Continuous cough monitoring with an AI-enabled mobile phone app for TB evaluation and treatment response

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Abstract Summary: Cough patterns are valuable for tuberculosis (TB) assessment and monitoring but are subjectively measured at few time points. We demonstrated the use of an artificial-intelligence (AI)-enabled mobile phone application to continuously record cough sounds and characterize longitudinal cough trends among people being evaluated for pulmonary TB. (46/50 words)

Introduction:
Although cough assessment is important for tuberculosis (TB) evaluation and monitoring, cough is typically assessed subjectively at single timepoints. Artificial-intelligence (AI) algorithms can automatically detect cough sounds and enable objective monitoring via mobile phones. We evaluated if changes in continuous cough patterns can distinguish patients with TB versus other respiratory conditions and reflect TB treatment response.

Methods:
We prospectively enrolled people with presumptive TB at outpatient clinics in five countries (India, Philippines, South Africa, Uganda, and Vietnam) and classified TB status based on positive sputum Xpert Ultra or culture results (Confirmed TB) or empiric TB treatment initiation (Clinical TB). Participants continuously carried a smartphone for 14 days with the Hyfe cough recording application. Cough frequency was calculated as the median number of coughs per hour (mCPH), and the mCPH was compared between participants with Confirmed or Clinical TB and those with other respiratory diseases (ORD) using Wilcoxon testing.

Results:
We included 519 participants (median age 39, 53.6% female, 12.7% living with HIV) who completed reference standard testing and cough recording. The mCPH for all participants on the first recording day was 5 (interquartile range [IQR] 3-9) and decreased to 3 mCPH (IQR 2-6) by day 14 (Figure 1). On day 1, mCPH was higher in participants with Confirmed TB (8, IQR 3.5-20) vs. ORD (4, IQR 3-7.63) ($p<0.001$), but similar between participants with Clinical TB (4.75, IQR 2-9) vs. ORD ($p=0.89$). All three patient groups had significantly reduced cough frequency by day 14 ($p<0.01$; Figure 1) but the reductions were steepest among participants with Confirmed or Clinical TB initiated on treatment.

Conclusion:
An AI-enabled smartphone was able to characterize distinct cough patterns and show treatment response in participants with Confirmed and Clinical TB. Objective cough monitoring should be further evaluated for TB evaluation and treatment response monitoring.