Nanomedicine for clinical diagnostics of antibiotic susceptibility

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Diagnosis of antimicrobial susceptibility is a bottleneck in clinical settings when a patient is in urgent need of optimal antibiotic treatment. Since current diagnostic techniques take 1-3 days, the clinician is left with no alternative, but to empirically prescribe broad-spectrum antibiotics. Despite the short-term benefit, such therapy shifts the patient's commensal flora and selects for resistant strains. By combining microbiology, nanotechnology and mathematical analysis, we developed a high-throughput nanowell antibiotic susceptibility testing (AST) device providing diagnostic results within 2-4 hours. Each of the 672 wells serves as an AST nano-incubator, where bacteria are exposed to a range of concentrations of multiple antibiotics. Optical recordings collected in real-time are processed by a mathematical algorithm that precisely defines the time point when bacterial growth shifts from lag to early logarithmic phase (Tlag). By translating Tlag to minimum inhibitory concentration (MIC), the antibiotic susceptibility profiles for clinical Uropathogenic *E. coli* (UPEC) isolates were detected within 2-4 h. Data collected from this high-throughput analysis were illustrated as a heatmap, allowing multiple resistance patterns to be differentiated at a glance. With a possibility to enhance multiplexing capacity, this device serves as a high-throughput diagnostic tool that rapidly aids clinicians in prescribing the optimal antibiotic therapy. Additionally, this device may serve as a useful tool for clinical microbiologists to capture emerging susceptibility patterns of bacteria.