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IDEAS THAT WORK
8-9 October 2015 | CSIR ICC

Diagnosing patients at point of care

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Ideas that work

Motivation

- "A long and healthy life for all South African" (DOH Key Outcomes)
- "The equalising principles of primary health care is a decentralised, area-based, people-centred approach of the district system" (NDP Vision 2030)
- "Critical elements of primary health care include prevention and the use of appropriate technology" (NDP Vision 2030)

Point-of-care diagnostics

- Point-of-care diagnostic are medical tests conducted at or near the site of patient care

Blood Glucose Meter and Test Strips

- Primarily aimed to provide same-day diagnosis to facilitate immediate decision-making

Image source: https://en.wikipedia.org/

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Umbiflow: low-cost Doppler ultrasound for low-resource settings

Why antenatal care?

- Millennium Development Goals for Child (#4) & Maternal(#5) Health
  - South Africa & the majority of Sub-Saharan Africa will not meet 2015 deadline

- Perinatal Mortality Rate
  - Developed nations ~ 10 deaths per 1,000 pregnancies
  - South Africa = 37 (WHO)

- 50% of women in developing countries don't receive adequate antenatal care (WHO: 4 visits)

Why antenatal care?

SF

Other Conditions

Clinic-Based Care

No

SGA

Yes

Refer

Primary Level: CLINIC

2 Weekly

Doppler Ultrasound

Umbiflow at the primary level can impact in 2 ways:

Caution

Assess Blood Flow

At Risk

9 / 10 SGA Referrals for Doppler

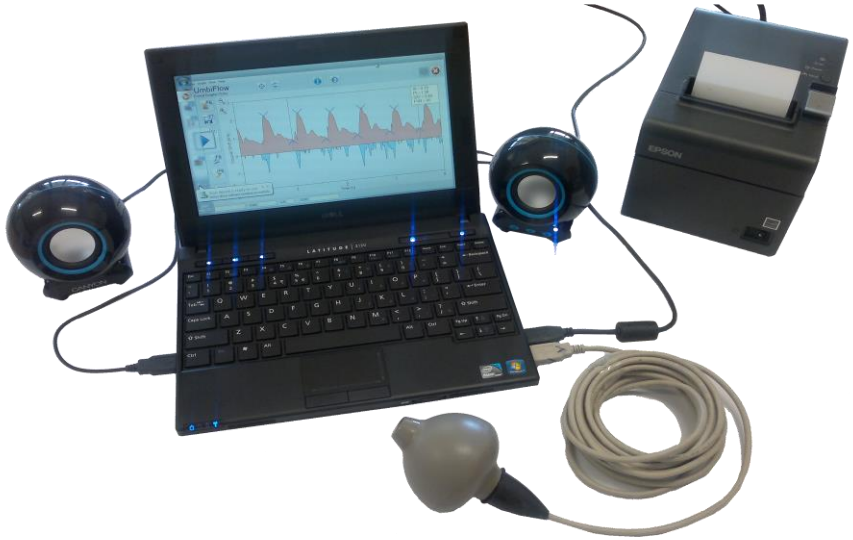
Healthy

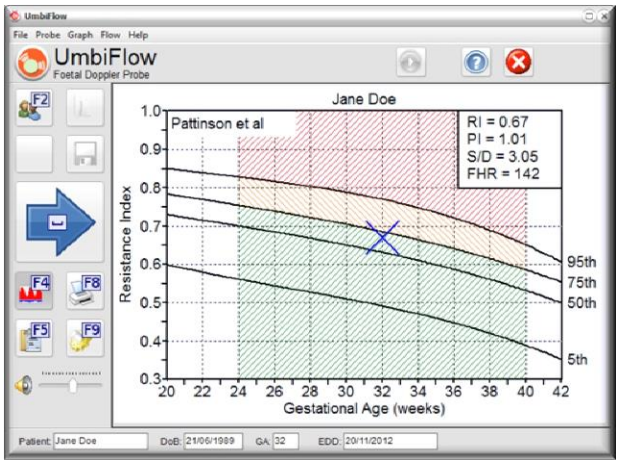
Intervention

Secondary Level: HOSPITAL

The approach

- A low-cost Doppler ultrasound system for assessment of blood flow in the umbilical cord
- Targeted at ante-natal clinics for use by nursing sisters
- Changes the paradigm of ultrasound being used only by specialists at the secondary level





Route to impact

- **CSIR has implemented an ISO 13485 Medical Quality System**
  - Permits commercialisation/technology transfer to happen
- **CE Mark targeted for 2015**
  - Will permit commercialisation
- **Umbiflow validated through clinical testing**
  - Reduced referral rates by up to 83% in small population study
  - 9% smaller babies detected in late bookers

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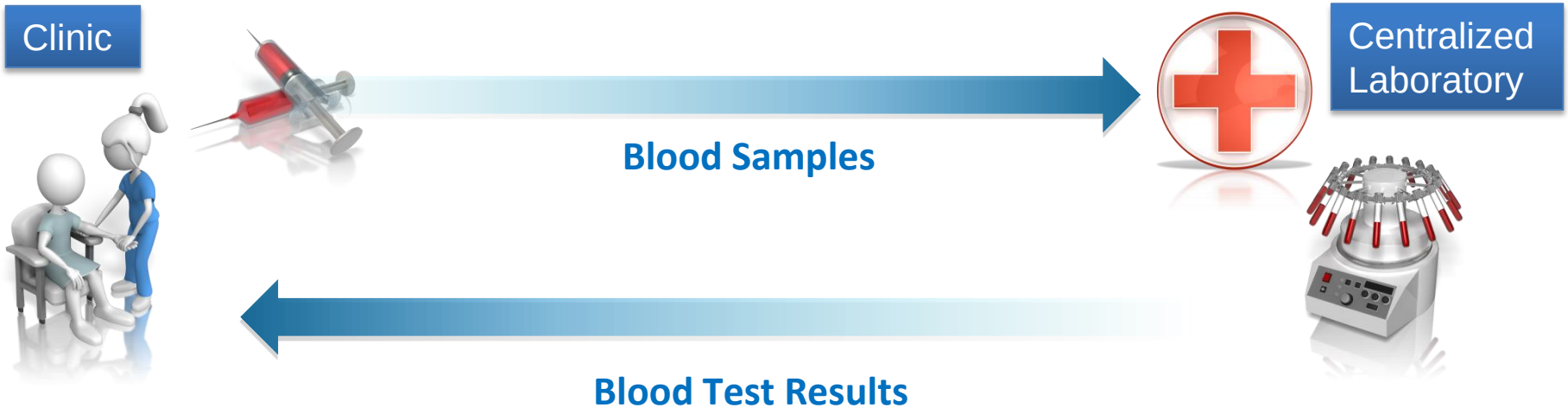
Cellnostics: point-of-care device for full blood count analysis

Current environment

Geographical separation between community *healthcare centres* and *centralized lab*



Turnaround time (TAT) directly impacts the quality of patient care

The solution: Cellnostics

Clinic

Blood Samples

Centralized Laboratory

Blood Test Results

Cellnostics

Clinic

Paper-based diagnostics

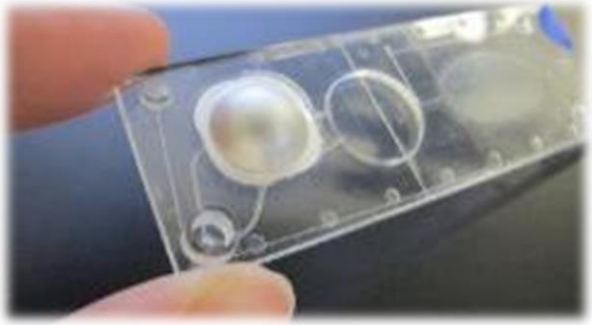
The ASSURED criteria

The World Health Organisation (WHO) states that diagnostics for the developing world should be ASSURED:

Affordable
Sensitive
Specific
User-friendly
Rapid and robust
Equipment free
Deliverable to end-users

Combining technologies

Different microsystems technologies each have pros and cons for effective point-of-care diagnostic implementations



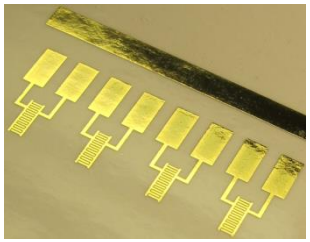
Cartridge-based microfluidics with readout systems A**SSURE**D

Lateral flow devices **A**SS**URE**D

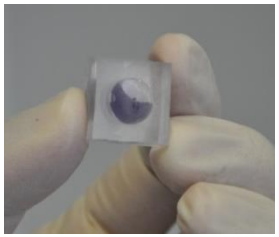
Aim to combine best of different microsystems from all platforms to provide optimal solution that encompasses all **ASSURED** criteria

The platform

Integrate all components found in more expensive equipment onto pieces of paper. This include:

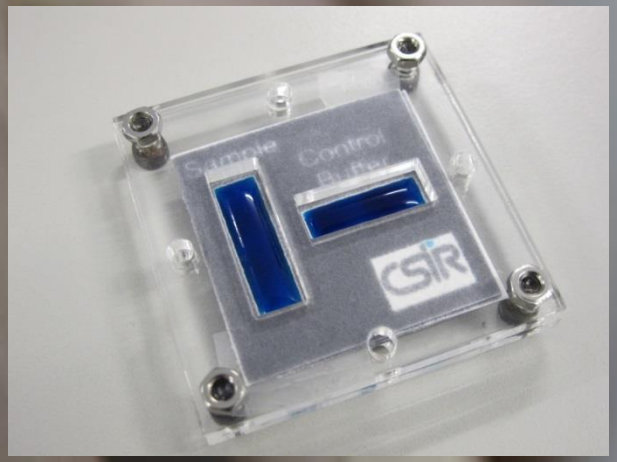


Design and printing
Reagent introduction
Adhesive layers
Assembly and Reagent storage
3D fluid flow and control
Electronics on paper
Readout and Result
Printed energy storage

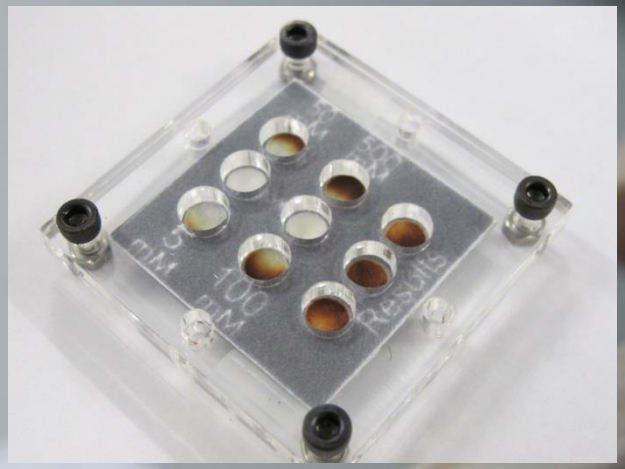


A fully integrated, printable device

Impact



Sensors for medical and environmental diagnostics, also agriculture, drug detection, veterinary, and mining.



K. Govindasamy, S. Potgieter, K. Land and E. Muzenda, Fabrication of Paper Based Microfluidic Devices, Proceedings of the World Congress on Engineering 2012 Vol III WCE 2012, July 4 - 6, 2012, ISBN: 978-988-19252-2-0

Conclusion

- **Increase access to under-served communities**
- **Improve the quality of healthcare provision**
  - Quicker diagnosis at initial point of care
  - Better patient outcomes
- **Reduce cost**
  - In the healthcare system due to reduced work load at secondary hospitals and laboratory
  - For patients who save money on transport costs

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Thank you

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