



Professor Edith Hillan (Canada)

*The role of technologies in the  
delivery of maternity care in  
remote and rural settings*

Celebrate... nurses and midwives, breaking down barriers, leaving no-one behind  
5th Commonwealth Nurses and Midwives Conference 6–7 March 2020 London UK



# **The Role of Technologies in the Delivery of Maternity Care in Remote & Rural Settings**

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**&**

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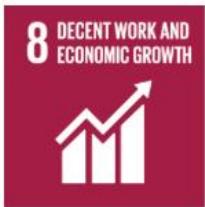
**BOUNDLESS**

# Presentation

- Background
- Use of Technology in Health Care
- Point of Care Devices
- Clinic-in-a-Box
- Conclusion



# SUSTAINABLE DEVELOPMENT GOALS



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# Goal 3 : Targets for 2030



- Reduce the global maternal mortality ratio to less than 70 per 100,000 live births
- End preventable deaths of newborns and children under 5 years of age
  - reduce neonatal mortality to 12 per 1,000 live births
  - under-5 mortality to 25 per 1,000 live births
- End the epidemics of AIDS, tuberculosis, malaria and other neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases

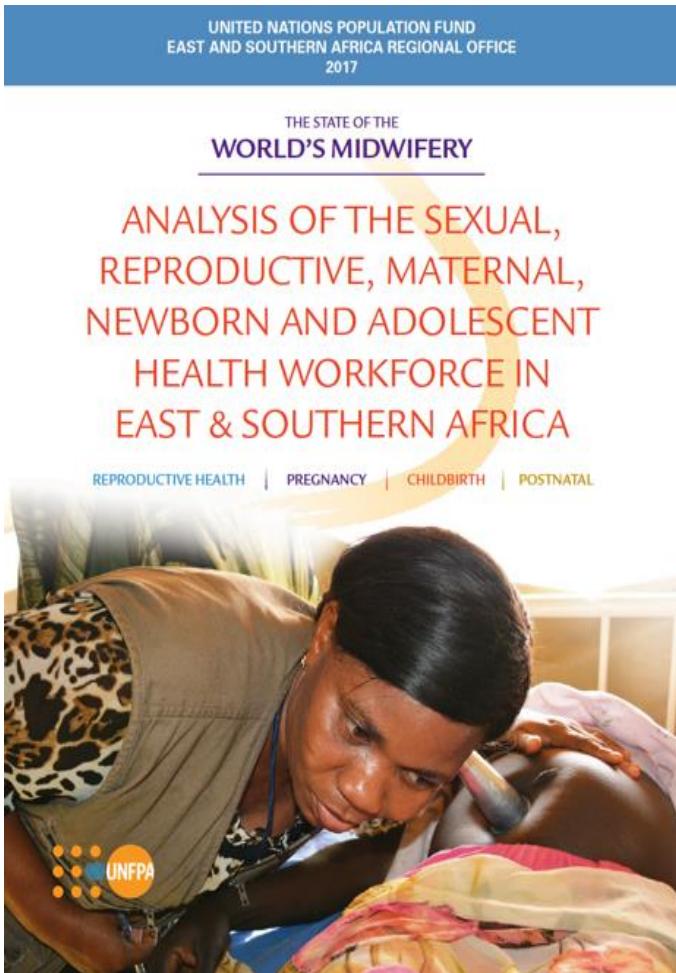


# Progress towards the Sustainable Development Goals

- 303,000 women died due to complications of pregnancy and childbirth in 2015
  - 64% in Sub-Saharan Africa
- Neonatal mortality rate 18 deaths per 1,000 live births in 2017 (2.5 million)
  - 27 deaths per 1,000 live births in Sub-Saharan Africa
- 81 % of births took place with the assistance of a skilled birth attendant in 2018
  - 50% in Sub-Saharan Africa

UN Social and Economic Council : July 2019

# Importance of Health Workforce



- Focuses on 21 of the 23 countries in UNFPA East and Southern Africa region
- 14% of the world's births in 2015
- 2% of the world's doctors, nurses and midwives in 2013
- Sub-Saharan Africa around 50% births have a skilled birth attendant present



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# What is Needed

- It is well-recognized that availability and access to healthcare is inversely related to health needs
- In most high-income countries, health care systems make use of the latest technological solutions, whilst in low- and middle-income countries often basic primary healthcare is unavailable or inaccessible
- Ability to diagnose, treat and monitor illness and disease vitally important

# Role of Health Technologies



- Information and Communications Technologies
  - Artificial Intelligence
  - Mobile health apps
  - Cloud computing
- Telemedicine
- Point of Care Devices

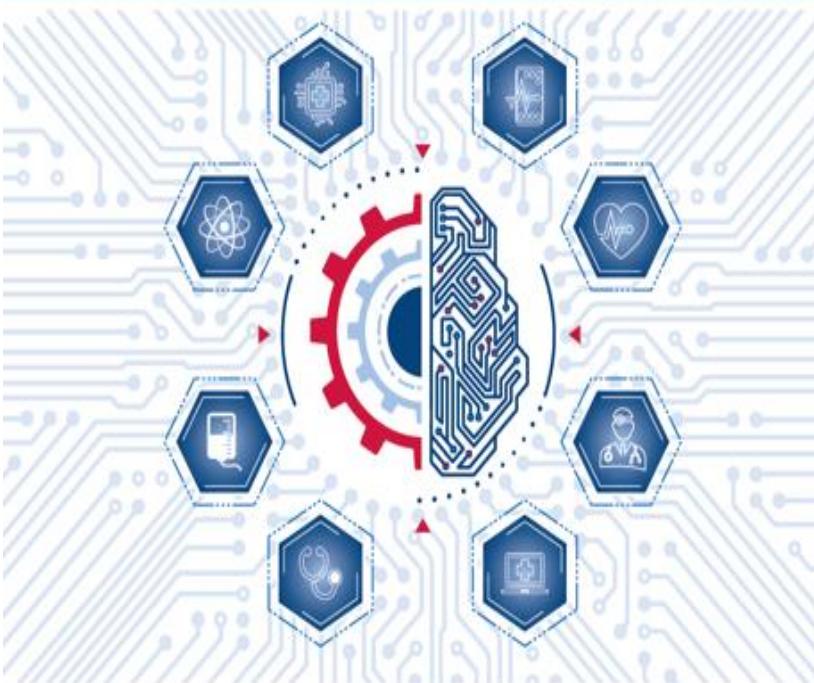
# Artificial Intelligence

- **Definition:**
  - The use of computers for automated decision-making to perform tasks which normally require human intelligence
  - Processing of digital data such as blood pressure, heart rate, temperature
- **Machine Learning**
  - A sub-set of AI that uses algorithms to give computers the ability to learn without being programmed
  - More data allows more accurate prediction



## Artificial Intelligence in Global Health

Defining a Collective Path Forward



From CII's Innovating for Impact Series

- Huge potential of AI in global health - improving health quality, cost, and access in LMICs
- One component of many under the broader digital health umbrella
  - AI-Enabled Population Health
  - Community Health Worker Support
  - Clinical Decision Support Tools
- Identifying what actions can best accelerate the appropriate use of AI to improve health in LMIC contexts

# Point of Care technologies

TPP1: HOME



**Self-testing  
(home-based)**

User: Lay person

Device: RDT (pregnancy-type) or dipstick

Purpose: Self-assessment and referral

TPP2: COMMUNITY



**Testing in the community  
by health workers**  
(e.g. village workers, paramedics)

User: Minimally trained health worker

Device: RDT

Purpose: Triage and referral

TPP3: CLINIC / HEALTH POST  
(Out-patient)



**Testing in the clinic by  
healthcare providers**  
(e.g. doctors, nurses)

User: Clinic staff

Device: RDT, handheld instruments

Purpose: Diagnosis and treatment

TPP4: PERIPHERAL LAB



**Testing in the  
peripheral laboratory**

User: Lab tech

Device: RDT, molecular tests, ELISA, microscopy, etc

Purpose: Diagnosis treatment monitoring

*Simplest*



# HIV : Monitoring CD4 Counts

- State-of-the-art flow cytometer
  - Bulky, expensive and difficult to run
  - Requires sophisticated infrastructure to operate and manage
  - Inaccessible for routine clinical use



# CD4 Instrument Architecture



- Power Supply
- Communications
- Automatic sample control
- Automatic sample loading
- Sample preparation
- Known volume ➤ cells/micro litre

# Point of Care Technologies

- Move away from centralized laboratory testing
- Testing at or near the site of patient care
  - Improved patient-centered care and clinical outcomes
  - Improved compliance with treatment regimes
  - Better detection of emerging infectious threats
  - Increased affordability
  - Reduced anti-microbial resistance
  - Improved regulation and quality of testing
  - Facilitate epidemiological surveys

# Other Uses of This Technology

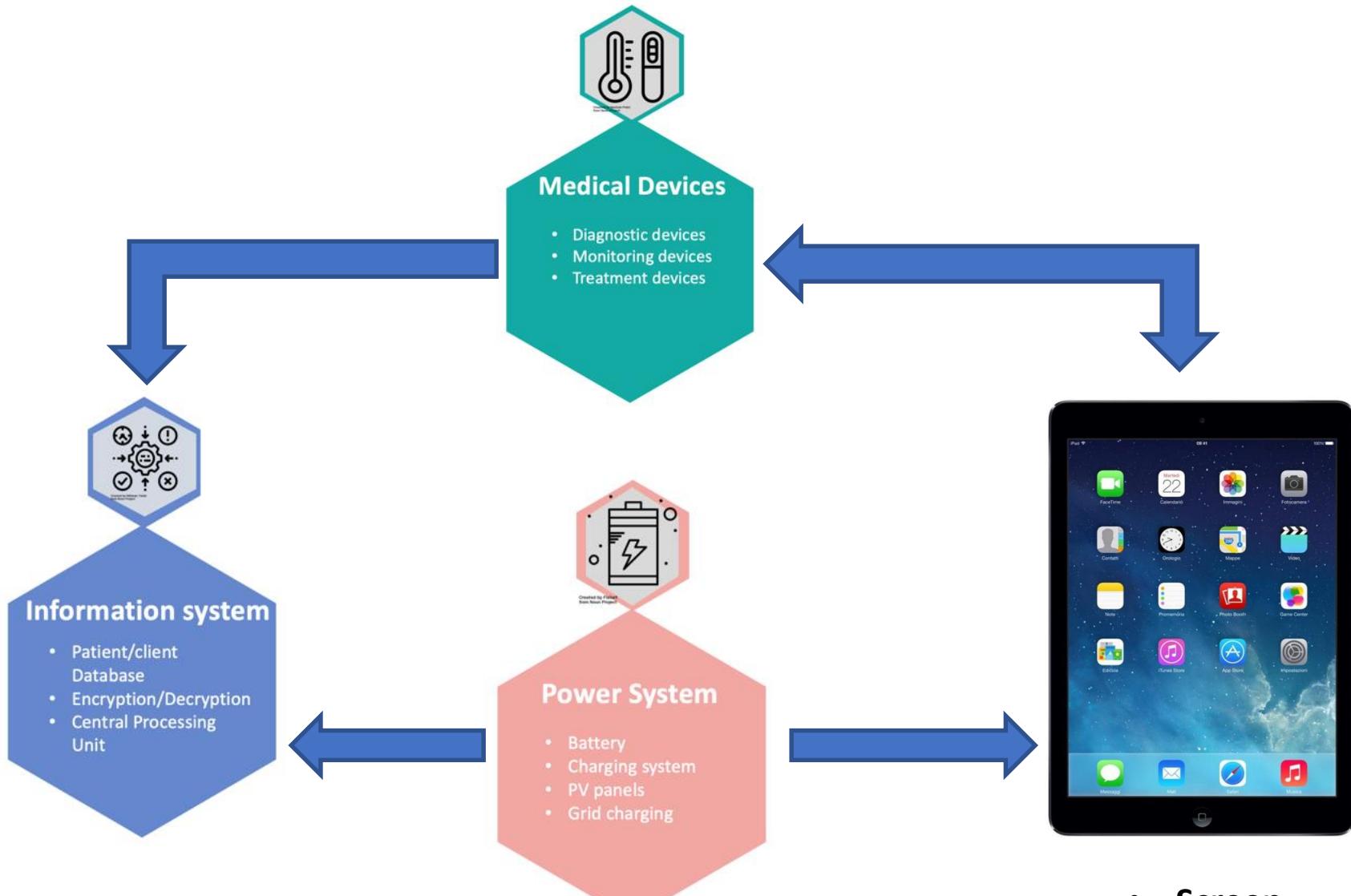
- Sepsis
  - Bacterial vs viral
- Anemia
- Malaria
- Tetanus
- Dengue
  - Identification of different serotypes
- etc, etc

# Development of a Clinic-in-a-Box

- Low-cost, portable and off-grid
- Infrastructure to support existing medical devices
  - Diagnosis, monitoring and screening of conditions
- Ability to store patient data and communicate with facility with health/medical expertise
- Can be operated by both midwives and those with limited health expertise
- Current focus neonatal care – but could be used as a platform to expand access to healthcare in other low resource areas

# Clinic-in-a-Box : Other Potential Uses

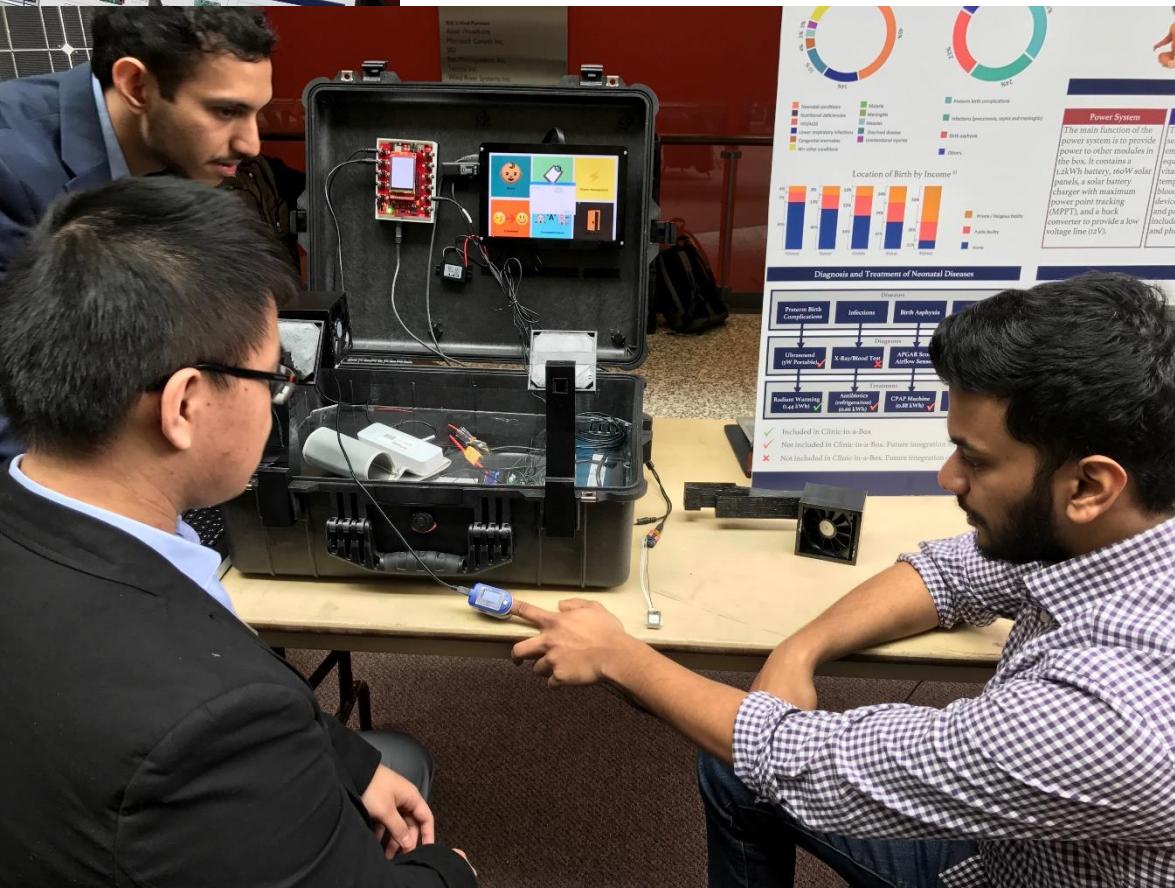
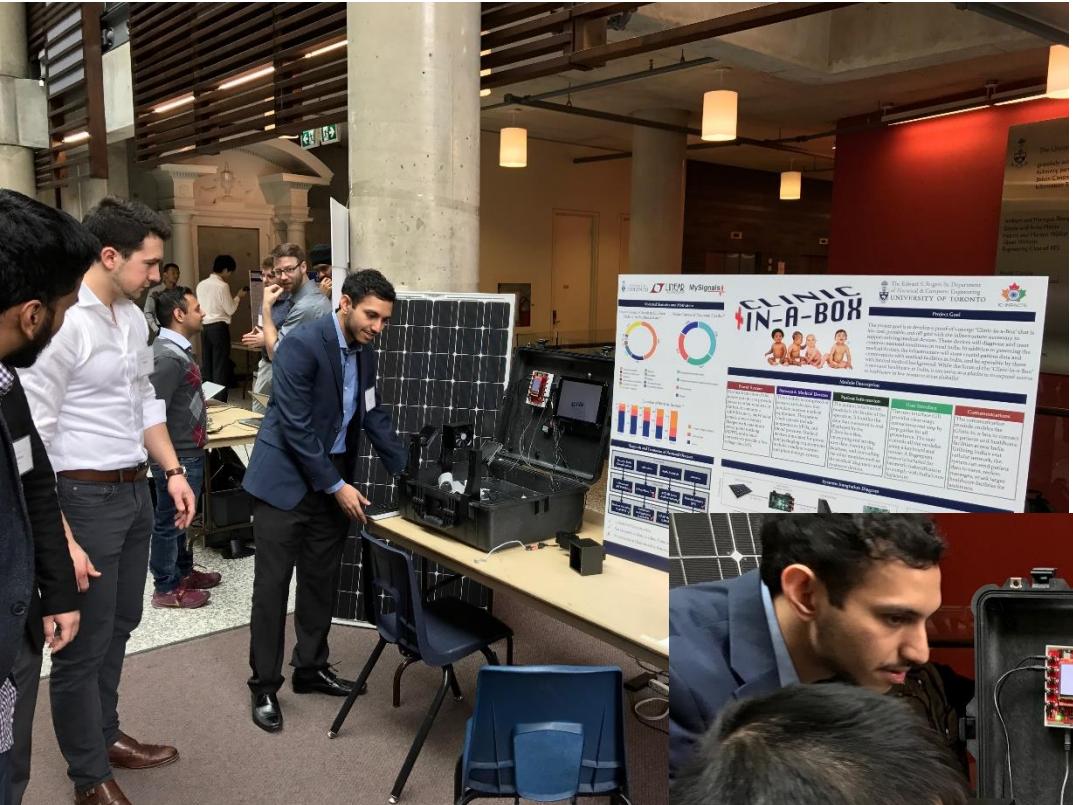
- Power supply can be used for e.g.
  - lighting using efficient LEDs
  - warming
- Connectivity allows for the implementation of quality assurance protocols
- GPS allows data to be tagged to a specific location
- Ability to connect to supply chain for efficient prescription and delivery of medications
- Can incorporate educational aids e.g. Safe Delivery App and other on-line education



# Clinic in a Box : Concept

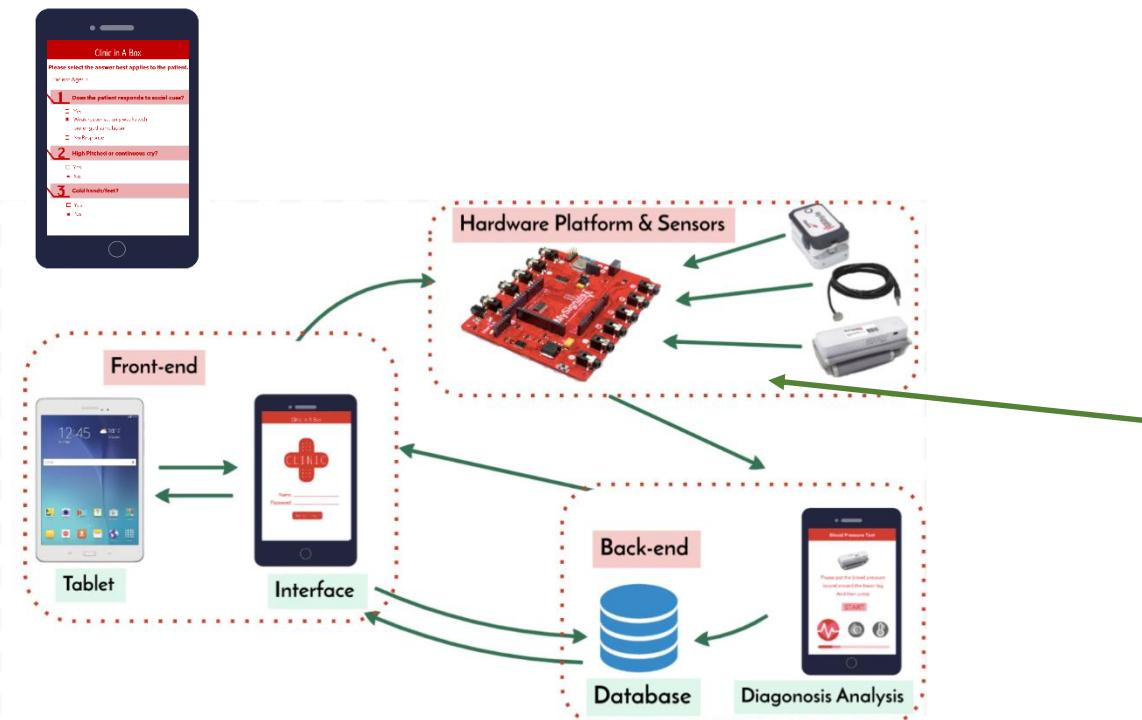
# Clinic in a Box

## Version 1

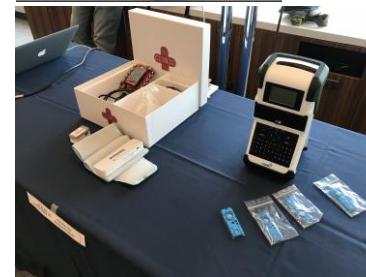


# Clinic in a Box – Version 2

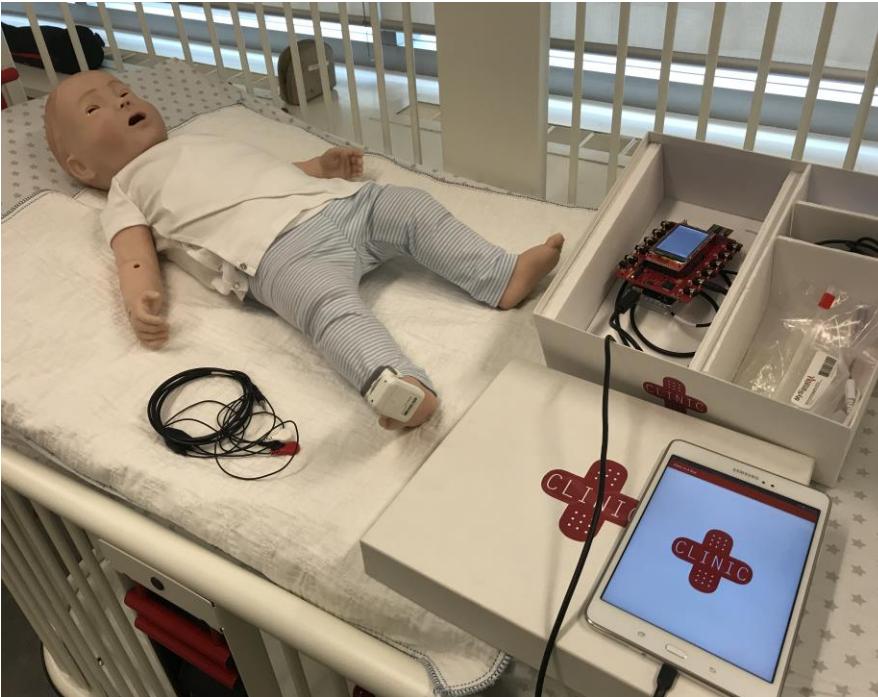
Integration of input from questionnaires,  
triage monitoring and POC blood tests



**Point of  
Care Device**



# Clinic in a Box – Version 2



# Clinic in a Box – Questionnaire input

Clinic in A Box  
Hello, Wendy. Welcome to the remote clinic!  
For the following questions, please select the answer that best applies to the patient:  
Patient Age: Less than 12 months

**1 Does the patient respond to social cues?**

Yes  
 Weak response, only wakes with prolonged stimulation  
 No response

**2 High Pitched or continuous cry?**

Yes  
 No

**3 Cold hands/feet?**

Yes

Clinic in A Box  
Hello, Wendy. Welcome to the remote clinic!  
For the following questions, please select the answer that best applies to the patient:

**2 High Pitched or continuous cry?**

Yes  
 No

**3 Cold hands/feet?**

Yes  
 No

**4 Grunting or pause in breathing?**

Yes  
 No

**5**

Clinic in A Box  
Hello, Wendy. Welcome to the remote clinic!  
For the following questions, please select the answer that best applies to the patient:

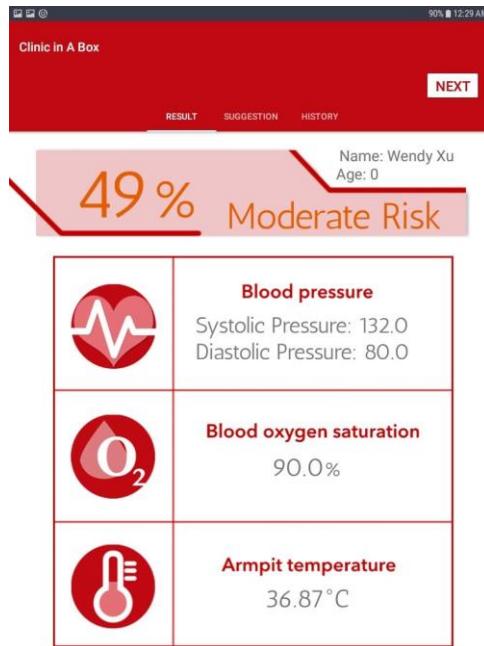
Mottled/Ashen/Cyanosis  


Pale or Flushed  


No abnormal appearance

**SUBMIT**

# Clinic in a Box – Results



# What the Future Might Look Like



- Anita lives in a rural village in Western Kenya, six hours from Nairobi and two hours on dirt roads from the closest hospital
- Community health worker helps women in her community who have just given birth
- Tablet with various apps that she uses in her work
- AI-enabled apps then provide health recommendations, diagnoses, treatment advice, and self-care recommendations



# Situation



- Newborn born at 35 weeks gestation
- High temperature and rash
- His mother is not sure what to do and calls Anita

# Action



- Anita checks his temperature, heart rate and respiratory rate using devices which send the information straight to her tablet
- She takes a photo of his rash with her tablet
- Following CHW health protocols provided by the app, Anita then follows up
- Drawing from health protocols on her app, Anita gives the mother suggestions on how to best care for her son, with specific instructions on when to visit a health facility if his condition changes

# Outcome



- Without her AI tools, Anita would not have been able to provide timely and accurate medical advice
- Without technology, Eric's mother would likely have had to travel to a health facility hours away
- Anita was also able to save an unneeded visit to an already overburdened health system

# Conclusion

- Much has been achieved over the last 30 years
- Much remains to be done
- Technology for health has an important role to play in developing solutions for those living in remote and rural settings
- No single discipline has all the answers – need for more interdisciplinary research

