Automated Prep of Nucleic Acids from Blood for Point-of-Care Applications

Steven S. Branda
Principal Member of Technical Staff
February 25, 2015
Sandia MedTech Showcase
Technology Overview

- Platform for automated prep of diagnostics-ready cDNA from clinical specimens (eg, blood) at POC.
  - RNA information content is stabilized immediately.
    - Sample transport, analysis, & storage without need of cold chain.
  - Output (formatted cDNA) compatible with a variety of detection methods (PCR, microarrays, NGS).
  - Sample processing is automated & self-contained.
    - Protects user from exposure to sample.
    - Protects sample from environmental contaminants.
    - User need not be technically skilled.
    - Frees up user for other work.
Platform-Compatible Benchscale Method for Blood → Formatted cDNA Prep

### Feature
- Fingerstick blood draw
- TRIzol inactivation of pathogen
- No cold or centrifugation steps

### Advantage
- Requires little expertise
- Protects user & waste manager
- Power draw is minimal
RNA Prep Module: Digital Microfluidics (DMF) with Macro-to-Micro Fluidic Interface

cDNA Synthesis Module: DMF with On-Board Heating/Cooling & Evaporation Control

Platform Yields Useful Blood RNA & cDNA

Integrated System: Automated, Low-Power, Low-Cost Blood cDNA Prep at POC

Approx. 8” x 12” x 5”, powered by laptop battery for ~8 h.
Integrated System: Automated, Low-Power, Low-Cost Blood cDNA Prep at POC

Features
- 8-plex sample processing
- Sealed sample chambers
- Injection molded components
- Standard PCB DMF board
- Integral peristaltic pump heads
- Plug-and-play electrical, fluid, & pump drive interconnects
- Disposable & cheap (~$5/prep)

Sample Prep Cassette, top view. Approx. 3.5” x 4” x 0.75”
Differentiating Strengths of Our System

• Stand-alone automated sample prep for POC applications.
  - Compatible with variety of detection methods & technologies.
    - PCR, microarrays, NGS.
    - Choose detection technology based on legacy, specificity, sensitivity,
      flexibility, speed, cost, etc.
  - Other POC systems integrate sample prep with detection.
    - “Sample-to-answer” eliminates choice in detection approach.
  - Other stand-alone systems are either large & expensive
    (robotic liquid handling) or not programmable (e.g., QIAcube).
    - “Sample-to-answer” eliminates choice in detection approach.

• Small (8”x12”x5”).

• Low power (≥ 8 h operation on laptop battery).

• Reagents & disposables are cheap (~$5 per sample).
Potential Commercial Applications

• Rapid detection & diagnosis of systemic infection.
  - Detect pathogen directly and/or indirectly (host response).
  - Deployment options:
    - ICU in developed countries.
    - Fixed & mobile clinics in outbreak response networks.
    - Field-forward locations in biosurveillance networks.

• Detection & diagnosis of cancer.
  - Detect cancer directly and/or indirectly (host responses).
  - Monitor response to treatment (*ie*, companion diagnostics).

• Detection & diagnosis of other human diseases & states.
  - Any condition associated with an RNA biomarker in blood.
    - Autoimmunity, neurodegeneration, stress, cardiovascular disease, etc.

• Basic & applied biomedical research.
  - Animal work (handles small samples; small footprint).
  - High-containment work (disposable cassette; small footprint).
  - Low-resource work (low power; simple to operate; cheap).