Accelerate Sepsis Diagnosis by Seamless Integration of DNA Purification and qPCR

Bang-Ning Hsu, Andrew C. Madison, Richard B. Fair
Department of Electrical and Computer Engineering, Duke University, USA

1. **Sepsis**
   - bloodstream infection
   - 25+ pathogen types
   - delayed/ineffective antimicrobial treatment → high mortality risk

2. **Traditional workflow**
   - turnaround: 6 ~ 10 hr
   - hands-on: 3 hr
   - manual sample transfer between instruments → time wasted

3. **Approach**
   - chemical lysis to qPCR on one chip
   - DNA purification by immiscible phase filtration
   - followed by qPCR prep, qPCR using digital microfluidics
   - multiplex detection: compartment eluent into droplets
   - improved detection limit: small eluent volume → high [DNA] in droplets

4. **Device**
   - top-down view
   - droplets transported by digital microfluidic actuation
   - side view

5. **Preliminary results**
   - immiscible phase purification
     - DNA retention: 47 ~ 88% relative to benchtop protocol
     - purification power
       = [inhibitor in]/[inhibitor out]
       40x lower bound
       10^2 ~ 10^3 x/wash achievable
   - eluent compartmentation
     - eluent from upstream purification stage
     - concentrated dsDNA in droplet:
       2.5 ng/µl = 13 x [DNA in]
     - minimum residual beads

6. **Significance**
   - prior immiscible phase filtration demo: 1 qPCR
   - integration with digital microfluidics:
     - inline auto qPCR prep
     - eluent compartmentation → multiple qPCR

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2. Crit. Care 2012, 16, 404
4. Lab Chip 2011, 11, 1747
5. Anal. Chem. 2010, 82, 2310