

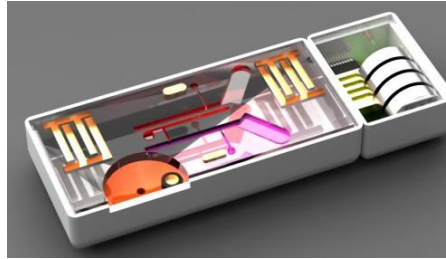
# Biomedical Healthcare solutions for Water Health

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University of Glasgow Research Fellow



# New technologies in Point-of-Care Diagnostics

Chronic illness  
Ageing population



## Common needs

Low cost  
Low power  
Integrated devices  
Fast time to results

Infectious diseases  
Critical care



‘in most communities, the principal risk to human health derives from faecal contamination.’

WHO (guidelines for drinking water quality 2011)

Limited infrastructure leads to limited capabilities:

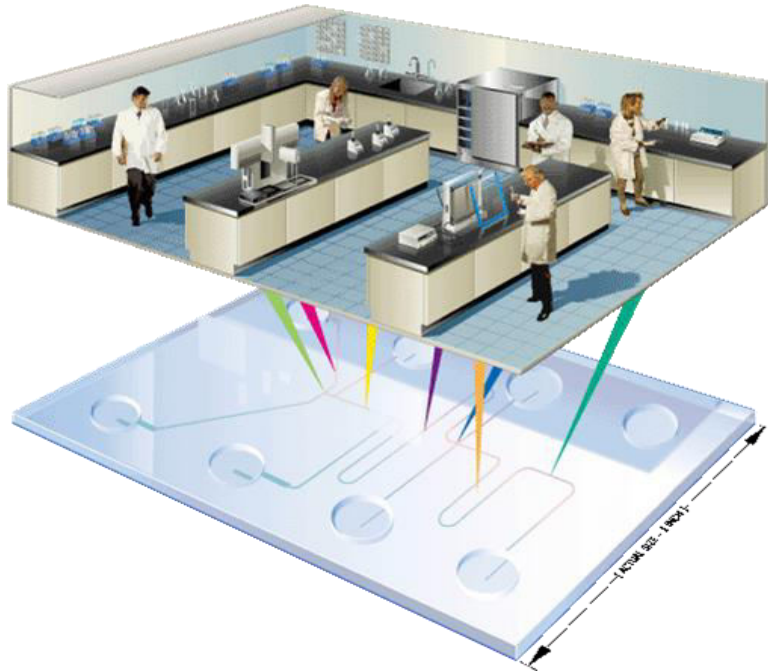


## **Multiparameter test kits :**

- Range of chemical contaminants (titration)
- pH as indication of microbial activity

# Lab-on-a-chip for specific information

## Low cost : paper microfluidics



Whitesides GM et al.

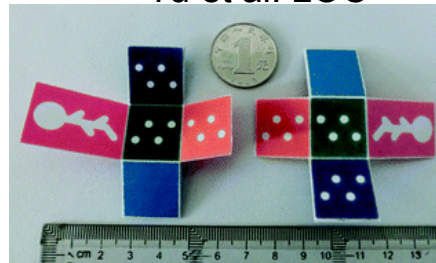


- Low-cost
- Simple (limited training)

But :

- Low sensitivity
- Mostly immunoassay (difficulty in integration)

Yu et al. LOC



# Lab-on-a-chip for specific information DNA information

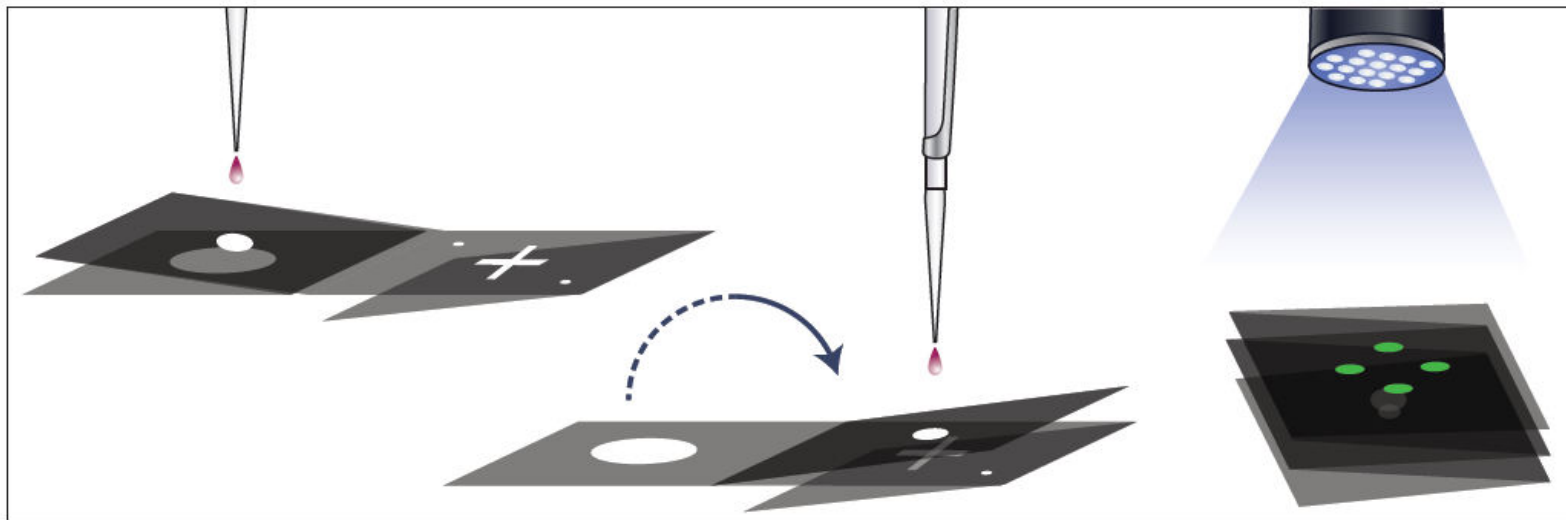
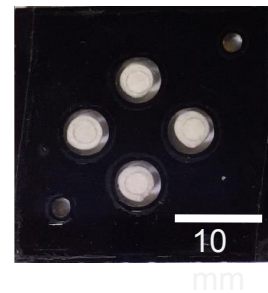
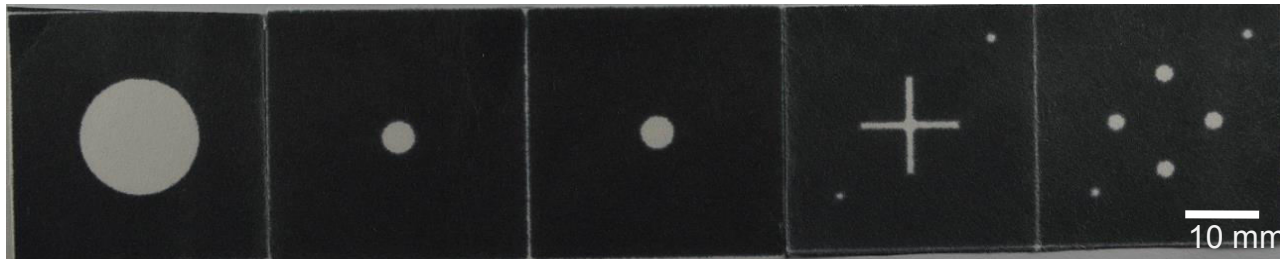


DNA carries information about species and (potentially) drug resistance

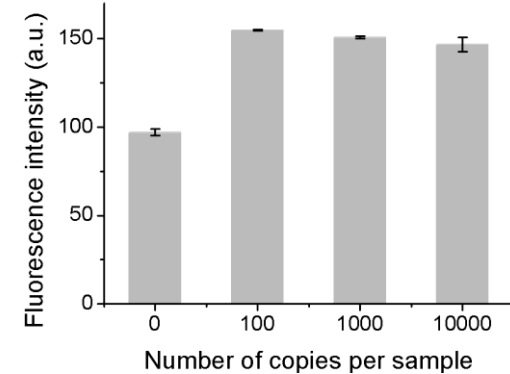
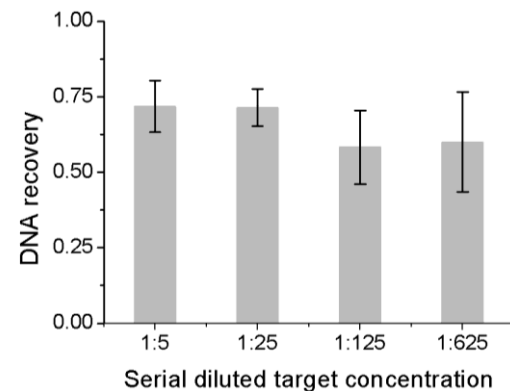
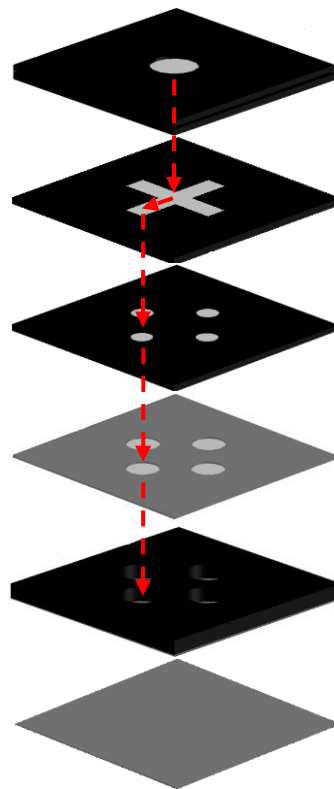
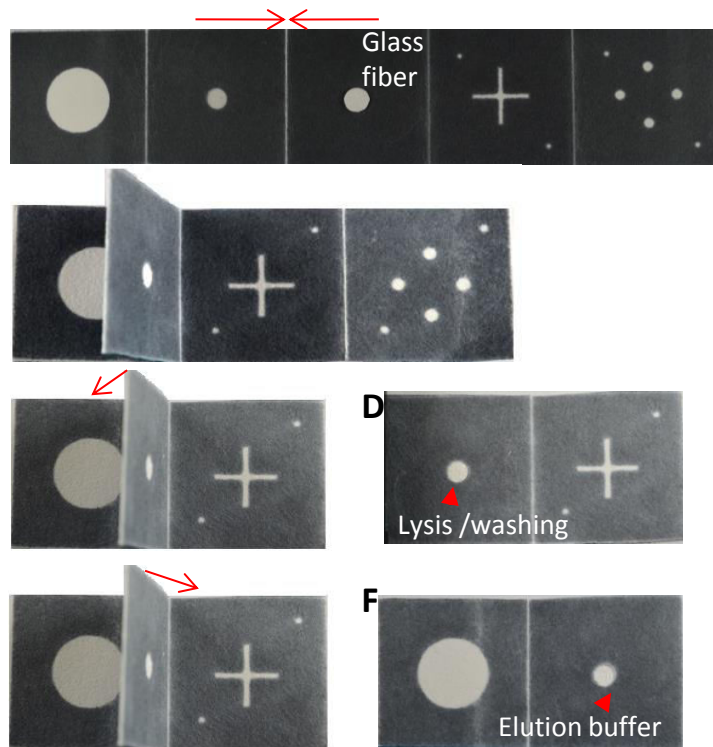
Important in clinical applications to enable treatment decision

*Difficulties in integrating analytical testing and purification*

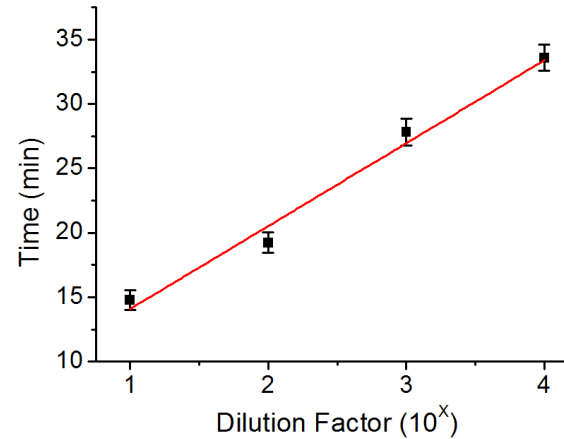
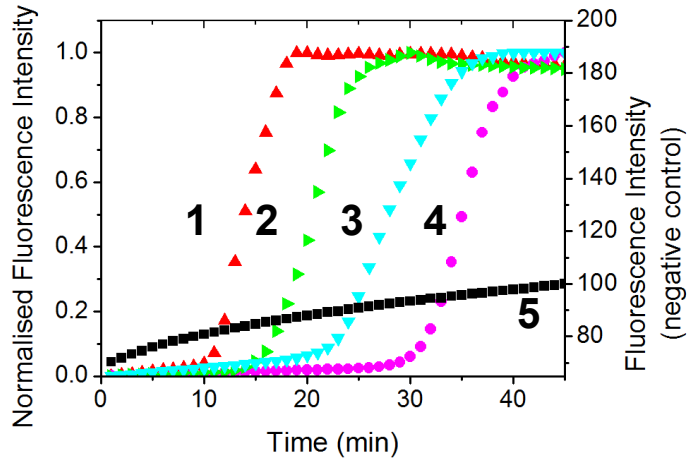
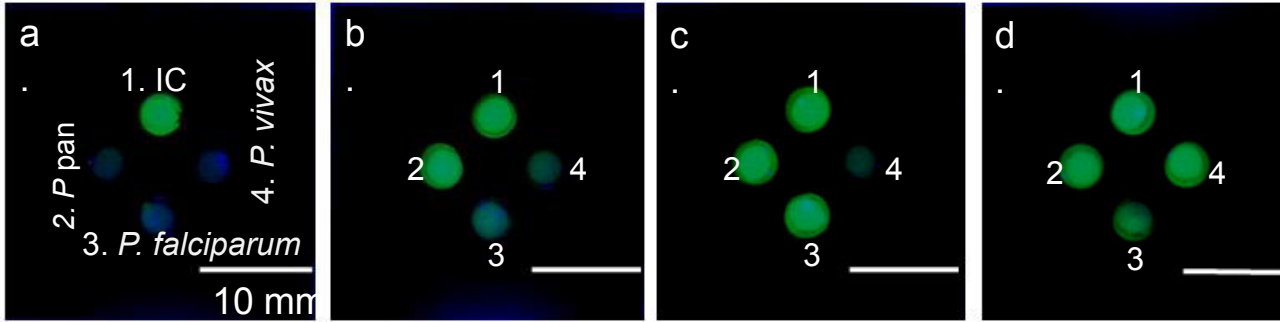
# DNA folding (origami)



# DNA folding (origami)



# Isothermal detection of Malaria species





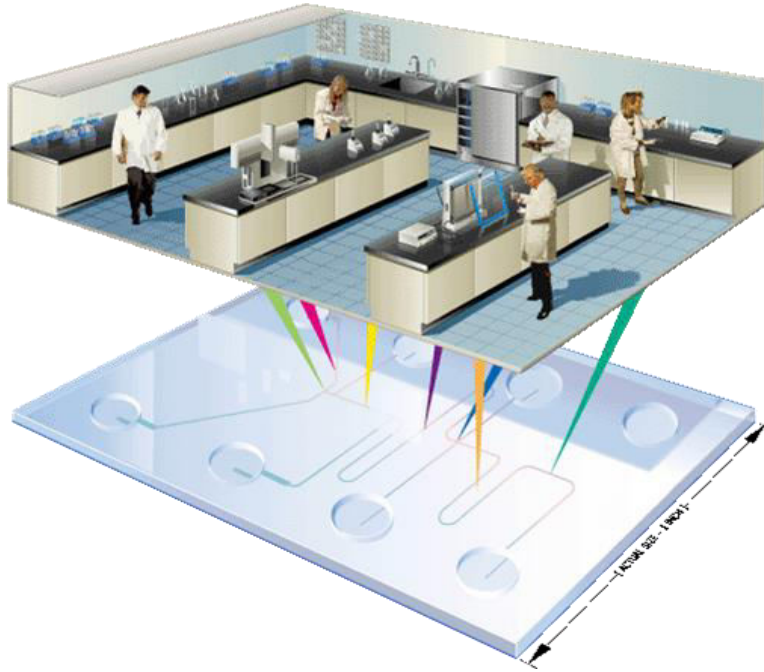
# Isothermal detection of Malaria species

## *Double-blind validation*

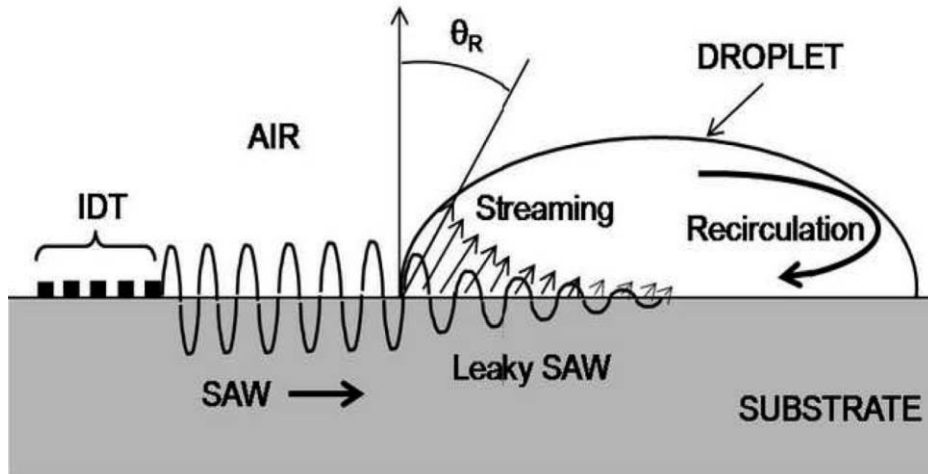
		PCR-MRL		Sensitivity	Specificity
		Positive	Negative		
<b>Origami LAMP</b>					
<i>Plasmodium</i> Pan	Positive	60	0	87%	100%
	Negative	9	11		
<i>P. Falciparum</i>	Positive	12	0	60%	100%
	Negative	8	60		
<i>P. Falciparum</i>	Positive	17	1	81%	98%
	Negative	4	58		

# Lab-on-a-chip for specific information

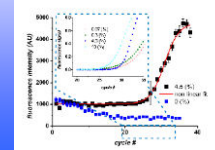
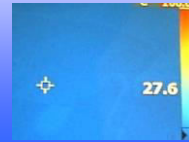
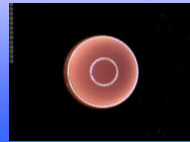
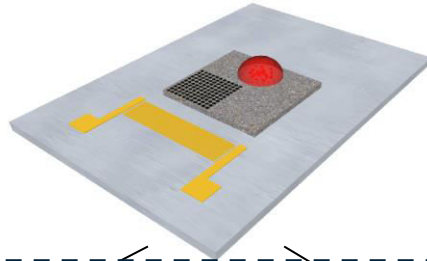
## *Complex analysis – Acoustic microfluidics*



Interaction between sound waves and liquids enables fluidic actuation



# Integration of molecular diagnostics



Sample

Cell lysis

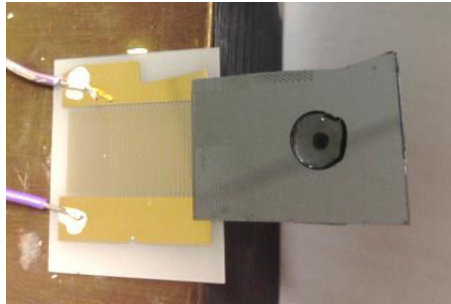
DNA amplification

Detection

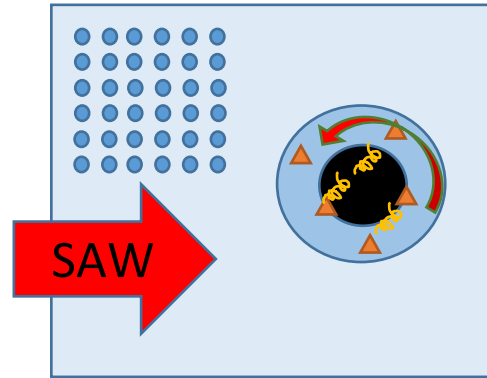
Answer

# Extraction from faecal samples

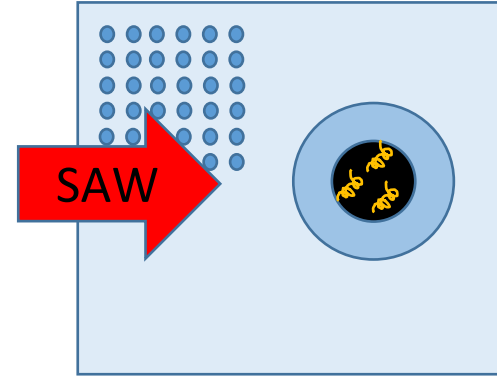
lysis and binding  
(SAW heating - 60° C)



washing

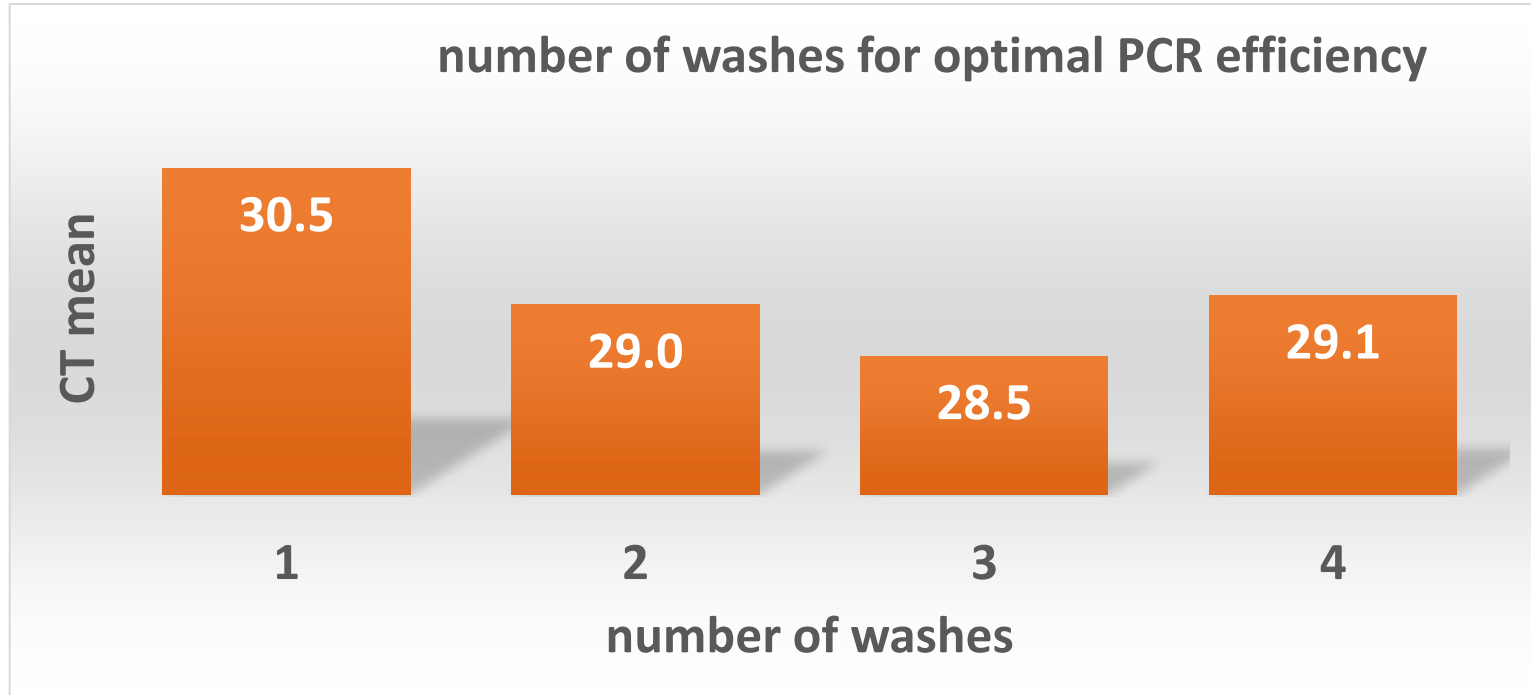


elution



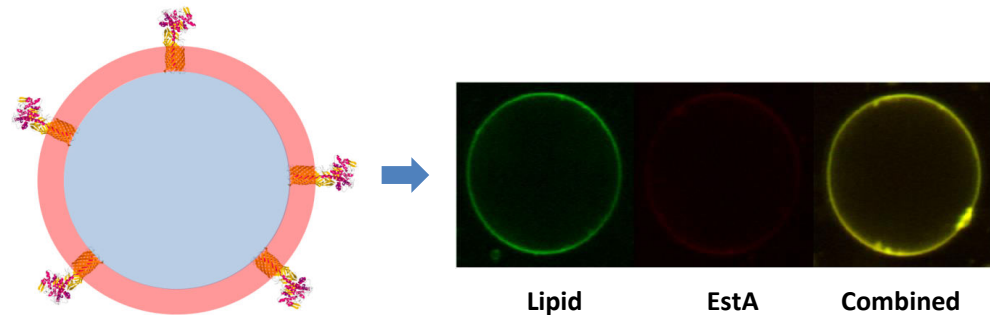
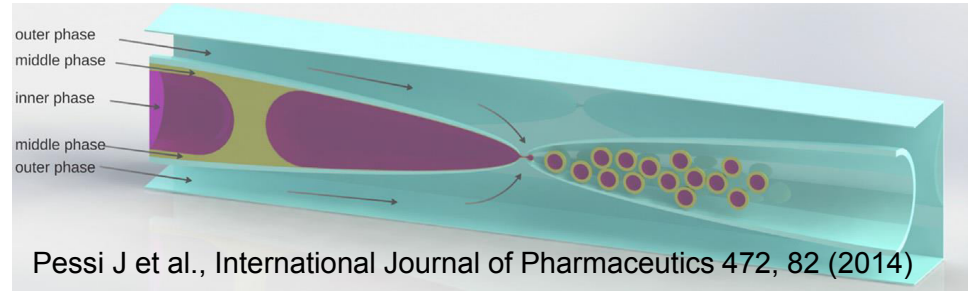
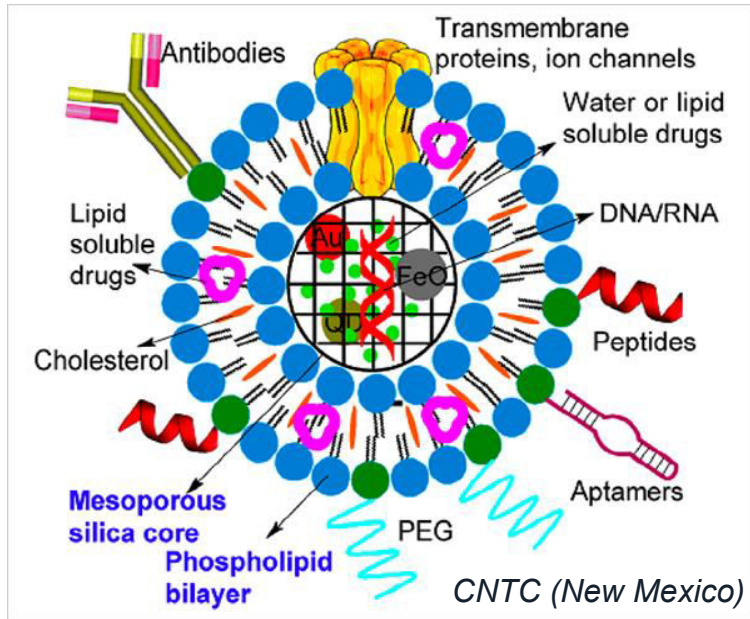
Developed for mycobacterium avium paratuberculosis (MAP) in milk and feces

# Extraction from faecal samples



- POC technologies for medical diagnostics may offer specific advantages for water health:
  - Low cost
  - Higher information content
  - Ease-of-use
- Implementation is challenging :
  - Volumes and sensitivities require re-engineering

## Protocells





## Biomedical Engineering

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& TROPICAL  
MEDICINE



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Andy Waters

Anna Amtman



European Research Council

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EPSRC

Engineering and Physical Sciences  
Research Council

Innovate UK

Technology Strategy Board