Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

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Inventors

Nongjian (nj) Tao

Fenni Zhang

Shaopeng Wang

Contact

Jovan Heusser
jovan.heusser@skysonginnovations.com

Rapid Digital Antimicrobial Susceptibility Testing

Antibiotic resistance has become a significant public health threat, causing billions of healthcare-related costs as well as 2 million hospitalizations and 23,000 deaths annually in the US alone. Clinical treatment of bacterial infections, especially in acute cases of sepsis, requires multiple steps, including antibiotic susceptibility testing (AST). Most AST techniques are slow, requiring culture, isolation and enrichment of the bacteria, delaying treatment and sometimes putting patients at risk. This also results in overuse of broad-spectrum antibiotics, which contributes to the antibiotic resistance epidemic. Rapid AST technologies are needed to reduce morbidity and mortality rates and administer accurate antibiotic treatment at the earliest possible treatment stage.

Researchers at the Biodesign Institute of Arizona State University have developed a novel imaging-based technology for point-of-care diagnosis of antimicrobial-resistant bacteria. This technology images clinical samples directly with an innovative large-image-volume solution scattering imaging (LVSi) system and a single-cell division tracking methodology/algorithm. Combining high sensitivity single cell division tracking with large volume imaging enables rapid AST, directly, on clinical samples. This technology was validated with 60 clinical urine samples, detecting 30 positive clinical samples with 100% categorical agreement with both culture results and on-site agar plating results.

This rapid, digital AST technology enables health care providers to prompt treatment with precise antibiotic treatments during the course of the appointment.

Potential Applications

- POC clinical diagnostics
  - AST, UTIs, etc.
- Drug development
  - Single cell detection for studying response to antibiotics and antibiotic resistance evolution
- Bacteria detection in non-medical applications

- Drinking water/beverages

Benefits and Advantages

- Rapid detection of bacteria in free solution (results in ~60 minutes)
- Works directly with raw clinical samples at clinically relevant bacterial concentrations (i.e. 104 cells mL-1 – tenfold less than the threshold for most samples)
- Minimal pre-processing, improved precision and shortened turnaround time
- Enables single cell detection capability

o Studying cell heterogeneity response to antibiotics and antibiotic resistance evolution

- Real-time tracking of individual cell growth and division without need for DNA primers, reagents or long incubation periods
- Eliminates microfluidics and pumps/valves – provides a simpler and more reliable measurement
- Improved throughput via simultaneous tracking of many cells
- LVSi images a large sample volume with low optical magnification so no sample enrichment is needed

For more information about this opportunity, please see

Zhang et al - Small - 2020

For more information about the inventor(s) and their research, please see

Dr. Wang's departmental webpage

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