Performance of selected respiratory rate timers for the detection of symptoms of pneumonia in children at the community level

Kevin Baker[1,8], Akasiima Mucunguzi[2], Lena Matata[3], Emily Danzer[4], Tedila Habte[5], Max Petzold[6,7], Jill Nicholson[1]; Karin Källander[1,8]

[1]Malaria Consortium, UK; [2]Malaria Consortium, Uganda; [3]Malaria Consortium, South Sudan; [4]Malaria Consortium, Cambodia; [5]Malaria Consortium, Ethiopia; [6]Gothenburg University, Sweden; [7]University of the Witwatersrand, South Africa [8]Karolinska Institute, Sweden

Introduction

Pneumonia is the leading infectious cause of death in children under five years. Community health workers (CHWs) and first-level health facility workers (FLHFWs) detect symptoms of pneumonia by counting respiratory rate (RR) in children with cough or difficulty breathing. This is often challenging and misclassification common. The pneumonia diagnostics project aimed to identify the most accurate and acceptable tools to support pneumonia diagnosis in Cambodia, Ethiopia, South Sudan, and Uganda. The devices tested were the MK2 ARI timer & beads, MK2 ARI timer, Rrate smart phone and respirometer feature phone applications (Figure 2).
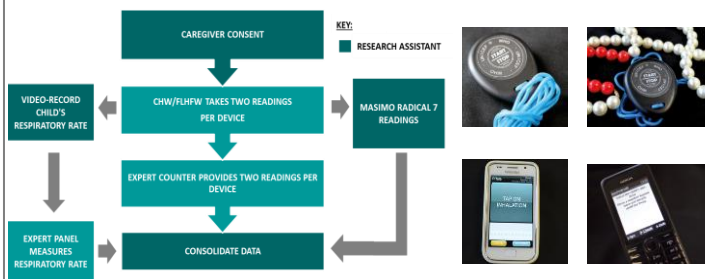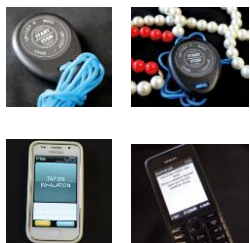
Methods

Figure 1: Performance evaluation flow   **Figure 2: 4 devices tested**

Four RR devices evaluated in hospital settings by CHWs and FLHFWs and their performance compared to two reference standards – an automated monitoring device (Masimo Root patient monitoring and connectivity platform with ISA CO2 capnography) and an expert clinician (Figure 1).

Results

While most CHWs and FLHFWs managed to achieve a valid RR count, the agreements with the reference standards were low for all four devices tested. Performance was consistently lower when the assessment was carried out on younger children (0-59 days). In the older age strata, the four devices performed fairly equally against the two reference standards, with no positive predictive value exceeding 80%, but with higher negative predictive values, especially in the oldest age strata (13-59 months) where they were all between 81-98%.
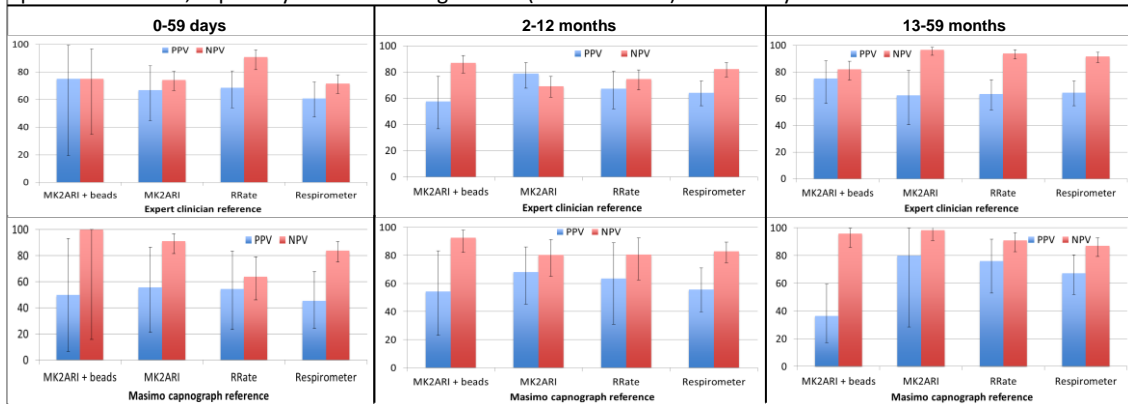

Fig 3-8: Positive and negative predictive values by device and by reference standard for children aged 0-59 months (95% CI)

Conclusions

Of the four RR devices tested in this study, none performed well. As the MK2 ARI timer is the cheapest option of the four devices tested, and as most CHWs are familiar with its use, other manual counting devices should not be introduced to replace the ARI timer. To maximise the effectiveness of community case management of pneumonia, it is recommended that improved, easy to use respiratory rate diagnostic aids for assessing symptoms of pneumonia for use in remote, resource poor settings are developed and tested. For this purpose, there needs to be a validate the reference standards available to establish the performance of new devices.

Kevin Baker, k.baker@malariaconsortium.org
Malaria Consortium, Development House, 56-64 Leonard Street, London EC2A 4LT.
www.malariaconsortium.org