication between health-care providers and patients for patient care, health practices, adherence to treatment and emergency situations.

Future eHealth system will be examination of a patient remotely at home on telemedicine platform for tele- appointments with physicians and remote testing by eHealth diagnostic devices for various vitals and even lab parameters! In eHealth settings, simple-to-use point- of-care devices for analyzing untreated blood and biological fluid samples are required, and they include urinalysis by paper strips [1,3]; liver function tests by paper-based device; nasal swab analysis to detect nucleic acids: sample and result read out device; smartphone compatible dongle for infectious diseases detection (based on microfluidic cassette); biochip for blood HIV detection; chip-based microfluidics devices for lithium , electrolytes detection in blood; wristband based detection of sweat glucose, electrolytes (sodium, chloride); and even a biosensor- based mouthguard and a wireless circuit board for detection of uric acid and other parameters in saliva [4,5].

AI based technology will help pregnant women in covid 19 pandemic to stay away from hospitals and get care from remote access during antenatal period and report in hospital only if required or advised.

The essential characteristics of futuristic ai are eDiagnostics

Point-of-care (POC) diagnostic technologies for clinical chemistry testing via portable devices with no or minimal user involvement, and newer self-testing eDiagnostics [1]; and futuristic research in such POC technologies to enhance their applicability at eHealth settings in future paving wave for new AI- based digital platform for diagnosis, treatment in pandemic situation, in remote areas and even in battlefield and space explorations [6,7].

Latest POC diagnostic technologies include wearables, paper diagnostics, chips and 3D printable diagnostics, do-it-yourself diagnostics and treatment platforms; cell- and microfluidics-based sensors and chips have become a reality. These ediagnostics require further workout to be used in eHealth system on larger scale such as automated, secure, cloud- based cost-effective ediagnostic approaches using readily available materials. They may consist of a single-use disposable paper device, or chip to perform biochemical analysis, smartphone attachment for signal acquisition; and remote telemedicine consultation and analysis; and a smartphone application to facilitate signal interpretation and transmission of test report to cloud or other databases of eHealth systems. Noninvasive, minimally invasive eDiagnostic device requiring minimal user involvement are nerd of the hour in eDiagnostic and eHealth system.

Blood, urine, saliva, tears, sweat, and breath samples are the biological fluids that can be obtained minimally invasively at home by the patients. Though the delivery and availability of biological fluid can have specific constraints for eDiagnostic device. Another impending issue in this regard is waste- disposal of ediagnostic real-time test platforms and legal and ethical concerns and issues of privacy especially in the era of cybercrime and hacking and eHealth system strategy prioritized in cost- effective manner. This is important that ehealth-care systems should be patient-friendly, have high operator efficiency in cost- effective manner for better health outcomes.

Wearable eHealth solutions

There is no or minimal involvement of user in wearable devices and they help in real- time monitoring of patients e.g., CGM wearable sensors, implantable CGM systems connected to a remote reader device; tatoos, patches, bandages, belts, contact lenses or sensors attached to mouthguards. All these wearable sensors can analyze various parameters in various biological fluids namely, sweat, saliva, tears, even blood. Even infrared and ultrasonic handheld readable devices, smart fabrics are available, and they have sensing elements incorporated into fabric. e.g., SmartVest are now available for monitoring of patients and even biochemical analysis of glucose. 3 D printed electrodes or aptamers in paper-based wearables can perform electrochemical analysis. Wearable eDiagnostic devices can cater to various diagnostic needs of eHealth systems.

Paper- based diagnostics available for eHealth applications

Test strips or test pads, single-step biosensors, sensor probes with several applications for urinalysis and blood analysis POC are available in the form of dipstick tests for semiquantitative detection of biomarkers such as glucose, ketone bodies, lipid profile, electrolytes, liver function test, kidney function test, microalbumin, illicit drugs abuse etc. are available or under development to be compatible with smartphone attachments or dedicated readers for reading the results of analysis.

Various technologies involved in development of ediagnostic devices include enzyme immobilization, fluorescent dyes, carbon nanotubes, quantum dots, multifunctional [2] nanospheres, and upconversion nanoparticles, photoluminescence, and microfluidics for detection of disease biomarkers. Nowadays even development of paper-based analytical devices (μPADs) have become feasible.

Microfluidic paper-based devices (μPADs) are paper based device which seem to be promising in several applications in eDiagnostics. Microfluidic paper-based devices have stacked layers of patterned paper that store reagents and allow controlled wicking of fluids inside them to give analyte detection test results. Even, 3D-μPADs are feasible for evaluation of liver function in untreated blood, for malaria and dengue fever detection in lysate blood and human chorionic gonadotropin in urine using indirect immunoassays (e.g., gold nanoparticles as reporting agents). 3D-μPAD based ELISA are also available for various analytes.

Paper-based analytical devices for blood analysis, urinalysis, and specific DNA sequences (e.g., for the detection of West Nile, E. coli, hepatitis, and tuberculosis) based on electrochemical μPAD are available based on antibody functionalized gold microwires, electrochemical impedance spectroscopy and electrode.

Also, microcell-based sensor for ehealth applications is available to detect hemoglobin and glucose in whole blood and albumin in urine and they are based on the storage of assay's reagents in dry form inside a microcuvette.

Laboratory-based testing devices are not compatible with eHealth systems as they are costly, heavy and require training of personals to operate them.

Point-of-care devices are portable, requiring fewer resources compared with clinical analyzers and can easily fit easily in most eHealth systems.

Conclusion

Digital technology offers hope and is allowing pregnant women to stay away from hospitals and improving antenatal care—for those who can get access, and ediagnostics will be promising for them during covid 19 pandemic [3].

Availability of Data and Materials

No data associated with this paper needs to be made available as this is perspective/opinion article, no weblink is available yet.

Consent for Publication

The corresponding author gives the consent for publication.

Conflict of Interest

None.

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Ethical Clearance

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