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# View Point

## E-Nose: An Easier Test for Tuberculosis

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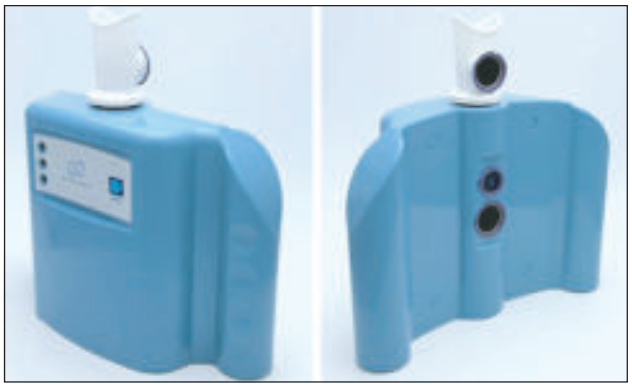
Tuberculosis (TB), a highly infectious airborne disease, remains a major global health problem. Many of the new diagnostic techniques are not suited for operation in the highly-endemic low-income countries. A sensitive, fast, easy-to-operate and low-cost method is urgently needed.[1] The so-called "E-Nose" is a battery-operated device, similar to an alcohol breathalyser, which offers a rapid and accurate diagnosis.[1] A patient simply blows into the device, and sensors pick up TB biomarkers in the breath droplets. One big advantage of this hand-held, battery powered device is that testing can be done at village level so people do not have to make the trip to distant hospitals or clinics for time-consuming testing with sputum.[2]

Some of the specific volatile organic compounds (VOC) associated with Mycobacteria tuberculosis organisms are now being discovered and a paper was published in 2008, but the method of predicting the presence of TB in sputum samples using the VOC biomarkers has yet to be fully optimised. Sensitivity and specificity levels for field detection of TB have been set by WHO at a minimum level of 85% and 95% respectively, and the e nose technique is working towards these figures. In a series of experiments carried out in Mbeya, Tanzania, Africa, data from a full 5 days of sampling was combined giving a total of 248 sputum samples analyzed. From the data obtained results showed specificities and sensitivities in the 70–80% region when actually predicting the presence of TB in unknown sputum samples.[3]

In another study the potential of two different electronic noses (EN; code named "Rob" and "Walter") were used to differentiate between sputum headspace samples from tuberculosis (TB) patients and non-TB patients. Only samples from Ziehl-Neelsen stain (ZN)- and Mycobacterium tuberculosis culture-positive (TBPOS) sputum samples and ZN- and culture-negative (TBNEG) samples were used for headspace analysis. With EN Rob, 284 samples from TB suspects (56 TBPOS and 228 TBNEG samples), and with EN Walter, 323 samples from TB suspects (80 TBPOS and 243 TBNEG samples) were investigated. The best results were obtained using advanced data extraction and linear discriminant function analysis, resulting in a sensitivity of 68%, a specificity of 69%, and an accuracy of 69% for EN Rob; for EN Walter, the results were 75%, 67%, and 69%, respectively. [4]

In another study in Amsterdam and Zambia the headspaces of cultures, spiked sputa, and sputum samples from 330 culture proven and human immunodeficiency virus-tested TB and non-TB patients. The EN differentiated between different Mycobacterium spp. and between mycobacteria and other lung pathogens both in culture and in spiked sputum samples. The EN correctly predicted 89% of culture-positive patients; the six false negatives were the four ZN-negative and two ZN-positive patients. The specificity and sensitivity were 91% and 89%, respectively, compared to culture. At present, the reasons for the false negatives and false positives are unknown, but they could well be due to the nonoptimized system used here.[5]

A Proof of Principle Study (30 participants) and a Validation Study (194 participants) was carried out to estimate the diagnostic accuracy of a sophisticated electronic nose (DiagNose, C-it BV) using exhaled air to detect tuberculosis. DiagNose measurements were validated using traditional sputum smear microscopy and culture on Löwenstein-Jensen media. The result showed sensitivity of 95.9% and specificity of 98.5% for the pilot study and in the validation study a



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sensitivity of 93.5% and a specificity of 85.3% discriminating healthy controls from TB patients, and a sensitivity of 76.5% and specificity of 87.2% when identifying TB patient within the entire test-population (best-case numbers). [1]

In the pilot study, two sub-studies were conducted at icddr,b's tuberculosis laboratory of Dhaka in Bangladesh, in collaboration with the Government of Bangladesh's National TB Control Programme. 'Electronic nose' technology was used to analyze exhaled lung air samples from 15 TB patients admitted to Dhaka's National Institute of Diseases of the Chest and Hospital. The findings were compared with 15 healthy participants. The results demonstrated a robust difference between the TB patients and healthy participants.[6]

The portability and fast time-to-result of the DiagNose enables a proactive screening search for new TB cases in rural areas, without the need for highly-skilled operators or a hospital center infrastructure. Dispensing with the needs for sputum samples, this new tool analyses lung air samples from TB patients for diagnosis. Its portability and time effectiveness enables a proactive screening search for new TB cases in rural areas, without the need for highly skilled operators or a hospital center infrastructure.

**Conflict of Interest :** None

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