Smartphone-enabled antibiotic resistance testing for point of care surveillance and treatment guidance

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Introduction

Rapidly characterizing antibiotic-resistant bacterial infections is key to effective antibiotic treatment and infection control. Current testing of human specimens primarily relies on culture, which is too slow to inform initial treatment (requires 1-3 days) and requires infrastructure unavailable at many clinics. Antibiotics are thus often given empirically (e.g., 3rd generation cephalosporin or carbapenem) but are becoming increasingly ineffective due to the spread of beta-lactamase enzymes which neutralize these antibiotics. Delays in effective treatment or administering inappropriate treatment can result in lifelong disability or death. Improved detection of these pathogens is required to prevent their further spread and facilitate optimized treatment.

Methods

A portable platform was developed to capture pathogens directly from urine or cerebrospinal fluid and characterize beta-lactamase related antibiotic susceptibility. The platform uses disposable microfluidic cartridges into which human samples are injected with an activatable-fluorescent probe cocktail. Changes in fluorescence provide rapid determination of antibiotic resistance, which is measured by a smartphone-based fluorescence reader. To demonstrate platform translatability and create further infrastructure for diagnostic surveillance, cartridges were produced on-site in Chiang Mai, Thailand and tested on direct human specimens.

Results
Despite significant background due to urine matrix variability, preliminary results suggest sensitivities of greater than 50% for cefotaxime and imipenem resistance in less than 20 minutes.

Discussion
The turnaround time of this assay is suitable for point of care (POC) detection, which can facilitate initial treatment guidance and limit nosocomial infections by expediting isolation of infected patients. Additionally, the platform is extensible to other aspects of POC testing.

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