USE CASE

Data-driven decision support to improve community-based diagnosis and treatment

The challenge

Treatable conditions (such as pneumonia, diarrhea, and malaria) result in millions of deaths each year among children living in low- and middle-income countries.

More than half of these deaths could be prevented with early clinical assessments and appropriate treatment. A primary way to achieve this is through access to health care professionals who can perform high-quality integrated assessment that will identify those children who are sick and require immediate intervention. However, many children in these settings do not have access to high-quality health care. Some programs have expanded access through community health workers (CHWs), also known as FLWs, but FLWs do not always have the time, resources, or ability to diagnose and treat patients with high-quality care.

The World Health Organization and UNICEF have developed a strategy called the Integrated Management of Childhood Illness (IMCI) to improve case management, overall health systems, and family and community health practices to ensure children receive high-quality care. A multicountry evaluation of the IMCI strategy has shown that it improves health worker performance and quality of care, and can improve child health outcomes if implemented well.[1] However, other studies have shown that achieving adherence to IMCI guidelines can be challenging. Most FLWs lack fast assessment support that aligns with the WHO's IMCI guidelines and enables FLWs to effectively use the guidelines to assess, treat, and diagnose their patients.[2]

Project dates
2018

Location
Nigeria

Health focus area
Child health

Partners

THINKMD

eHealth Africa

Kano State Primary Health care Management Board

Further information

http://www.thinkmd.org/

https://www.ehealthafrica.org/medsinc

Finette BA, McLaughlin M, Scarpino SV, et al. Development and Initial Validation of a Frontline Health Worker mHealth Assessment Platform (MEDSINC®) for Children 2–60 Months of Age. The American Journal of Tropical Medicine and Hygiene. 2019;100(6):1556–1565. https://doi.org/10.4269/ajtmh.18-0869.

1 Organization. Integrated Management of Childhood Illness. https://www.who.int/maternal_child_adolescent/topics/child/imci/en/

2 Mulaudzi MC, 2015. Adherence to case management guidelines of Integrated Management of Childhood Illness (IMCI) by healthcare workers in Tshwane, South Africa. S Afr J Child Health 9: 89–92.

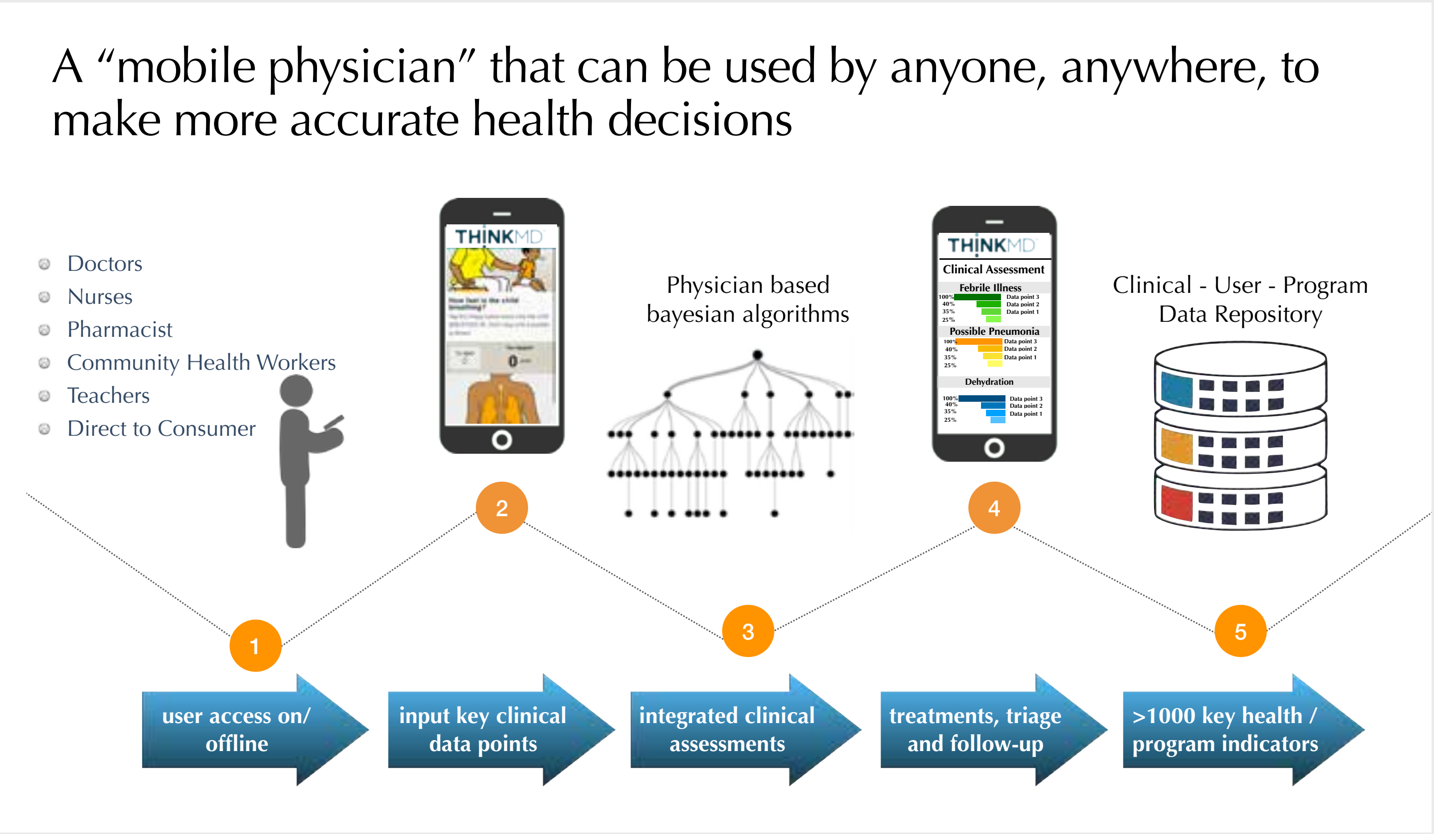
The solution

THINKMD developed a digital health point-of-care tool to support FLWs to assess, diagnose, and treat patients.

To use it, FLWs gather a series of data points about the patient's past and current history, symptoms, vital signs, and physical examination findings. The THINKMD technology relies on underlying algorithms to weight these data points compared to clinical best practices and global guidelines to generate a clinical risk assessment and recommendations for triage, treatment, and follow-up (Figure 1). In this way, the THINKMD technology can help any user to make a data-driven decision to identify how sick a person is, what illness they may have, and what next steps to take—thereby expanding access to high-quality health care.

The THINKMD technology was introduced in 15 health facilities in Kano State, Nigeria, in April to August 2018, to support FLWs to diagnose and treat patients and improve adherence to the WHO IMCI guidelines.

FIGURE 1. **The THINKMD technology processes acquired clinical data points through data algorithms to generate patient-specific triage, treatment, and follow-up recommendations**



Impact

In Kano State, Nigeria, the pilot of the THINKMD technology showed a 41 percent observable and 50 percent actual improvement in the ability of FLWs to appropriately diagnose sick children, according to the WHO-IMCI guidelines.[3] This was based on a pre-/post-observational analysis of 28 FLWs during the use of their current paper-based approach ("pre" n = 384 child assessments) compared to during their use of the THINKMD technology ("post" n = 384 assessments). Based on usability and acceptability surveys:

+ **93 percent of FLWs said the technology was very easy to learn and use.**
+ **100 percent of FLWs said the technology was a valuable training tool.**
+ **100 percent of FLWs said the technology helped them identify sick children.**
+ **100 percent of FLWs said they were extremely likely (75 percent) or likely (25 percent) to recommend use of the technology to other FLWs.**

This pilot built on prior research that was conducted to validate the THINKMD technology in three countries: Burkina Faso, Ecuador, and Bangladesh.[4] The validation study indicated a high specificity correlation between the THINKMD technology diagnosis and the "gold standard" of diagnosis by a local health care provider (LHP). Of the four key clinical conditions that the technology assessed—respiratory distress, dehydration, sepsis (systemic inflammatory response syndrome), and acute malnutrition—the correlation between the THINKMD and LHP assessment ranged from 55 percent to 97 percent. The 55 percent correlation between THINKMD and LHP assessment was in acute malnutrition in Bangladesh and was an outlier, with the next lowest correlation at 82 percent. Without that outlier, the comparative specificity of the four risk assessments was between 85 percent and 100 percent (the outlier had a 75 percent specificity for acute malnutrition in Bangladesh). As expected, there was a wide sensitivity range (0.12 to 0.81) between THINKMD and LHP assessment due to the low prevalence of these conditions in the test population. The validation study also asked the FLWs to provide input on how easy the THINKMD platform was to learn, how easy it was to use, and if it allowed them to do their job better. The results showed positive usability and feasibility responses from FLWs and LHPs related to the ease of use, learning, and job performance associated with the THINKMD technology (Figure 2).

While the initial validation study of the THINKMD technology showed promising results, a key limitation was the use of physician-based assessments as the benchmark or "gold standard" for comparison. Health practitioners are not error-proof and there can be large variability in clinical assessment results across practitioners. Another limitation raised by stakeholders was the lack of transparency into the back-end algorithms that merged internationally recognized WHO guidelines with a novel physician-based logic.[5] However, this is often the case for machine learning- and artificial intelligence-based algorithms used in digital health technologies and disclosure limitations of clinical algorithms regularly occur in peer-reviewed medical literature.[6] A final limitation was that the THINKMD technology had not been independently evaluated, although the validation testing approach was approved by institutional review boards and published in a peer-reviewed journal.[7] To ensure the quality of clinical assessments by mHealth platforms, more studies will be necessary to continue to validate and build the evidence base.

3 eHealth Africa, THINKMD, Kano State Ministry of Health. Community Health Worker (CHW) Adherence to the Integrated Management of Childhood Illness (IMCI) Protocol in Kano State, Nigeria before, during, and after use of the digital health platform MEDSINC. MEDSINC Implementation Field Report. 2018. https://www.ehealthafrica.org/medsinc

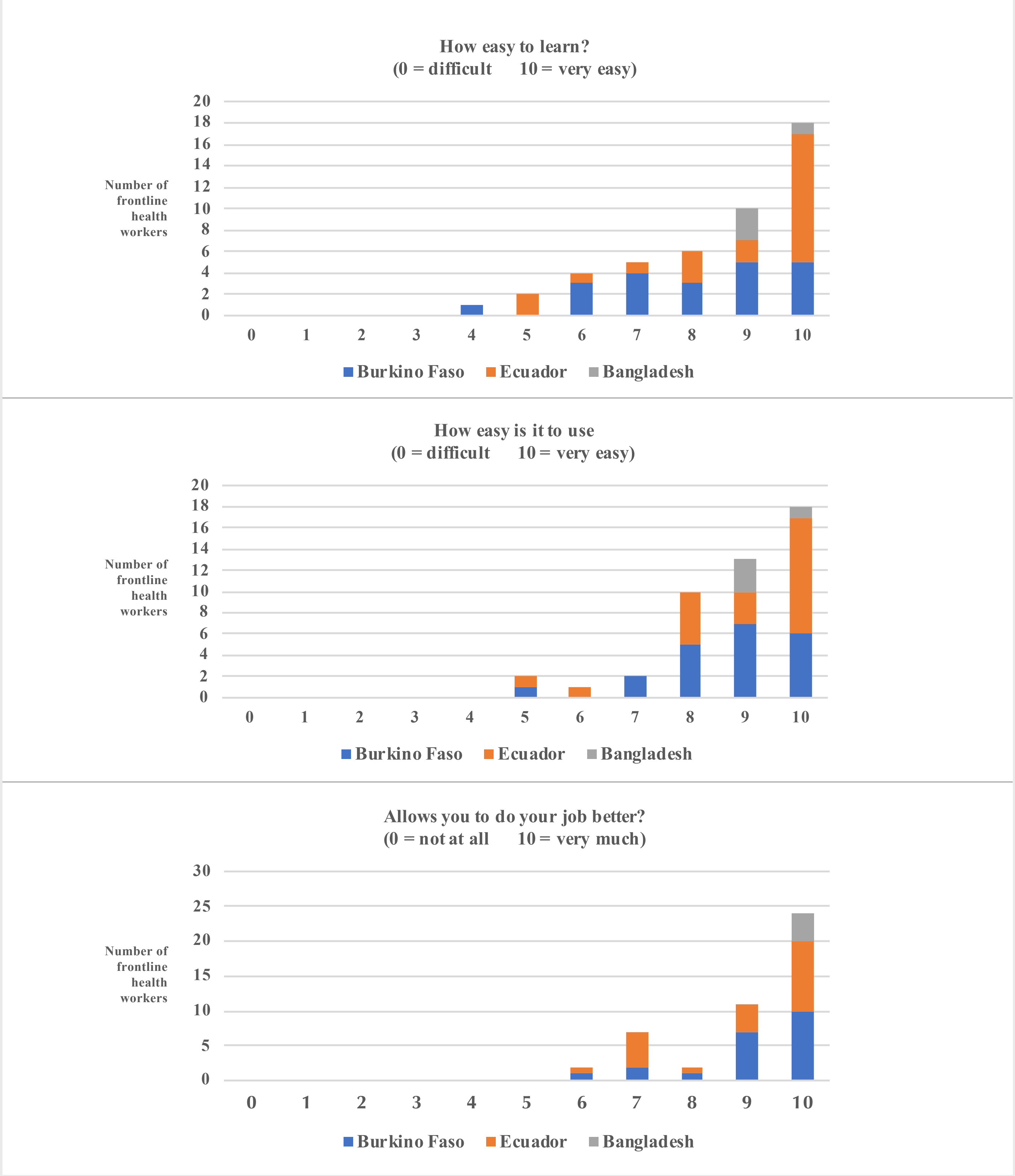
4 Finette BA, McLaughlin M, Scarpino SV, et al. Development and Initial Validation of a Frontline Health Worker mHealth Assessment Platform (MEDSINC®) for Children 2-60 Months of Age. Am J Trop Med Hyg. 2019;100(6):1556-1565. doi:10.4269/ajtmh.18-0869

5 Ansermino JM, Wiens MO, Kissoon N. Letter to the Editor: Evidence and Transparency are Needed to Develop a Frontline Health Worker mHealth Assessment Platform. Am J Trop Med Hyg. 101(4), 2019, p. 948. doi:10.4269/ajtmh.19-0411a

6 Finette BA, McLaughlin M, Scarpino SV, et al. Authors' Response. Am J Trop Med Hyg. 101(4), 2019, p 949. doi:10.4269/ajtmh.19-0411b

7 Finette BA, McLaughlin M, Scarpino SV, et al. Authors' Response. Am J Trop Med Hyg. 101(4), 2019, p 949. doi:10.4269/ajtmh.19-0411b

FIGURE 2. Usability and acceptability of the THINKMD technology among frontline workers



Scale and future health system applications

The data science assets in this use case include the THINKMD technology itself, the associated training approach, as well as the study design for the initial validation study of the technology and a field-based pilot that followed. The THINKMD technology could be expanded to other settings to support FLWs to improve their ability to appropriately diagnose and treat sick children. At the time of publication, the THINKMD technology has been used to assess 300,000 patients across more than ten countries.[8] For example, in Zambia, Healthy Learners[9] is training teachers to be school health workers as part of an integrated school health model. The THINKMD technology is currently used in 45 schools to increase quality of care and health outcomes of over 110,000 school-aged children, with plans to continue to scale the approach in partnership with the Ministry of Health and Ministry of General Education of the Government of Zambia.[10]

The data science assets related to the validation study and field-based pilot of the THINKMD technology could be adapted and used to inform the study design for other digital health tools. The data themselves could also be used for other applications, including disease surveillance and project evaluation. For instance, the platform gathers significant user- and program-specific information that could be continuously analyzed for project evaluation purposes or to complete key performance indicators. The data could also be used to illustrate or unearth health system barriers or challenges in program delivery. For example, one district's data showed an unusually high instance of malnutrition. The data generated by the tool enabled the project managers to quickly isolate which two clinics had high rates of malnutrition, and they were able to determine that the facilities' scales used to weigh children were broken.

The THINKMD technology can also be adapted for emergency response. In response to the COVID-19 pandemic, THINKMD has released a COVID-19 screening and educational tool. The tool guides users through a self-risk assessment to indicate whether they have symptoms associated with COVID-19. The algorithm is being dynamically updated based on the latest clinical data and guidelines. Based on individual results, the tool provides information on seeking medical care and recommended response measures. Additionally, the data can be aggregated for emergence and monitoring of the pandemic and building predictive disease models to inform population-level responses to the pandemic.[11]

8 https://thinkmd.org/

9 https://www.healthylearners.org/

10 THINKMD. "THINKMD Partners with Healthy Learners to Scale School-based Health Program in Zambia." 2020. https://thinkmd.org/thinkmd-partners-with-healthy-learners-to-scale-school-based-health-program-in-zambia/

11 https://thinkmd.org/covid-19/

Implementation considerations

User acceptability

A mobile health platform that is validated also needs to be useable by FLWs to reach scale. The challenge with many mobile health platforms is that the FLW is making subjective decisions that require specific skills to do correctly. Learning and maintaining those skills require training and supervision, which in turn require a significant amount of funds. The THINKMD platform seeks to guide FLWs through collecting the data, leading to more data collection for less effort.

Adaptability

The THINKMD technology can be configured to change the language, user interface, or underlying guidelines/treatment protocols.

Health system linkages

The THINKMD technology can be linked with the existing country health information system to ensure the captured data are not only used at the point-of-care for patient-specific diagnosis and treatment, but also to inform population health interventions. For example, if the data were aggregated and available to district health officials, they could use the information to better target resources to specific geographic areas based on disease burden. Although this functionality was not included in the Kano State pilot in Nigeria, THINKMD has partnered with Ona to integrate the functionality of THINKMD's FLW platform with Open Smart Register Platform (OpenSRP), an mHealth platform that connects FLWs to national health systems.

Cost

Potential implementers and program managers should consider the cost-benefit analysis of adopting THINKMD. There are cost requirements to acquire THINKMD and train cadres of healthcare workers in its operation. However, the platform is intentionally designed to enable sustainable scale over time. This would be the result of cost savings achieved through reductions in requirements for supervision and a less expensive training at the front end. For example, the evaluation of the pilot in Nigeria estimated a more than 50 percent reduction in training cost when the THINKMD technology training was implemented using a distance learning approach.[12,13]

12 eHealth Africa, THINKMD, Kano State Ministry of Health. Community Health Worker (CHW) Adherence to the Integrated Management of Childhood Illness (IMCI) Protocol in Kano State, Nigeria before, during, and after use of the digital health platform MEDSINC. MEDSINC Implementation Field Report. 2018. https://www.ehealthafrica.org/medsinc

13 https://www.businesswire.com/news/home/20180130005503/en

Data science assets

PRODUCT

THINKMD technology for data-driven diagnosis and treatment

Data for Management

Data Transformation

Data for Impact

Mobile data collection tool

Decision support tool

THINKMD developed a digital health point-of-care tool to support FLWs to assess, diagnose, and treat patients.

To use it, the FLWs gather a series of data points about the patient's past and current history, symptoms, vital signs, and physical examination findings.

The THINKMD technology relies on an underlying algorithm to weight these data points compared to clinical best practices and global guidelines to generate a clinical risk assessment and recommendations for triage, treatment, and follow-up. This back-end technology design uses clinical knowledge and practice data points to inform the technology's algorithm, which then learns from data generated by users of the technology platform. Essentially, the technology translates how physicians would analyze clinical data points and creates an algorithm to replicate that process. The THINKMD technology uses an ever-growing set of data to continuously improve and modify its core algorithm for diagnosis.

For more information

http://www.thinkmd.org/medsinc

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PROOF

Design of the field-based pilot of the THINKMD technology:

Study design, research protocols, and data collection tools

Data Collection

Data Transformation

Data for Impact

Research methods

Research protocols

The THINKMD suite of tools was evaluated through a two month pilot study among CHWs in Kano State, Nigeria.

The field-based pilot study was designed to understand the feasibility, acceptability, and usability of the THINKMD digital clinical assessment platform and how its use could improve adherence to IMCI clinical guidelines.

The study design, research protocol, and data collection tools were co-designed by eHealth Africa, THINKMD, and Kano State Primary Healthcare Management Board. The research protocol and study design included the research questions, an operational definition of IMCI clinical adherence, specifications on data collection processes, and sample selection and size. The data collection tools included usability and acceptability surveys as well as tools to capture observational data on CHW adherence to the IMCI guidelines.

The research protocol included the following research questions:

1. Do the CHWs find the THINKMD clinical technology usable? Do they find it an acceptable technology to perform clinical assessments and to treat sick children or to refer them to seek care with a trained clinician?
2. Does the MEDSINC platform improve the healthcare capacity and clinical assessment consistency of CHWs to accurately assess a child compared to currently used clinical assessment, triage, and treatment tools?
3. Does the THINKMD analytics and visualization platform improve programmatic and national-/state-level health monitoring, evaluation, and development compared to currently used information monitoring systems?
4. What is the potential health and economic impact of a THINKMD implementation based on assessments and interventions (preventative and curative) provided by CHWs?

For more information

eHealth Africa is a Nigerian nonprofit organization with the mission to "build stronger health systems through the design and implementation of data-driven solutions that respond to local needs and provide underserved communities with tools to lead healthier lives." https://www.ehealthafrica.org/medsinc

PROOF

Design of the validation study of the THINKMD technology:

Study design, research protocol, and data collection tools

Data Collection

Data Transformation

Data for Impact

Research methods

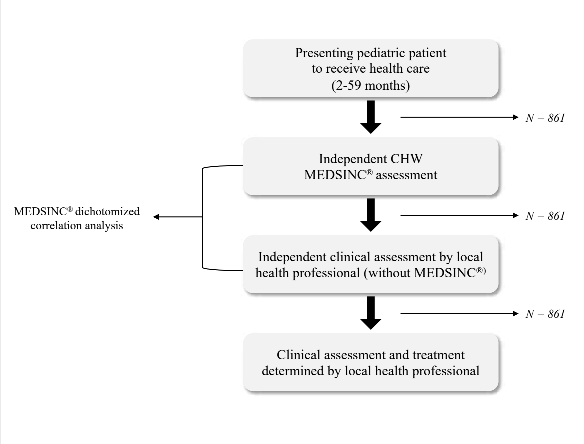
Research protocols

Validation testing was done to gain insights into the clinical logic accuracy of the THINKMD technology.

Field-based testing was conducted in Burkina Faso, Ecuador, and Bangladesh. The validation testing compared clinical assessments that were generated from FLWs using the THINKMD technology to clinical assessments by local health care professionals for the same children. UNICEF, local ministries of health, icddr,b and other local research organizations were engaged as co-leads of the study.

The validation study design specified the study sites, sample selection and enrollment process (Figure 1), and the statistical methods for analyzing results. The validation study also included questionnaire surveys to assess the usability of the THINKMD technology from stakeholders, including health care workers at national, regional, local, and community levels as well as child caregivers.

FIGURE 1. Validation study design and recruitment of subjects



For more information

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PEOPLE

Training approach for use of the THINKMD technology

Methods and approaches for learning

To introduce end users to the THINKMD technology, a train-the-trainer approach was taken as part of the field-based testing in Burkina Faso, Educador, and Bangladesh.

This entailed initial training occurred of LHPs who then trained the FLWs in groups of two to four participants. Average traning time for each group was four to six hours. The training content was the same at each level (LHP and FLW) and included a presentation on the background, functionality, and full use of the THINKMD platform. The participants also worked through test cases, including practice on taking heart and respitory rates using a metronome, and using colleagues as example patients. For each site, there were training modifications based on available technology, number of participants, experience of participants, and other requests from the collaborators.

The THINKMD user interface also facilitates additional follow-on training in an interactive manner. The technology includes the ability to teach the user how to evaluate patients and how to use the tool itself thorugh visuals, GIFs, and videos that teach and reinforce how users should inform the data points collected through the input system. Users also can play these visual aids after they have added data to the platform, in order to ensure that they performed the diagnostic evaluation properly.

In Nigeria, the training-of-trainers model was conducted remotely due to financial constraints. This distance learning approach resulted in a more than 50 percent reduction in training cost. Of the CHWs trained in Nigeria, 93 percent said the THINKMD technology was very easy to learn and use. Additionally, 100 percent of CHWs said that the THINKMD technology was a valuable training tool.

For more information

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