

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

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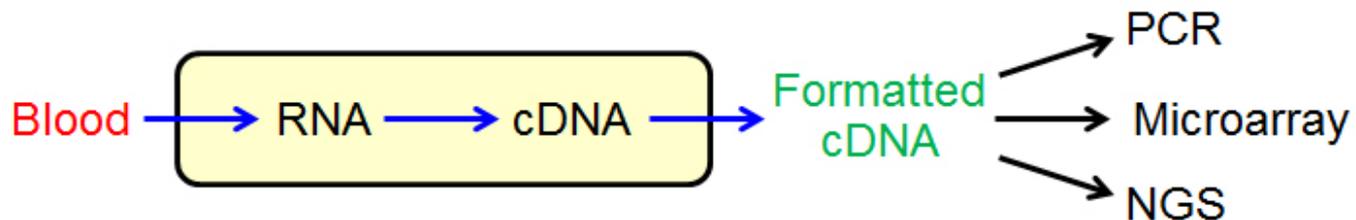
Principal Member of Technical Staff

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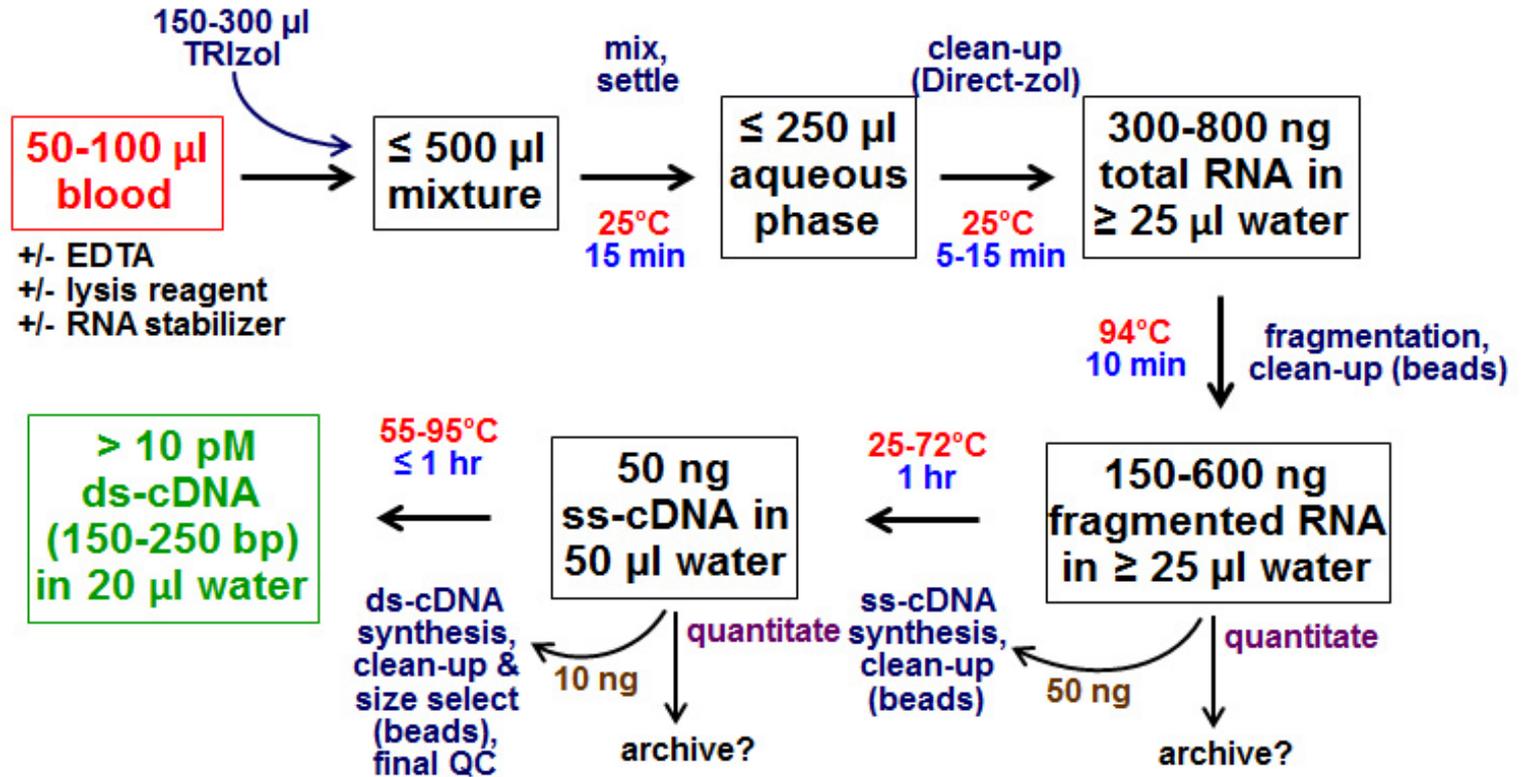
Sandia MedTech Showcase

# 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



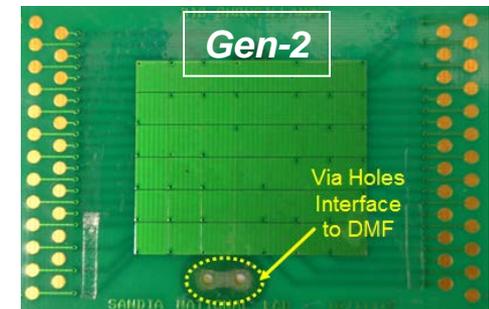
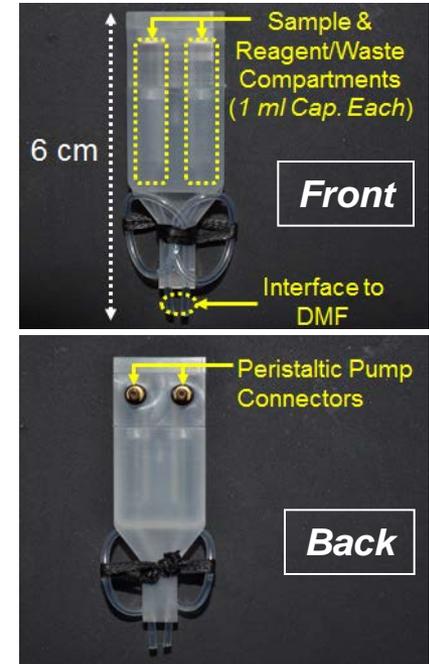
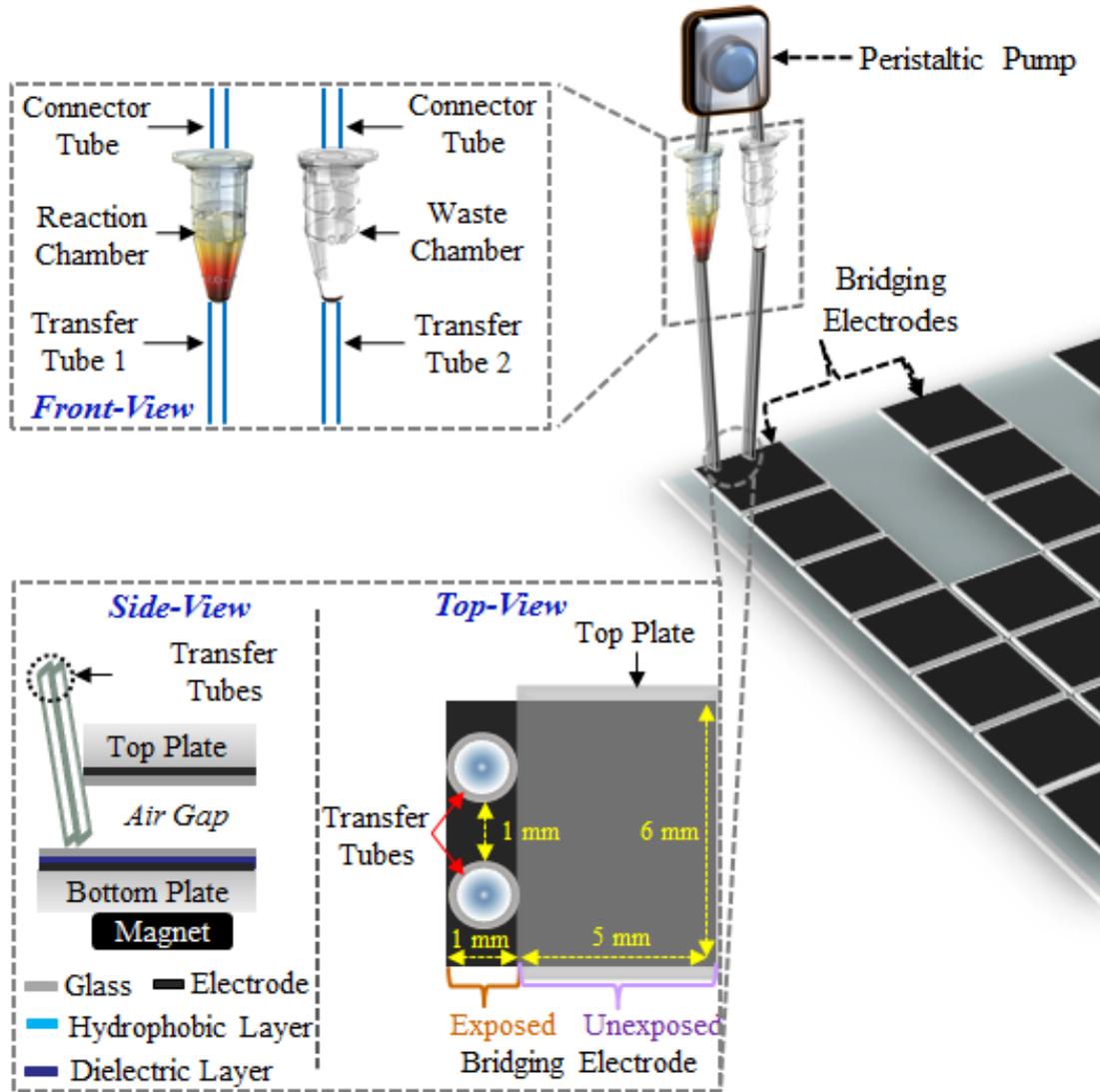
## Feature

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

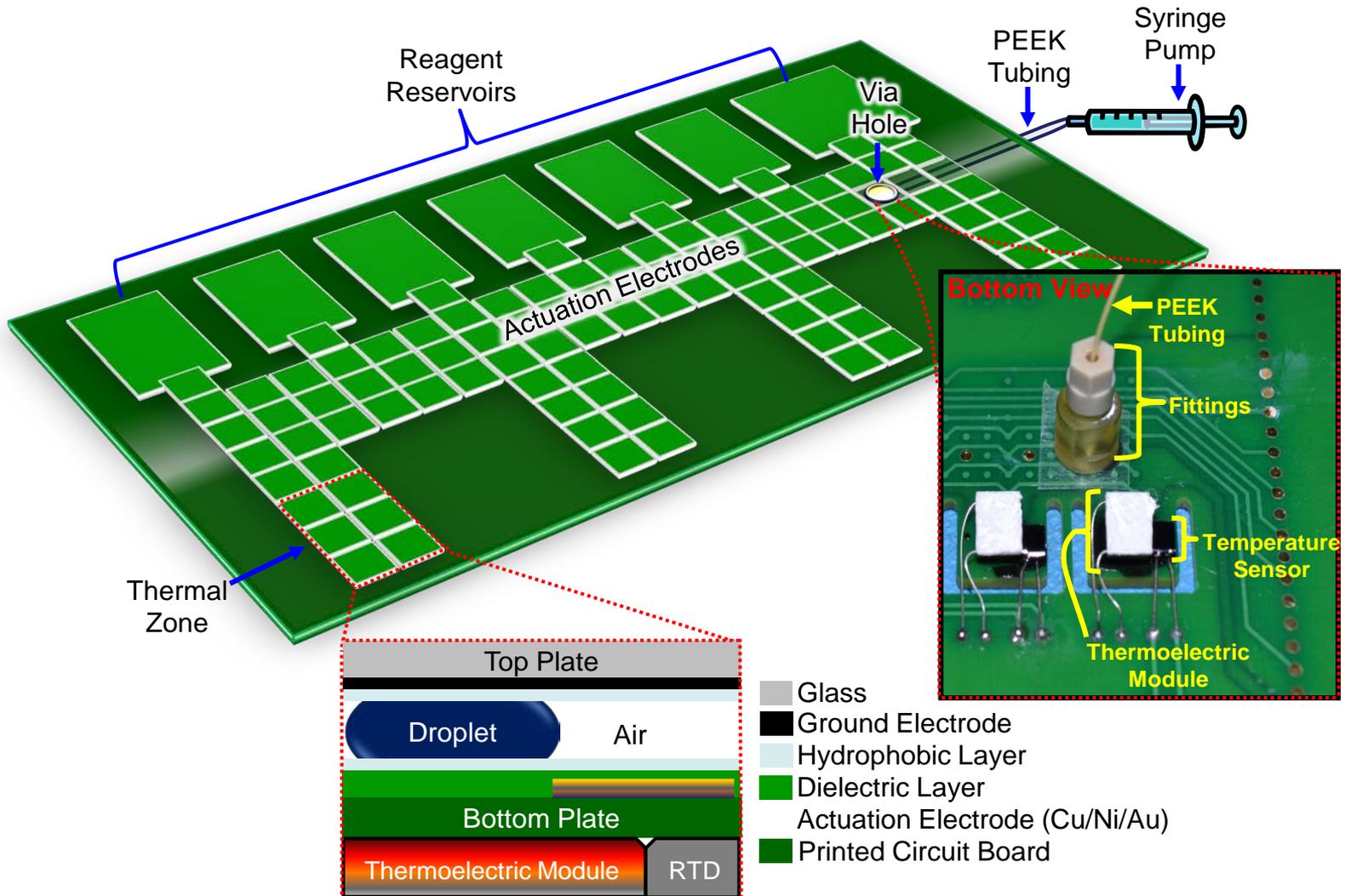
## Advantage

- Requires little expertise
- Protects user & waste manager
- Power draw is minimal

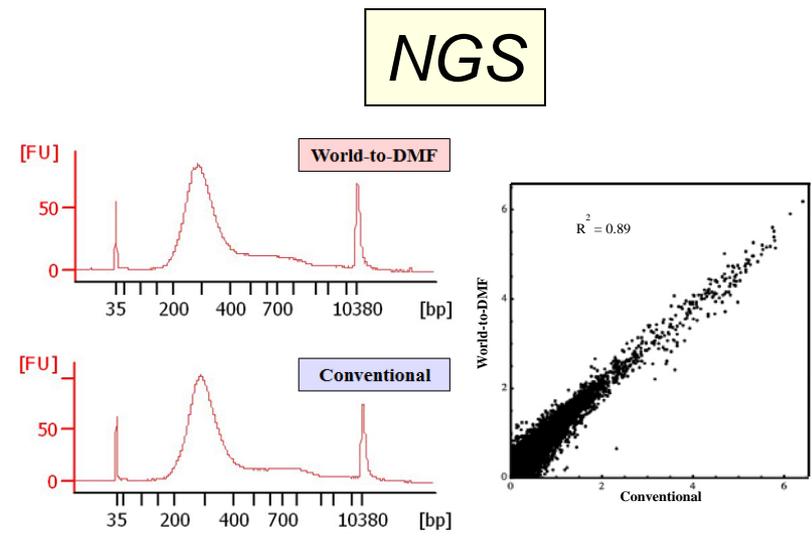
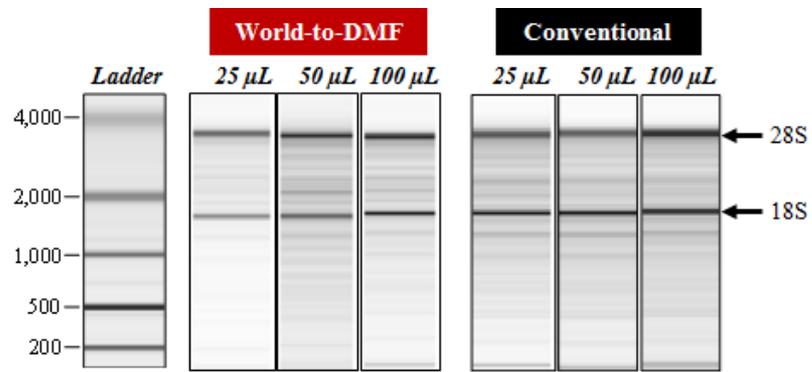
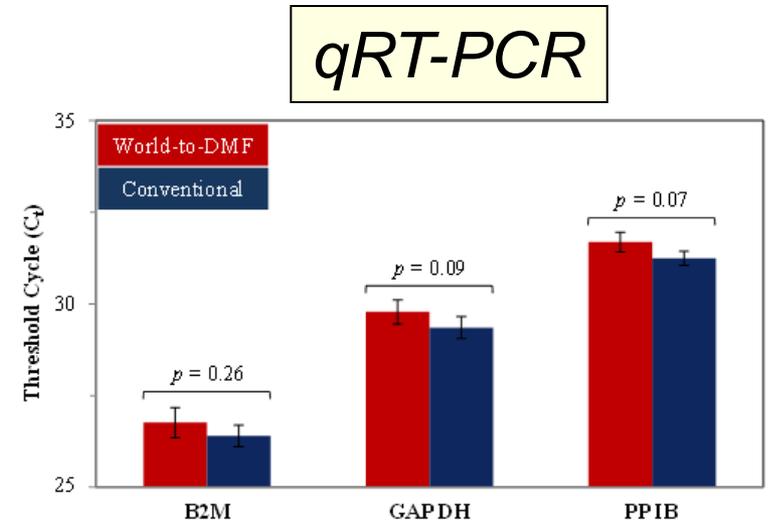
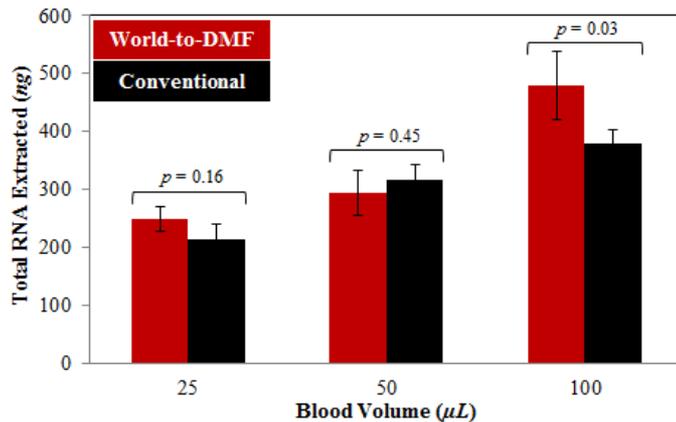
# RNA Prep Module: Digital Microfluidics (DMF) with Macro-to-Micro Fluidic Interface



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



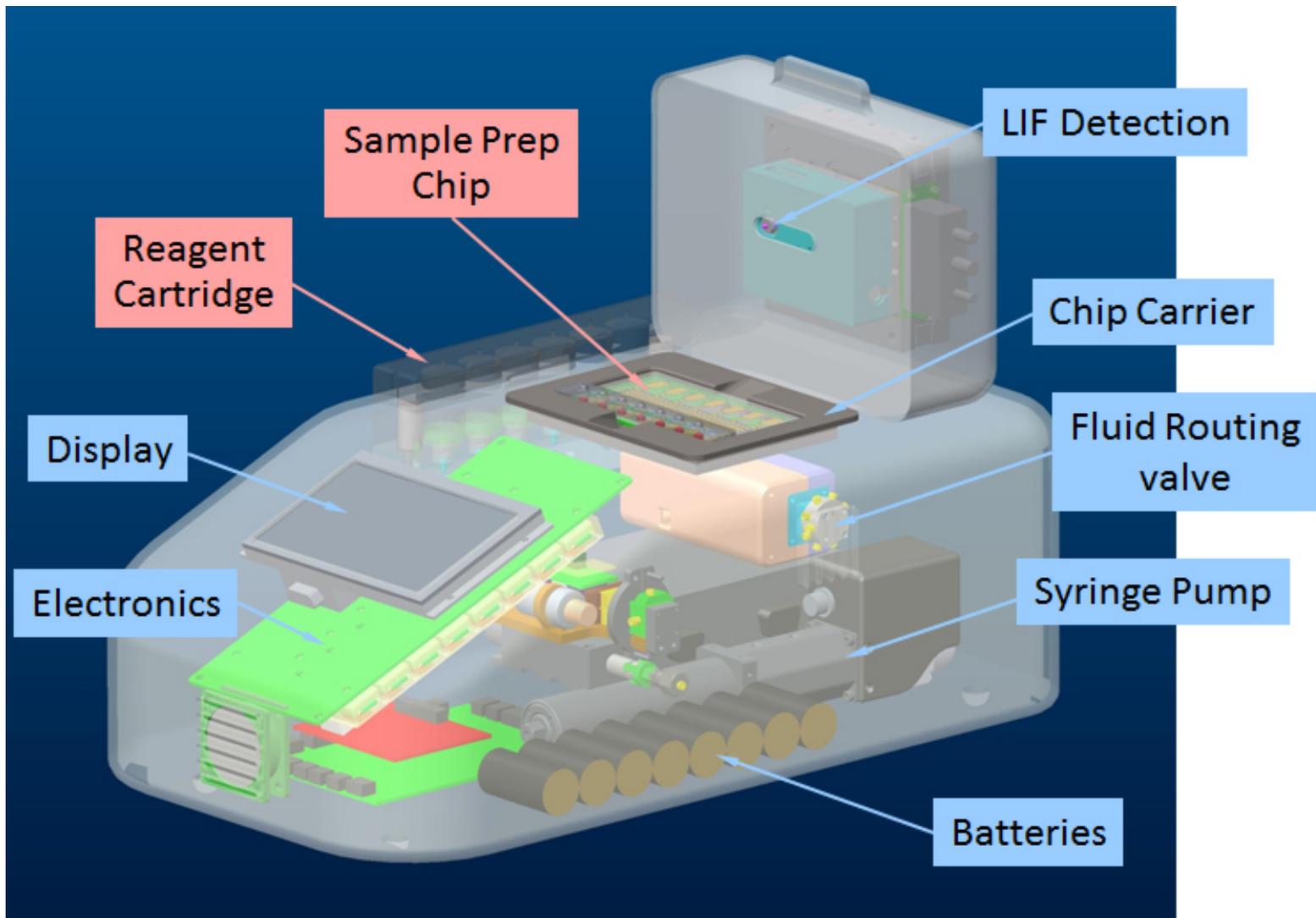
# Platform Yields Useful Blood RNA & cDNA



Volume (µL)	World-to-DMF			Conventional		
	25	50	100	25	50	100
A <sub>260</sub> /A <sub>280</sub>	1.65 ± 0.04	1.94 ± 0.12	1.99 ± 0.21	1.98 ± 0.17	1.89 ± 0.03	1.70 ± 0.14
RIN	6.8 ± 0.5	6.9 ± 0.7	6.2 ± 0.5	7.1 ± 0.4	6.5 ± 0.9	6.7 ± 0.3

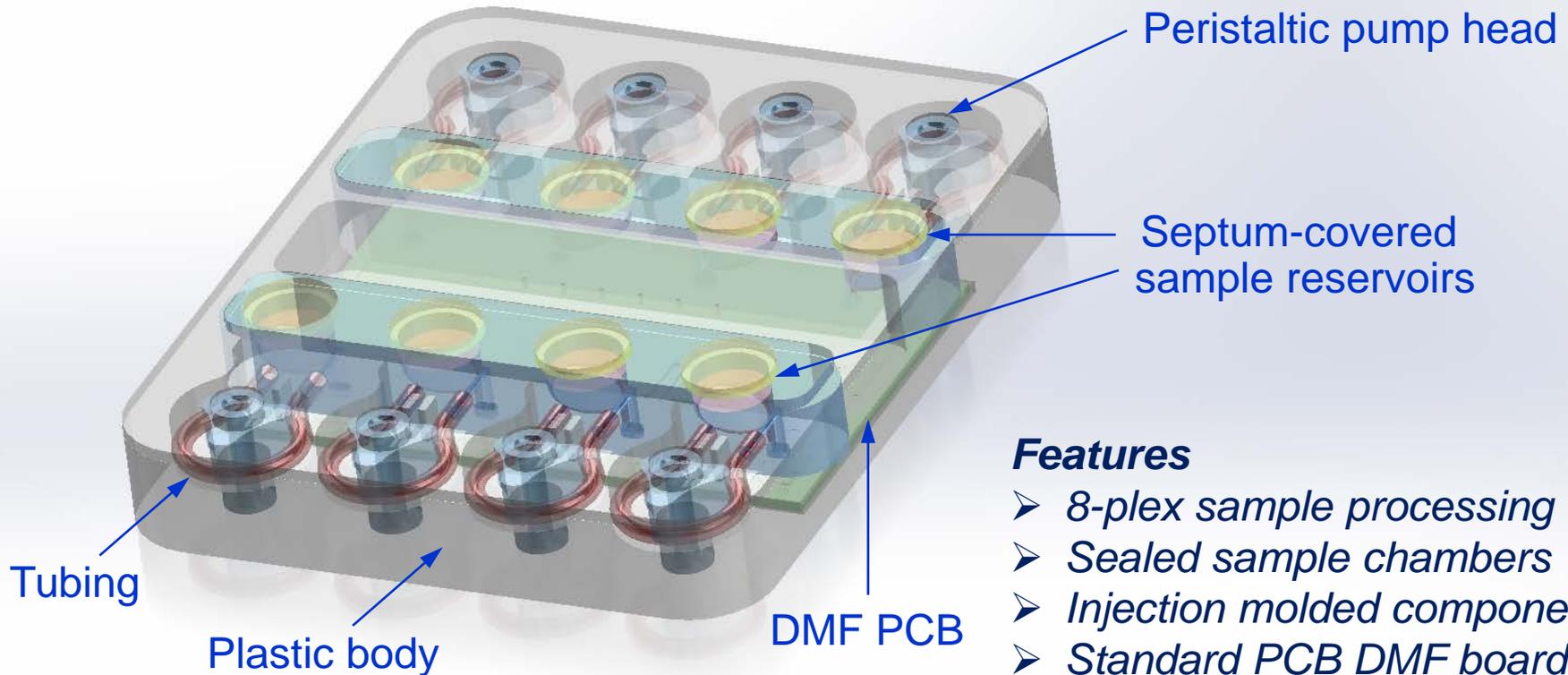
Jebrail MJ *et al.*, Anal Chem 86:3856 (2013); Lab Chip 15:151 (2015).

# 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



Sample Prep Cassette, top view.  
Approx. 3.5" x 4" x 0.75"

## 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)

# Differentiating Strengths of Our System

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- **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 (eg, QIAcube).
    - “Sample-to-answer” eliminates choice in detection approach.
- **Small (8”x12”x5”).**
- **Low power ( $\geq 8$  h operation on laptop battery).**
- **Reagents & disposables are cheap (~\$5 per sample).**

# Potential Commercial Applications

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- **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).