Perspective

Future of health diagnostics

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Abstract

A diagnosis is often the first step to take in order to arrive at a decision on how best to treat a patient. With the emergence of new medical technologies such as wearables, big data, and artificial intelligence, the future of health diagnostics will not only be about timely and precise treatment, but also prevention.

A diagnosis is often the first step to take in order that a right medical decision can be made on how best to treat a patient. It typically involves a procedure that examines one’s symptoms so as to identify a disease or condition. In fact, medical diagnosis has been dated as far back as ancient Egypt as recorded in the Edwin Smith Papyrus,1 and in ancient China where the Yellow Emperor’s Inner Canon proposed four methods of diagnosis: inspection, auscultation-olfaction, interrogation, and palpation.2 Also, Hippocrates, often regarded as the “Father of Medicine,” was known to have diagnosed his patients by tasting their urine and smelling their sweat.3 Thankfully, we have since developed more palatable, accurate, and consistent methods of diagnosis although these are mostly performed at a healthcare facility or laboratory. Despite tremendous progress made, there are still challenges. According to a report published by the National Academies of Sciences, Engineering and Medicine4 in 2015, diagnostic errors leading to “inaccurate or delayed diagnoses still persist throughout all settings of care and continue to harm an unacceptable number of patients.”

Indeed, some diagnoses are still fraught with problems. One is diagnostic error where many will encounter at least one in their lifetime.4 Causes and factors of diagnostic errors5 can include not being able to detect a disease due to hardly noticeable symptoms, placing too much emphasis on certain aspects of the diagnosis or encountering a disease with symptoms that may be mistaken for another. Another is lag time due to delay before an actual diagnosis is made. This can include illness onset to medical encounter lag time or medical encounter to diagnosis lag time. One example is lag time due to delay in x-ray reports, a factor that can pose a major challenge in delivering prompt medical treatment. The Department of Health and Human Services has found that x-ray reports are seldom available to physicians in the emergency room before patient discharge.6 These diagnostic problems are not only harming patients by preventing, delaying, or providing unnecessary treatment, but also causing adverse psychological or financial consequences.

Apart from above problems, current diagnoses are done either ad hoc with motivation arising from a medical situation, or periodic arising from a health screening exercise. As such, we typically get a snapshot of our own health condition at a point in time, rather than continuously over time, which for some patients is necessary. There is thus a need to resolve these problems and improve the accuracy, specificity, speed, and frequency of health monitoring and diagnosis.

With the emergence of medical technology, big data, and artificial intelligence (AI), we are starting to see how some of these problems can eventually be solved. Indeed, these technological advancements are not only going to change, but also revolutionize the way diagnosis is going to be done. In fact, current research and development efforts are giving us...
a glimpse into what the future of diagnostics will look like where diagnosis will be passed from doctors to patients, from being performed at the clinic to anywhere, from conducting periodic health screening and ad hoc testing to continual screening and monitoring, and from standard to more personalized diagnostic testing.

Here are some medical innovation and technological trends that are going to significantly influence the future of diagnostics. Under the guise of a watch or smartphone, these everyday portable and wearable devices are now able to monitor our health round the clock and can potentially detect or even prevent illnesses. Already, we have these devices that can sense or measure our motion, steps, pulse, blood pressure, ECG, etc. There is even anecdotal evidence to suggest that these devices can alert users of a potential medical situation such as a cardiac abnormality and to seek medical professional help. Also, leveraging on these wearable devices that can collect data from users uninterrupted, healthcare practitioners can now better monitor the health of individuals or track the effectiveness of an administered treatment. Although data privacy is of great concern to the users and should be properly addressed, the benefits that can be derived from it will be tremendous.

Moving ahead, diagnostic devices may even be imperceptibly embedded into our daily accessories—such as a toothbrush, mirror, bed, toilet bowl, etc. Continual sensing of biological contents in our sweat, saliva, urine, and stool, which are naturally secreted from our body and constantly secreted daily, do contain tremendous amount of information that can be indicative of the condition of our health and disease. Such useful health indicators are not only help us to intercept disease early, but also potentially prevent it. Instead of flushing our “data” away each day, we can leverage on them to work toward a healthier us.

Although all these smart devices are going to form the building blocks of future diagnostics, the challenge is how to manage and make sense of the data and information that we have collected from these devices. The steps of how to process, analyze, and present them in a meaningful and timely fashion for doctors and patients to act upon are critical. With the advent of AI, we are seeing how AI is going to transform the way we manage and present the data. In fact, deep-learning algorithms are already being developed to aid in developing new drugs, interpreting medical images, managing electronic patient records, etc. For example, a recent study conducted by an international team suggests that AI may be more accurate in diagnosing breast cancer from mammograms than human experts. As such, the future of diagnosis will be about developing the most effective algorithms for diagnosis. Although there are still challenges and limitations in how AI can be currently implemented due to a lack of rigorous clinical validation, this will eventually be ironed out with time as algorithms are further improved and properly validated to augment medical professional’s ability to make quicker and more accurate diagnosis. Moving forward, the smart devices will become part of an integrated network of health technologies, individuals, doctors, and health institutions, and when these devices are coupled with AI, they will enable quicker and more precise diagnosis, more effective user-doctor communication, and even disease prevention.

Looking ahead, the future of diagnostics will still incorporate traditional modalities but with significant adoption of new smart medical technologies, health analytics, and AI. Similar to disruptions in other industries, the health diagnostic community is going to see newcomers such as consumer technology and AI companies dominate the industry as their devices and algorithms are increasingly being modified for use in health monitoring and diagnosis. These companies that produce watches, fitness trackers, and smartphones and have not previously dealt with FDA regulatory approvals will have to now work with them to redefine what constitutes a medical device. Finally, as we enter the era of precision medicine, wearables and AI, the future of health diagnostics will not only be about timely and precise treatment, but also prevention.

CONFLICT OF INTEREST

There is no conflict of interest to declare.

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