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Development of a low-cost aerosol filter for detection of *Mycobacterium tuberculosis*

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Background:

Mycobacterium tuberculosis (TB) aerosol droplets pose significant occupational risks, particularly to healthcare workers, who in low and middle-income countries (LMICs) have presented with a three-times higher incidence of TB[1]. Assessing the infectiousness of TB patients is particularly challenging, especially in LMICs[2]. Improvement of infectivity detection could have broad impacts on global TB control.

Material/methods:

We enrolled subjects with suspected TB, with 2+ or 3+ auramine smear, in Lima, Peru and collected clinical, microbiological, radiographic, and cough frequency data. In addition, air-sampling was performed over a 15 minute period of maximally induced cough via a portable 2L/minute vacuum pump onto a PTFE filter with 0.3µm pores. Air-sampling was taken on day 0 and 14 of treatment. Air was sampled at 1m distance from the patient's face in an airborne infection isolation room.

In parallel, we performed serial dilutions of 1 McFarland TB suspension overlaid on filter material, to define the limits of detection of TB on this medium.

The filters were subsequently tested with GeneXpert PCR, standard Microscopic Observation Drug Susceptibility (MODS) assay, MODS with a single-step disinfectant, and MODS with NaOH decontamination. Cultures were assessed up to 8 weeks or until positivity.

Results:

5 subjects, so far, have been enrolled and completed the two air-samplings. 4 subjects were 3+ on auramine smear at diagnosis, and 1 subject was 2+. All subjects were found to have positive MODS sputum cultures from their day 0 collection. The average time to positive culture was 8.4 days (95% CI: 4.82 to 11.98). Only 1 subject had a positive day 14 MODS culture, which presented after 6 days. All subjects were drug-sensitive on MODS, in all cultures.

The filters of subjects revealed no positive GeneXpert PCR, nor any positive cultures of MODS with or without disinfectant. Nonetheless, none of the filters developed fungal or bacterial contaminant cultures.

Results from serial dilutions and additional subjects will be presented at the conference.

Conclusions:

Low-cost effective tests for infectivity of TB patients is needed within LMIC healthcare settings for a quick risk assessment of TB aerosols. Our device, so far, has not shown presence of TB aerosols, despite the subjects having active TB on sputum culture. This could be a result of desiccation of mycobacteria on the filter or TB aerosols being below the threshold of detection. No contamination of cultures reveals the efficacy of the disinfectant, as contamination remains a problem in prior studies[3].

The concurrent laboratory study will find the threshold of detection of these filters. These studies combined will elucidate the applicability and efficacy of this device. Prior studies have used unique models to measure TB transmission[4]. Current limitations include small sample size. Future studies will further improve low-cost tests for TB infectivity.