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New Machine Learning Smartphone Platform Tackles Detecting Middle Ear Fluid. Useful?

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In a piece published today in the journal *Science Translational Medicine*, researchers present a proof-of-concept study maintaining they designed “an accessible solution that uses speakers and microphones within existing smartphones to detect middle ear fluid by assessing eardrum mobility.” Why should this matter? Middle ear fluid can be present, in particular, in pediatric ear diseases that impose a hefty health care burden to assess and treat. So doing warrants often innumerable visits to the pediatrician, urgent care or other healthcare facility so a medical professional can physically examine a patient which, in part, involves visually inspecting the ears and this can be especially challenging for those living in remote locations. That said, will this new technology that employs a machine-learning algorithm after transmitting chirps from the phone to measure eardrum vibration to detect middle ear fluid and drum mobility once a self-made, funnel-shaped paper cut-out for smartphone adaptation is in place actually make a dent as a screening or diagnostic tool?

The reality of pediatric ear issues

Most commonly, younger children due to a host of factors - including but not limited to tinier, sometimes tortuous ear canals that predispose them to trapping fluid or exposure to more germs in general like upper respiratory infections due to poor hygiene (ie sticking everything in their mouth, not washing hands) - are susceptible to ear infections (or AOM=acute otitis media) or persistent fluid in the middle ear without infection (or otitis media with effusion). The former, when untreated, can lead to complications like eardrum perforation, hearing loss, mastoiditis or

meningitis while the latter can be troublesome in delaying speech, causing behavioral problems or adversely impacting sleep, for example. Often, growth alone reduces the number of infections or other issues a child might have - with aging, the anatomy typically gets bigger and more optimally drains.

In the interim, young children and infants routinely with the common cold or otherwise will endure frequent illness. But, when it comes to diagnosing ear infections and optimizing their treatment, discerning what is viral in origin versus what is bacterial, for instance, is a main priority. The former which depending on your source is often the culprit up to 80% of the time and usually improves with supportive care. The latter necessitates therapy with antibiotics. And, the more antibiotic courses for ear infections an individual receives in a short time frame, the more likely that child will be on the path to surgical ear tube placement and, thus, an expansion of doctor visits and increased testing in their future. Short of puncturing the eardrum to collect the fluid to analyze the precise etiology, which is traumatizing to an otherwise well child and would do more harm than good, ear infections are diagnosed clinically by an experienced doctor who can decipher on exam whether a drum is normal or protuberant, inflamed and filled with pus or retracted and dull.

What is the utility of technology in this space

In terms of diagnostics, the real world utility of technology in this space highly depends on the ability for the application not simply to tell you if middle ear fluid is present, but to weigh in on whether it is purulent and infected, along with implementing improved modes to showcase the appearance and motility (or lack thereof) of the eardrum. There are tools in the telehealth space that amplify remote imaging. For screening or monitoring purposes, there might be greater usefulness. For example, after an ear infection, a child might have persistent fluid that takes time to resolve or a child is exhibiting poor speech and behavior problems.

The notion of increasing accessibility, given smartphones are omnipresent, and making such a process more convenient holds promise. This study involved parents watching an instructional video first and demonstrated good results. However, as this was merely a proof-of-concept study, those numbers are small and there is refining that needs to take place (eg dealing with confounding diagnoses that complicate the picture, screaming or uncooperative child, continued improvement by machine learning once larger data set).

Source:

Justin Chan et al. Detecting Middle Ear Fluid Using Smartphones. *Sci. Transl. Med.* **11**, eaav1102(2019). 15 May 2019.

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