Current State of Pneumonia Diagnostics
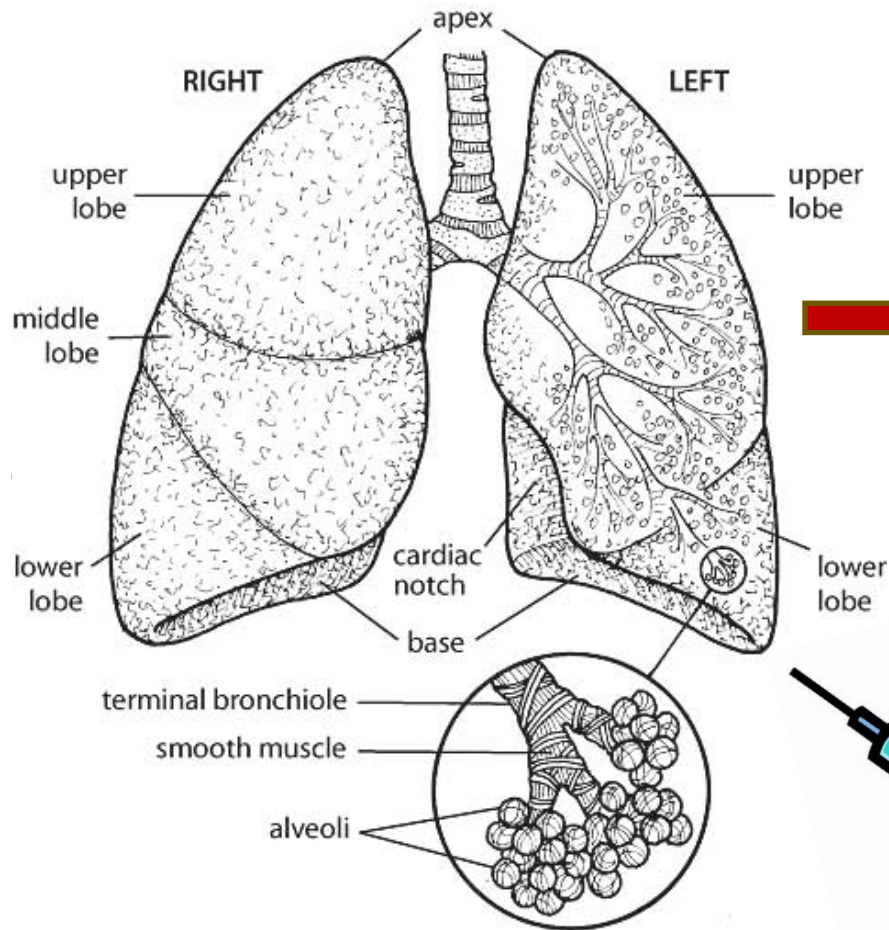
The MDG Health Alliance Pneumonia Roundtable

Deborah Burgess, PhD

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Pneumonia – A Diagnostic Challenge

Blood culture positive in 5-10% of cases

More invasive lung aspirates

Respiratory Rate Counters: Current Technologies

UNICEF Timer

- Times one minute, beeping at 30 second and 60 second marks

- Multiple Challenges, including:

    - Battery life

    - Movement of child

    - Visually determining breaths

    - Remembering the count

Counting Beads

- Color-coded, age-specific

- Improves accuracy of diagnosis in breath count assessment and provides a tool to communicate the diagnosis to the caregiver

- Challenges

    - Accuracy of determining respiratory rate is much lower

    - Bead colors need to be appropriate for context

Pneumonia Diagnosis

" We need a Judge to decide if the child should receive treatment or not and to also tell this to the mother…". For many CHWs participating in user research on pneumonia diagnostics, **an ideal device is something that can be put on the child, somehow does the counting and diagnosis on its own and then shows the result in a way that the child's mother would understand.** This would also help to reduce "wasting drugs" on children that just have a common cough or cold"

Source: UNICEF Website

Respiratory rate counters: current and pipeline technologies

Concept development	Field validation	Available for use

Breathing Sounds Analysis
- **Designer: James Cook Inst. Higher Learning**
- **Description:** Breathing Sounds collected via cell phone & analyzed
- **Value:** Can withstand child moving. Diagnose more than Resp Rate
- **Maturity:** Proof of concept demonstrated

JAMES COOK UNIVERSITY AUSTRALIA

Phone Oximeter
- **Designer:** Lionsgate Tech / UBC[3]
- **Description:** RR is detected by a probe and data is interpreted by a smart phone application.

Android app - Mpneumonia
- **Designer:** UW and PATH
- **Description:** Health worker taps screen for each breath, automatic one minute timer

Java app
- **Designer:** Malaria Consortium
- **Description:** Works as calculator where health-worker presses button for each breath, automatic reading on screen after one minute screen

malaria consortium
disease control, better health

Accelerometer
- **Designer:** HOPE/Guardit
- **Description:** Automated respiratory rate reading by pattern on 15 second cycles. Hand crank powered.

PROJECT HOPE

UNICEF Timer
- **Designer:** UNICEF
- **Description:** Times one minute, beeping at 30 second and 60 second marks
- **Value:** Allows clear timing for respiratory rate assessment
- **Maturity:** Currently available

Counting Beads
- **Designer:** International Rescue Committee
- **Description:** Color-coded, age-specific beads to help with counting breaths
- **Value:** Improves accuracy of diagnosis in breath count assessment and provides a tool to communicate the diagnosis to the caregiver
- **Maturity:** Currently available

Pulse oximetry: current and pipeline technologies

Concept development	Field validation	Available for use (currently in well-equipped settings)

Solar-powered finger pulse oximeter[1]

- **Designer:** Zaman Lab, Boston University
- **Description**: Inexpensive pulse oximeter powered by cell phone batteries
- **Value:** Fit for use in children (and adults), powered by readily available cell phone batteries which can be charged with solar panel devices (providing enough power for up to 450 spot checks)
- **Cost**: On target to be manufactured for <$20
- **Maturity**: Yet to be field tested
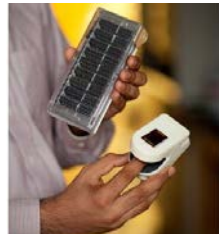
Nossal oximeter

- **Designer:** Nossal Institute
- **Description:** Consists of finger probe and data processing box that connect to a mobile phone to display the oxygen saturation reading
- **Value:** High affordability
- **Cost:** ~$10
- **Maturity:** Prototype developed. Currently adapting technology for field use (e.g. greater portability, ruggedness, etc.)

Phone Oximeter

- **Designer:** Lionsgate Technologies, UBC[6]
- **Description:** Pulse oximeter probe and phone application that transmits data to smart phone for easy reading and recording
- **Value:** Mobile platform allows for multi-functionality (e.g. phone can host many different sensors for detecting vital signs, including resp rate)
- **Cost:** $10-$40
- **Maturity:** LGT Phone Oximeter app and devices to be launched this year, 2013[3,4]

Finger pulse oximeter[2]

- **Designer:** Many
- **Description:** Optical sensor placed on finger to detect blood oxygen saturation and pulse
- **Value:** Uses two 'AAA' batteries and automatically turns off after 7 seconds of idleness to save power (up to 2,000 uses)
- **Cost:** $27-$100
- **Maturity:** Widely available in Western world, slow to uptake in low-resource settings
- **Players:** Many

Handheld pulse oximeter[5]

- **Designer:** Lifebox
- **Description:** Highly accurate and portable pulse oximeter designed for surgical settings
- **Value:** High accurate, appropriate for children four mo. in age to adult, Includes educational materials (CD ROM), displays audible and visual alarms, runs on battery or main power outlet
- **Cost:** $250-$750
- **Maturity:** Available, but designed for surgical operating rooms rather than POC
- **Players:** Many for Western world setting

Other Diagnostic Approaches in the Pipeline

Diagnostic Approach	Progress
Chest Auscultation ■ Digital processing of lung sounds to distinguish pneumonia from wheeze & bronchitis	■ Historical evidence for use of lung sounds in diagnosis of pneumonia ■ John Hopkins University evaluating device in Nepal & Peru
Diagnosis of Bacterial vs. Viral Infection ■ Use of host response biomarkers on a point of care test, similar to a malaria RDT	■ Multiple groups evaluating existing biomarkers / proteomic analysis ■ Combinatorial strategy with 3-4 markers shows promise - > 90% sensitivity & NPV

■ **Antigens or DNA in urine**
 	
■ **Volatile organic compounds**
	■ New areas of research that several groups are exploring
	   ■ Serum Institute of India
	   ■ University of Otago, New Zealand

Pneumonia Prognostic ■ Simple algorithm, that integrates measurements such as respiratory rate, pulse ox & MUAC to **predict treatment failure**	■ Algorithm development initiated ■ Final algorithm will run on cell phone & will complement existing algorithms

Concluding Remarks

- Diagnosis of pneumonia is crucial for ensuring the appropriate administration of treatment

- Pneumonia is a challenging disease to diagnose and has been the "Forgotten Stepchild" of diagnostics for many years

- The pneumonia diagnostics field is making progress, but to achieve impact we need to:

  - Evaluate those technologies that are ready to go into the field and accelerate the development of those that are demonstrating technical promise

  - Generate key information, such as market size and required cost structure, to help engage the multinational diagnostics industry

  - Create a global community that is committed to the successful development, evaluation and sustainable adoption of quality diagnostics for pneumonia

Diagnostics play a critical role in the GAPPD Treatment Strategy

Thank You

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