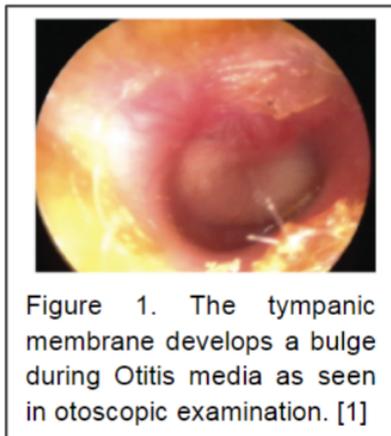


A paper fluidic biosensor for rapid detection of pathogens in middle ear infection

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Specific problem being addressed: Otitis media (OM) is an infection of the middle ear primarily seen in children below school-going age. OM infections can lead to a punctured tympanic membrane and chronic infections can be associated with conductive hearing loss. Given the multitude of species and strains that can cause OM, there is a need for rapid feedback that would allow diagnosis of bacterial OM, description of the bacterial species/strains involved in the infection, and prescription of the most suitable antibiotic regimen. This project which is done in collaboration with Carnegie Mellon University and IIT Bombay aims at developing a paper-based biosensor to rapidly and specifically detect the bacterial pathogen responsible for OM.

Project Summary: OM infections can lead to a punctured tympanic membrane. Otoloscopic examination of the middle ear in OM reveals redness and bulging of the tympanic membrane and accumulation of fluid in the middle ear (Figure 1). Recurrent or chronic infections can be associated with conductive hearing loss and subsequent language acquisition delays that can result in learning disabilities and socialization problems. Typically, ear infection is symptomatically treated with analgesics in the initial stage, while antibiotics are prescribed for those who do not respond to symptomatic treatment.



A progression of antibiotics is used, in pursuit of symptomatic relief. Since there are a number of species and strains that are involved in OM, it is necessary to develop a biosensor that would allow rapid and specific identification of the bacterial pathogens involved in OM. Development of a rapid diagnostic technique can affect the treatment in the following two ways. Firstly, it would help in distinguishing acute otitis media (AOM) from otitis media with effusion (OME). AOM is a result of infection in the middle ear, while OME results from an obstruction of the Eustachian tube and does not benefit from antibiotic treatment. Since a rapid diagnosis technique does not exist, antibiotics are prescribed for both conditions. Secondly, if the specific strain of the bacteria responsible for AOM is identified, a specific antibiotic could be prescribed instead

of a broad spectrum one. Both these measures would contain the unnecessary use of antibiotics and prevent development of antimicrobial resistance. So, there is a need for a rapid and culture-independent test to determine the specific microbial composition and drug resistant profile of the infectious agent in the middle ear fluid prior to prescribing antibiotics. [1] American Family Physician. 88: 436 (2013)

Impact of this innovation: The annual treatment costs of OM in the US exceed 5 billion dollars. In India, >6% of the population has Chronic Suppurative Otitis Media (CSOM), a condition that follows ineffective primary treatment of OM. Statistics indicate that an effective first-line treatment of OM infections could have a far-reaching consequence in both treatment expenditure and socio-economic impact in both countries. Therefore, our proposal to develop a rapid diagnostic technique can affect the treatment in two ways. First, it would help in distinguishing acute otitis media (AOM) from otitis media with effusion (OME). AOM is a result of infection in the middle ear, while OME results

from an obstruction of the Eustachian tube and does not benefit from antibiotic treatment. Since a rapid diagnosis technique does not exist, antibiotics are prescribed for both conditions. Therefore, our diagnostic technology can avoid up to 8 million courses of antibiotics annually in the United States alone (Pediatrics. 101:165 1998). So the second impact of our technology is the specific strain detection of the bacteria responsible for AOM, This helps the doctor to prescribe a specific antibiotic instead of a broad spectrum one. Both these measures would contain the unnecessary use of antibiotics and prevent development of antimicrobial resistance.
