A conversation with Malaria Consortium, February 6, 2019

Participants

- Kevin Baker – Research Specialist, Malaria Consortium
- Charlotte Ward – Senior Research Officer for Pneumonia Diagnostics, Malaria Consortium
- Alice Maurel – Senior Program Coordinator for Pneumonia Diagnostics, Malaria Consortium
- Maddy Marasciulo – U.S. Business Development and Global Case Management Specialist, Malaria Consortium
- Andrew Martin – Research Analyst, GiveWell

Note: These notes were compiled by GiveWell and give an overview of the major points made by Mr. Baker, Ms. Ward, Ms. Maurel, and Ms. Marasciulo.

Summary

GiveWell spoke with Mr. Baker, Ms. Ward, Ms. Maurel, and Ms. Marasciulo of Malaria Consortium as part of its investigation into pneumonia diagnostics. Conversation topics included the scope of pneumonia-related death, methods of diagnosing pneumonia, the impact of improved pneumonia diagnosis on antimicrobial resistance, past and present work on pneumonia diagnosis, and Malaria Consortium's project proposal.

Scope of pneumonia-related death

Pneumonia is one of the leading global causes of death and disability and the leading cause of mortality in children under five worldwide. In 2017, pneumonia was attributed as the cause of approximately 2.6 million deaths, of which over 800,000 were children under the age of five.

Lack of funding

Despite its global impact on child mortality, pneumonia received only $3 billion in funding from 2000-2015, compared to $5.6 billion for tuberculosis and $38 billion for HIV/AIDS. Malaria Consortium believes that interest in pneumonia-related activities has either remained static or decreased over the past five years.

Causes and methods of diagnosing pneumonia

Pneumonia is an acute pulmonary infection primarily caused by viruses and bacteria. Children who do not breastfeed or are exposed to smoke from cooking fires are more at risk. Pneumonia can be difficult to diagnose in resource-constrained countries as it requires thorough assessment of respiratory symptoms such as cough, difficulty or noisy breathing, the presence of chest indrawing, precise counting of the number of breaths in one minute, assessment of oxygen saturation in the blood through pulse oximetry, and confirmation by X-ray and bronchoscopy. The complex nature of pneumonia is likely one of the reasons that over 90% of

funding for pneumonia focuses on vaccination, with little funding provided for pneumonia diagnostics.

X-rays

Hospitals in developed settings regard X-ray technology as the highest standard for pneumonia diagnosis. However, the accuracy of X-rays depends significantly on the expertise of the medical professionals reading the X-rays.

Manual counting of breaths

X-ray technology is scarce in developing contexts. Health workers in these settings often use fast breathing as a proxy for pneumonia, counting the number of breaths a child takes in 60 seconds. If the respiratory rate (RR) exceeds a certain threshold, which is determined by age by the World Health Organization, the child is diagnosed with pneumonia.

Historically, the only diagnostic tool commonly used when counting RR is an acute respiratory infection (ARI) timer, which provides an audible signal when 60 seconds has elapsed. The ARI timer, developed by the World Health Organization (WHO) and UNICEF in the 1990s, measures elapsed time but does not assist health workers in recognizing and counting breaths. The process of counting breaths, which involves observing the expansions and contractions of a child's chest, can be highly difficult—particularly for children with irregular or fast breathing patterns.

Health workers, regardless of context or setting, are not always able to accurately count RR, especially in children with severe pneumonia who may have up to 70 breaths per minute. This is consistent with Malaria Consortium's observations of health workers in developing contexts. During trainings, health workers are asked to count the breaths in WHO videos of various children with fast breathing, and some responses have varied by as much as 10-15 breaths. The standard acceptable variability is +/- 2 breaths. Accuracy often improves with practice, but it is not consistent nor is it a reliable proxy for accurate diagnosis of an illness which could potentially be treated with antibiotics. This is especially concerning in an era of global antibiotic resistance. Accurate and reliable diagnosis of pneumonia is especially desirable for community health workers who in many countries are allowed to treat children with high RR with amoxicillin.

Automated devices for developing settings

Automated devices for diagnosing pneumonia in developing settings may possess one or both of the following capabilities:

- Automatic counting of RR and indication of fast-breathing or normal-breathing
- Pulse oximetry (measurement of oxygen saturation to indicate severity of pneumonia)

Impact of improved pneumonia diagnosis on antimicrobial resistance

Manual counting of RR can result in either overcounting or undercounting the number of breaths a child takes, particularly in younger children (who have faster breath rates). Due to the narrow interval between a classification of fast-breathing and normal-breathing, manual counting may therefore lead to misdiagnosis and incorrect prescription of antibiotics. Increased accuracy of pneumonia diagnosis should lead to more rational use of antibiotics and a consequent reduction in antimicrobial resistance (AMR). Furthermore, a lower number of drugs necessary for procurement and a lower burden of AMR on health systems would also result in cost benefits.

Past and present work on pneumonia diagnosis

Past work on pneumonia diagnosis

UNICEF's ARIDA project

In the early 2010s, UNICEF began work on its Acute Respiratory Infection Diagnostic Aids (ARIDA) project, publishing a Target Product Profile that specified ARIDA requirements for devices used to diagnose pneumonia. One core ARIDA requirement is that a device is able to perform automated RR counting, thereby making it easier for health workers to classify a child as either fast-breathing or normal-breathing.

In 2016, UNICEF partnered with Malaria Consortium for the development of ARIDA field trial protocols and implementation of the field trials.

Malaria Consortium's initial testing of diagnostic devices

Prior to its involvement with UNICEF's ARIDA project, Malaria Consortium received a grant from the Bill and Melinda Gates Foundation (BMGF) to test nine devices for pneumonia diagnosis. Malaria Consortium field-tested the ARIDA devices in Ethiopia and Nepal, which included assessing the usability and acceptability of devices among health workers and caregivers. Findings from an assessment in Ethiopia of an automated RR counter include:

- Health workers correctly performed their job approximately 75% of the time (significantly above Malaria Consortium's expectations).
- Health workers expressed positive feelings about the device, including that it supported them in performing their job well and encouraged caregivers to visit health posts.
- Caregivers expressed positive feelings about the device, including that it was convenient and free to receive a pneumonia diagnosis at a health post (the alternative was traveling to a health center and paying for services).
- The device assisted health workers in communicating results of diagnoses to caregivers, which could have resulted in less caregiver

demand for antibiotics after being presented with a negative diagnosis (no quantitative data on this hypothesis exists).

Additional research Malaria Consortium would like to conduct

Background and overview

Malaria Consortium is proposing a three-pronged project to build the evidence base for and scale-up of automated diagnostic devices:

1. **Performance studies in controlled settings** – The first component of Malaria Consortium's project would involve randomized controlled trials (RCTs) comparing the performance of the test devices to standard practice.
2. **Implementation evaluation** – Malaria Consortium would analyze how automated diagnostic devices are implemented in different contexts and use the resulting data to build cost-effectiveness models.
3. **Scale-up** – Throughout the project, Malaria Consortium would engage with national health ministries to ensure that the research results are used to scale-up implementation of automated diagnostic devices.

Rationale for additional research

Existing data suggests that automated devices are likely to be superior to manual counting for diagnosing pneumonia, and many stakeholders are interested in these devices.

Without performance and cost-effectiveness data, Malaria Consortium believes that governments and organizations will not significantly invest in these devices or search for external investors.

Goals of additional research

Malaria Consortium's primary focus would be on building the evidence base for scalable deployment of automated diagnostic devices. Its ultimate goal would be to have effective diagnostic devices introduced at different levels of health systems, thereby improving the management of pneumonia for children under five and increasing the rational use of antibiotics.

Performance studies component

Malaria Consortium would like to conduct studies on the performance of the automated diagnostic devices in the countries in which it has already studied acceptability for both devices. It believes that studying devices in multiple settings is important for developing a broader understanding of performance and because governments typically wish to see evidence from local contexts.

Methodology

Performance studies would be conducted in hospital inpatient departments.

Implementation evaluation component

In order to build a robust dataset on the implementation and cost-effectiveness of automated diagnostic devices, Malaria Consortium would also like to conduct field assessments of the devices at various health system levels in six countries—all of which have relatively high pneumonia prevalence.

Situational analysis

Prior to implementation, Malaria Consortium would analyze existing infrastructure in the six selected countries to better understand capacity for scale-up of automated diagnostic devices.

Implementation

Malaria Consortium would pilot automated diagnostic devices in specific regions of the six selected countries, implementing at different levels of health systems (community, facility, private).

Process evaluation

One to two years after implementation, Malaria Consortium would conduct an evaluation of the intervention using data gathered.

Cost-benefit and cost-effectiveness analyses

Prior to implementation, Malaria Consortium would build cost-benefit analyses for its intervention based on previous models. Benefits may include:

- Reduced financial burden on health systems
- Improvement of and increase in care-seeking behavior
- Reduced cost per intervention
- Faster consultations at both the community and health center level
- Rational use of antibiotics

After implementation, Malaria Consortium would utilize results from its process evaluation to conduct cost-effectiveness analyses of different diagnostic devices at different levels of health systems and in different settings. Malaria Consortium would like to conduct the cost-effectiveness analyses with an academic partner.

Scale-up component

Throughout the project, Malaria Consortium would be engaging with national health ministries, utilizing evaluation results to promote scale-up of automated diagnostic devices.

All GiveWell conversations are available at
http://www.givewell.org/research/conversations