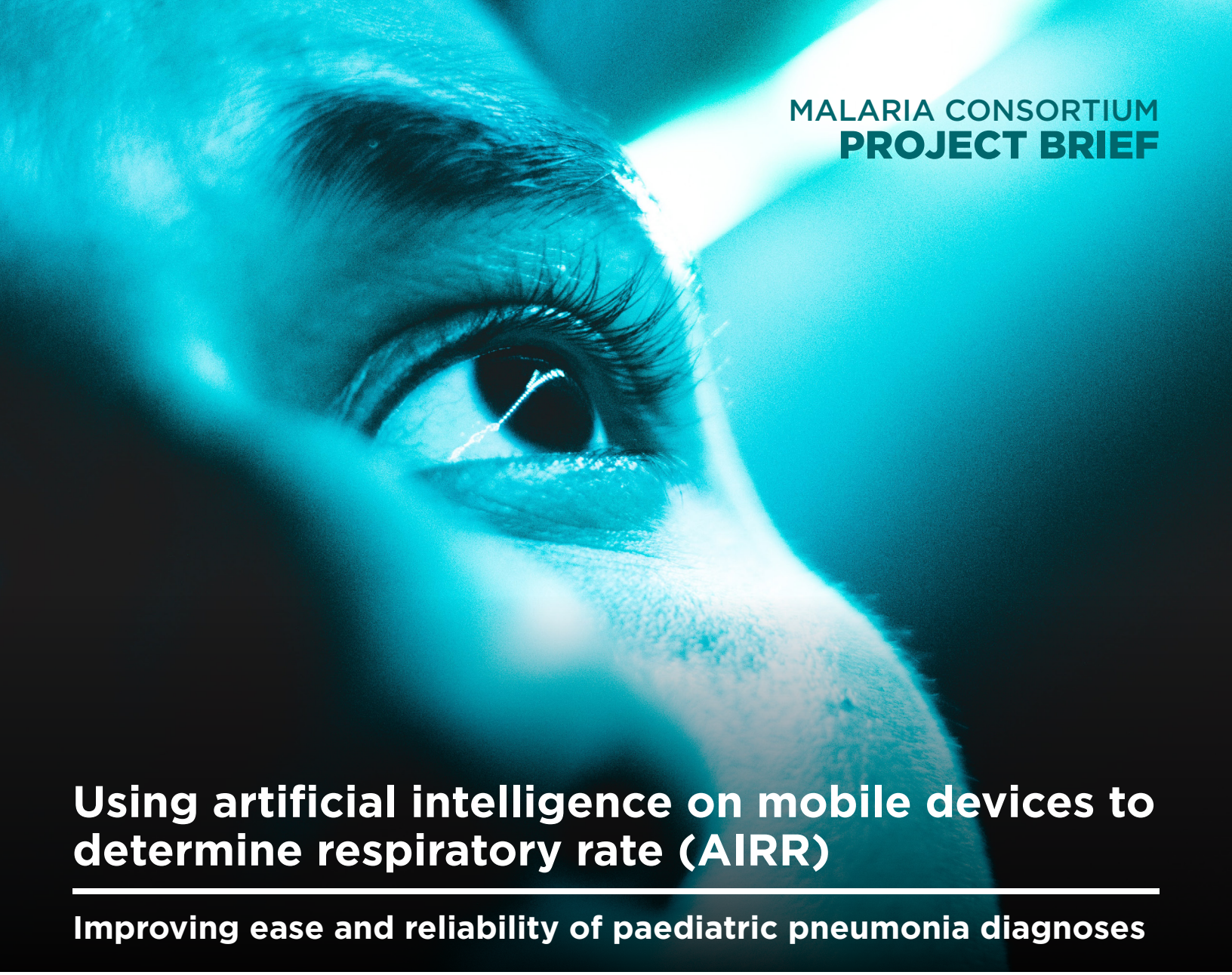

MALARIA CONSORTIUM
PROJECT BRIEF

Using artificial intelligence on mobile devices to determine respiratory rate (AIRR)

Improving ease and reliability of paediatric pneumonia diagnoses

Background

Pneumonia remains the leading cause of infectious mortality in children globally, causing more deaths than HIV, tuberculosis and diarrhoea combined in 2016.[1] If we are to meet the global goal of eliminating preventable deaths in children under five by 2030, reducing the burden of pneumonia in low- and middle-income countries (LMICs) will be key.

Traditionally, the benchmark for diagnosing pneumonia has been a chest x-ray. However, these are rarely available in LMICs — especially outside of hospital settings, where most cases present — and diagnoses are primarily based on respiratory rate (RR) and the presence of cough or difficulty breathing. Healthcare workers measure RR by visually counting the number of breaths a child takes, with the aid of a stopwatch or an acute respiratory infection timer. Not only can this be unreliable,[2] but poor application of guidelines can lead to inappropriate treatment and missed diagnoses.[3]

Artificial intelligence (AI) applications could hold the key to addressing these issues. Recent examples show promise in interpreting video data for vital sign monitoring, offering an opportunity to advance this field with real-time diagnostic applications.[4,5] With mobile health (mHealth) platforms also becoming increasingly prevalent in LMIC

Countries
Cambodia

Ethiopia

Malawi

Nigeria

Donor
Swedish Research Council

Length of project
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Partners
Johns Hopkins University

Karolinska Institutet

Oulu University

VTT Technical Research Centre of Finland

settings[6] — which often experience high patient loads and lack sufficiently trained healthcare workers — AI applications hosted on mobile devices could help to improve the reliability and ease of diagnosing paediatric pneumonia, without increasing the burden on healthcare workers.

Project outline and objectives

RR has previously been successfully extracted from video data,[5,7] but models to date have not explicitly focused on children or those with pneumonia. This study, therefore, will look to develop, and subsequently assess the feasibility of using, AI to determine RRs in children under five in LMICs using videos captured on mobile devices. We will collect video data in concurrent and historical research studies in Cambodia, Ethiopia, Malawi and Nigeria.

We aim to:

- develop and assess an AI algorithm to measure RR and danger signs (e.g. chest indrawing and nasal flaring) from videos
- develop a standardised, pragmatic testing protocol that considers the duration of measurement, video quality and optimal camera positioning.

Activities

To develop the algorithm, we will:

- collate videos that have used a range of cameras, include children with and without pneumonia, and are recorded in a variety of environments
- analyse video data using AI that can detect and amplify movement and colour variations, to extract and isolate the respiratory signal from voluntary or involuntary movements
- train an AI model using respiratory signal data and annotations and assess how the algorithm classifies pneumonia compared to an expert counting of RR.

To inform the feasibility of implementation in real-world contexts, we will examine the minimum quality required for a video to be interpretable and, subsequently, develop, test and assess standardised guidelines for recording videos. To this end, we will:

- review footage to determine common features of 'good quality' videos
- consult stakeholders — including healthcare providers in primary and secondary care in LMICs, and researchers with experience of launching mHealth innovations — around the feasibility of real-world implementation
- train healthcare providers to use the pilot protocol and assess video data quality
- conduct focus group discussions with research teams and healthcare providers conducting recordings to evaluate the ease of understanding and implementing the protocol, assess perceptions of its usefulness and identify barriers.

Learning

Drawing on this study's results, we anticipate a further study to evaluate the effectiveness of the protocol in the future.

Karolinska Institutet · Swedish Research Council · University of Oulu · VTT

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Cover image: AI could hold the key to the future. Credit: unsplash.com/Ian

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