Landscape Analysis Report: Landscape Analysis for Severity Assessment and Triage and Home Self-Monitoring AFI Tools for LMICs

FIND

September 13, 2021

IQVIA

FIND

Document: Final Landscape Analysis Report: Landscape Analysis for Severity Assessment and Triage and Home Self-Monitoring AFI Tools for LMICs

Prepared for: FIND

Prepared by: IQVIA AG

RESTRICTION ON DISCLOSURE STATEMENT

All technical, financial, cost, and pricing information in this document is confidential and shall be used only for FIND evaluation purposes or for purposes of performing any agreement entered into as a result of this document. Receipt of this document acknowledges acceptance of this Restriction on Disclosure Statement.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

All trademarks, trade names, product names, graphics and logos of IQVIA, Quintiles, or IMS Health contained herein are trademarks or registered trademarks of IQVIA Holdings, Inc. or its subsidiary, as applicable, in the United States and/or other countries. All other trademarks, trade names, product names, graphics and logos contained herein are the property of their respective owners. The use or display of other parties' trademarks, trade names, product names, graphics or logos is not intended to imply, and should not be construed to imply, a relationship with, or endorsement or sponsorship of IQVIA Holdings, Inc. or its subsidiaries by such other party.

No agreement or obligation regarding this proposal will exist until a written contract has been fully executed.

Acknowledgement

This report is funded by FIND and has been prepared, edited, and designed by IQVIA. IQVIA is grateful for the support of Dr. Karell Pelle, Senior eHealth Scientific Officer, FIND for her valuable guidance and consistent support.

The team would like to express their sincere gratitude to experts from UNITAID, African Society for Laboratory Medicine, World Health Organization Country Office (Nigeria), Ministry of Health (Nigeria), e-Health Africa (Nigeria), Association of Community Health Practitioner (Nigeria), Basic Healthcare Services (India), Max Hospital (India), Gate Ventures (India), Sri Satya Sai Central Trust (India), Save the children (India), Ministry of Health (Kenya), UNICEF Country Office (Kenya), Kenya Medical Research Institute, Kenya Pediatric Association, and Evidence Action (Kenya) who were interviewed for this study, openly shared their insights and experiences, and contributed to this report.

Our efforts as a team were greatly enhanced by the contributions of our Project Advisors and experts. The IQVIA team was led by Dr Senthilnathan Padmanaban (Project Lead), Deepak Batra (Project Advisor), Dr Tripti Bajaj (Senior Consultant), Samar Samir (Project Consultant) and Dr. Shalini Kumari (Project Consultant).

Table of Contents

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Table of Figures

List of Tables

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Table of Abbreviation

AFI	Acute Febrile Illness	IDSR	Integrated Disease Surveillance and Response
AAP	American Academy of Pediatrics	IeDA	Integrated e-Diagnosis Approach
ABCD	Airway-Breathing-Circulation/Convulsion/Coma-Dehydration	IHI	Ifakara Health Institute
ADSPHDA	Adamawa State Primary Healthcare Development Agency	IMAI	Integrated Management of Adolescent and Adult Illness
ALMANACH	Algorithms for the Management of Acute Childhood illnesses	IMCI	Integrated Management of Childhood Illness
APE	Agentes Polivalentes Elementares	LMICs	Low-Middle Income Countries
API	Application Programming Interface	MedAL	Medical Algorithm
ARI	Acute Respiratory Infections	MFS	Médecins Sans Frontières
CCM	Community Case Management	MHRA	Medicines and Healthcare products Regulatory Agency
CCM	Community Case Management	MUAC	Mid Upper Arm Circumference
CDSA	Clinical Decision Support Algorithm	NGO	Non-Governmental Organization
CDSS	Clinical Decision Support System	NLP	Natural Language Processing
CHW	Community Health Workers	PEWS	Pediatric early warning system
CPGs	Clinical Practical Guidelines	PHR	Personal Health Record
CVL	Clinica Valle del Lili	POCT	Point of care Test
e-CDA	Electronic Clinical Decision Algorithms	P-SATS	Revised Pediatric South African Triage Scale
ED	Emergency Department	QECH	Queen Elizabeth Central Hospital
EEA	European Economic Area	REC	Registre Electronique de Consultation
EMACC-WG	Emergency Medicine and Critical Care working group	SATS	South African Triage Scale
EPFL	Ecole Polytechnique Fédérale de Lausanne	SBI	Serious Bacterial Infection
ETAT	Emergency Triage Assessment and Treatment	SLeCCM	Supporting LIFE electronic Community Case Management Application
GP	General Practitioner	Swiss TPH	Swiss Tropical and Public Health Institute
HCF	Healthcare Facilities	TDH	Terre des hommes
HW	Healthcare Workers	UNICEF	United Nations Children's Fund
iCCM	Integrated Community Case Management	UTI	Urinary Tract Infection
ICRC	International Committee of the Red Cross	WHO	World Health Organization

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Executive Summary

Background

Acute Febrile Illness (AFI)/Fever is a common presentation of illnesses. Severity assessment, treatment, and subsequent diagnosis to identify the root cause of fever are key aspects of AFI management. The current AFI management practices, especially at primary healthcare settings in LMICs are limited by availability of innovative tools. This makes it extremely challenging for healthcare workers to effectively diagnose and manage AFI. FIND and its partners are working on filling this diagnostic gap by facilitating development and validation of tools to support AFI management in LMICs.

Objectives

FIND assigned IQVIA to, a) Conduct a landscape analysis to map existing tools used for severity assessment and triaging of AFI at primary care by healthcare workers, b) Mapping of tools for home-use in supporting self-monitoring of clinical signs and symptoms, c) Understand potential barriers and enablers in implementation of AFI tools in LMICs, and d) Identify potential product introduction pathways for selected tools in selected countries

Methodology

A desk research was done to identify relevant existing tools for which information were available in the public domain. The desk research was followed by primary research consisting of 19 key informant interviews conducted among country level stakeholders in India, Nigeria, and Kenya, and international stakeholders from organizations such as UNITAID, WHO, and ASLM. The countries were selected based on the criteria provided in Annexure 5.1 and the country level stakeholders included representatives from MOH, healthcare provider associations, public health strategy, and digital health experts.

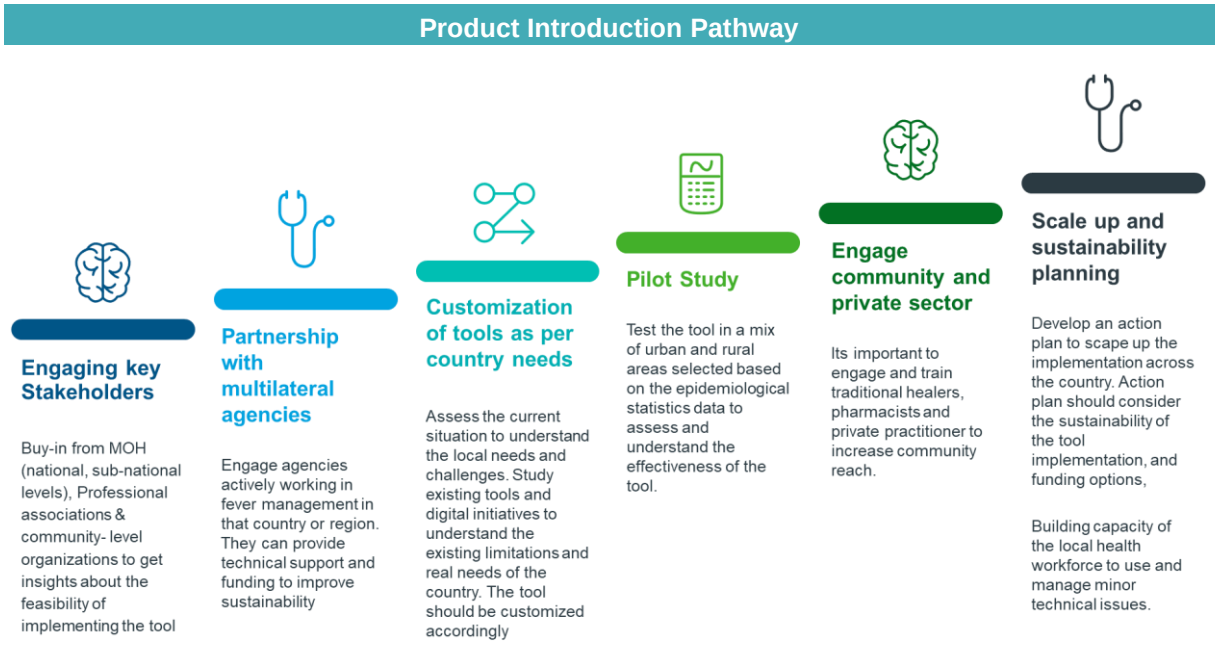
Key Findings

1. **36 AFI tools were identified and selected** based on their functionality related to severity assessment/triaging of fever and their ability to provide guidance for appropriate fever management at home and timely referral to higher level care. The tools are primarily classified based on 2 key user-segments i.e. **tools used by healthcare workers at primary care level (18 tools) and tools used by patients/caregivers at homes (18 tools**. **Tools are further classified as paper-based (7 tools), and digital (29 tools).** Digital tools were mainly mobile apps and eCDAs.
2. **IeDA, Almanach and APE app emerged as the top-ranking tools for healthcare workers, and Symptomate, Mediktor and Ada-Check your Health are ranked as top ones in home use category.**
3. **IMCI is the most popular paper-based tool,** however several studies highlight that implementation and use of IMCI is time-consuming in daily practice.
4. **Governments are willing to implement digital tools but require technical and financial support**- The selected countries have implemented some sort digital initiative for disease surveillance, which shows their willingness to implement and adapt innovative and efficient digital tools.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

5. **Key challenges to implementation of the tools** include lack of funds, need for extensive user training, inadequate staff availability, poor IT infrastructure (mobile phones and internet) at the primary care level, lack of engagement and buy-in from MOH staff at regional and facility levels, concerns around data privacy, and lack of regulations for implementation of digital initiatives.

6. **Stakeholder involvement including MOH departments and staff at central and regional levels and private sector partnerships are critical for successful adoption of new tool** - The study highlighted several key enablers for successful implementation of tools, as shown below:



7. **Key desired features of the digital AFI tools for HCWs are:** For HCWs to effectively manage AFI cases, digital tools should be simple, easy to use, and cost effective. The tool should be based on a clinical algorithm to support healthcare providers in assessing, diagnosing, and treating cases based on the entered symptoms, and provide support in severity triaging and referral of severe cases to higher level of healthcare. Tool should also work on both online and offline modes and sync the data that has been collected in offline mode whenever the network is available.

8. **Ease of use, ability to work on online and offline mode, availability in local language, free to use are some of the desired features of the digital AFI tools for patients and caregivers**. It is critical that the tool should support patients/ caregivers in assessing their condition based on the entered symptoms and clearly recommend next steps using color-coded triage system which may range between homecare, seek medical consultation, and seek emergency care immediately. It should not promote self-treatment and only guide the patients to seek timely medical advice. Additional useful features could be telemedicine consultation especially considering COVID restrictions.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Introduction

1.1. Project Background and Context

Acute febrile illness (AFI), often presented by malaise, myalgia, and raised temperature is a non-specific manifestation of infectious diseases. It is frequently characterized as fevers resolving in three weeks and lacks localizable organ specific signs or symptoms. Tropical regions and low-resource settings have the highest burden of febrile illness. Failure to identify the cause of AFI often results in increased use of antibiotics, wastage of medicines and increased morbidity and mortality. The etiologic investigations on the global burden of febrile illness are valuable public health data sources. These contribute to necessary information on disease prevalence and estimates of morbidity and mortality. It is also useful for guiding appropriate empiric treatment and fever case management, in areas where access to reliable confirmatory laboratory diagnostics for local causes of AFI is otherwise limited[1].

Current AFI Management Practices and Key Challenges - Several fever management guidelines/ paper-based algorithms like Integrated Management of Childhood Illness (IMCI), Integrated Community Case Management (iCCM) and Integrated Management of Adult Illness (IMAI) have been developed by the World Health Organization for better management of AFIs, and these cover different age groups and levels of care. Other than providing guidance on management of AFI, these guidelines also help in assessment of severe clinical signs to deliver appropriate care and refer patients to higher levels of care, if required. As a result, they also help in reducing the use of antibiotics and antimalarials, thereby aiding in reduction of drug resistance and improving efficacy of such medications as shown in evaluation study conducted in Multi-Country such as Brazil, Uganda, and Tanzania of the Integrated Management of Childhood Illness strategy, WHO [2]

Several studies highlight that implementation and usage of IMCI (most common and widely used guideline) is too time consuming in daily practice[3]. Another challenge is the lack of supervision of health workers using IMCI guideline in remote areas, which further undermines the correct implementation and adoption of tool[4].

Potential Solutions - Over the past years, electronic clinical decision algorithms (eCDA) have emerged as potential solutions offering structured decision pathways for AFI management. The decision trees are aligned with the clinician's workflow and guide the user through the consultation process[5]. Further, such tools can also be used at home by patients or caregivers to assess the disease severity and obtain treatment when indicated, thereby reducing caseload of the already overburdened health systems with limited resources such as those in LMICs. FIND and its partners are working on filling the diagnostic gap by facilitating the development and validation of tools to support AFI management in low middle-income countries (LMICs). These are digital tools that can help clinicians to manage fever cases and

[1] Rhee, C., Kharod, G. A., Schaad, N., Furukawa, N. W., Vora, N. M., Blaney, D. D., ... & Clarke, K. R. (2019). Global knowledge gaps in acute febrile illness etiologic investigations: A scoping review. *PLoS neglected tropical diseases*, *13*(11), e0007792.

[2] Eleanor Gouws, Jennifer Bryce, Jean-Pierre Habicht, João Amaral, George Pariyo,Joanna Armstrong Schellenberg, & Olivier Fontaine (2004) Improving antimicrobial use among health workers in firstlevel facilities: results from the Multi-Country Evaluation of the Integrated Management of Childhood Illness strategy, WHO

[3] Bernasconi, A., Crabbé, F., Rossi, R., Qani, I., Vanobberghen, A., Raab, M., & Du Mortier, S. (2018). The ALMANACH Project: Preliminary results and potentiality from Afghanistan. International journal of medical informatics, 114, 130-135.

[4] Pandya, H., Slemming, W., & Saloojee, H. (2018). Health system factors affecting implementation of integrated management of childhood illness (IMCI): qualitative insights from a South African province. *Health policy and planning*, *33*(2), 171-182.

[5] Keitel, K., & D'Acremont, V. (2018). Electronic clinical decision algorithms for the integrated primary care management of febrile children in low-resource settings: review of existing tools. *Clinical microbiology and infection*, *24*(8), 845-855.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

conduct severity assessment. In the process, FIND has assigned IQVIA to conduct a comprehensive landscape analysis of the existing tools to improve severity assessment and triage of AFI. The mapping will also include tools for home use to support self-monitoring of clinical signs and symptoms, including pneumonia at primary care and beyond to identify children who require referral in LMICs. IQVIA, in consultation with FIND, will further identify some functionally promising and scalable tools, and define introduction pathways to implement the tools in LMICs.

Figure 1 shows the classification of AFI tools considered for this study. The tools are categorized in two groups, namely (a) tools used by frontline workers (for screening, identifying and triaging assessment of febrile patients) and (b) tools used by patient and their families (for screening prior to the consultations

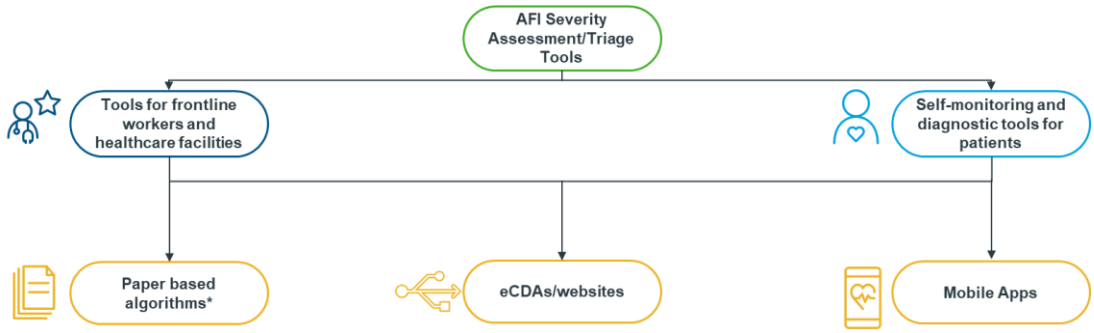


Figure 1: Classification of AFI Tools

and for self-monitoring post consultations with the health professionals). Further, they are categorized based on their functional and technological modality (paper-based/e-CDA/Mobile applications/ websites).

1.2. Project Objective

As stated above, the project objective is to conduct a landscape analysis, i.e., a comprehensive mapping of existing AFI tools, with focus on digital tools and mobile applications used in LMICs. The study focuses on:

1. The mapping of AFI tools for two key user segments: -
    a. **Healthcare workers:** to help them triage children presenting with AFI at low-level healthcare facilities.
    b. **Patients/ caregivers** – to help them self-monitor and/or screen for clinical signs and symptoms post consultation at home.
2. Understand the potential barriers and enablers in implementation of AFI tools in LMICs and identify potential product introduction pathways for selected tools in selected countries.

The landscape analysis mapped the tools based on the below parameters:

- Type, Tool Owner/organization, Year of implementation
- Countries of use & Key users
- No. of patients/cases registered/number of downloads
- Application, features, and functions of the tool including severity assessment and triage
- Use of AI algorithms or human readable algorithms
- Types of clinical data collected by the tool, collection, and storage of personal health information
- Technology specifications of digital tools
- User friendliness, level of training required, and scalability
- Cost model (Monthly/yearly/one-time subscription if the tool is chargeable)
- Case studies, pros, and cons

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Section 2: Project Approach and Methodology

Detailed desk research followed by primary research was carried out to achieve the above stated project objectives.

2.1. Methodology of Desk Research

IQVIA conducted an extensive desk research on the existing tools used to diagnose and manage AFIs in LMICs and developed countries.

- **Search criteria and filters**

IQVIA reviewed data sets and reports published later than Jan 1, 2000 till date. Preference was given to peer reviewed journals, publications and tools were also identified from Google Play Store and iPhone App Store.

- **Keywords used for searching tools**

AFI, Acute Febrile Illness in LMIC, eCDS/Mobile App/Algorithm/Guidelines+AFI+LMICs, AFI+Diagnostic tools/devices, IMCI/IMAI/iCCM+tools/guidelines/eCDS/ Apps, Homecare tools+AFI, AFI/Fever Monitoring/Management Tools/Apps/Guidelines, AFI/Fever+ Triage/Severity Guidelines/ Tools, AFI+Healthcare Facility/ Community Health Worker+Tools/Apps, , Symptom Checkers+Fever, AFI in India, AFI in Africa.

- **Web database and repositories**

PubMed, Embase, Medline, Scopus, Elsevier, ScienceDirect, Springer, SciELO, Web of Science, EBSCO, Lancet, other national, and other international online sources/repositories, as shown below:

- **Other data Sources**

2.2. Primary Research

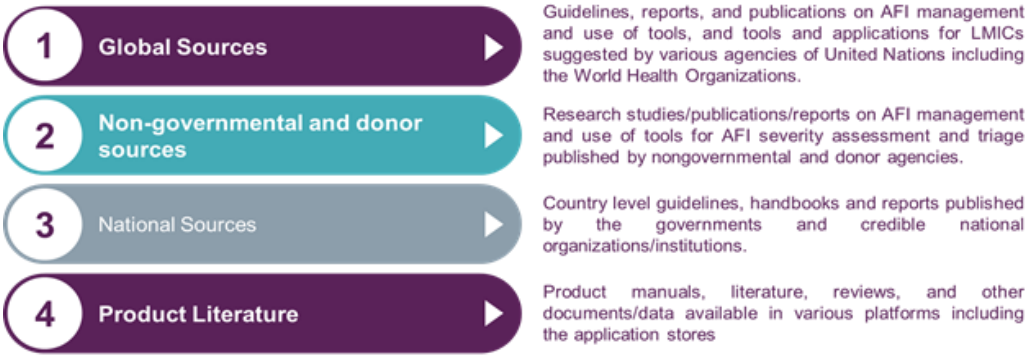


Figure 2: Types of data sources

Primary research was conducted among key stakeholders in selected countries to understand the existing guidelines, electronic clinical decision support algorithms (eCDAs) or mobile application used to manage AFI. An attempt was also made to understand the key enablers and barriers to develop and

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

expand such tools in low-resource settings. Further, the research attempted to understand the need for such tools, process of implementing new tools, and product introduction pathways.

2.2.1. Selection of Countries

Based on the desk research, IQVIA selected 10 LMICs in the regions of East Africa, West Africa, and Asia where maximum number of AFI tools were piloted/implemented. The countries from east Africa region were Tanzania, Rwanda, Malawi and Kenya, the countries from west Africa region were Nigeria, Burkina Faso, Mali, and Niger, while from Asia Bangladesh and India were identified. Based on a scoring mechanism consisting of 11 indicators, three countries were picked for primary research. These countries were-**Kenya, Nigeria,** and **India.** The scoring process is detailed in Annexure 5.1.

2.2.2. Identification of Stakeholders

IQVIA decided to engage various categories of stakeholders such as public health experts, healthcare providers, digital health experts, MOH officials and officials from international organizations. The objective was to capture different perspectives from a diverse stakeholder group to help understand the AFI management practices and key opportunities and challenges that exist.

Sampling Method: The respondents for the interview were selected based on purposive sampling method. IQVIA also leveraged its in-country networks for gathering information and on boarding of stakeholders for conducting interview. IQVIA interviewed at least 5 stakeholders from each selected country and 2 key stakeholders from global agencies working in AFI's such as WHO, UNICEF, UNITAID, ASLM. The details of the respondents are provided in Annexure 5.2.

2.2.3. Data collection

Data was collected via virtual and physical interviews as applicable. Each interview was 45 minutes to one-hour long. The interviews were conducted using semi-structured discussion guides developed for each stakeholder group.

2.3. Limitation of the Study

1. Limitations around the desk research

The desk research included only free to access/use data sources, materials, and products. While accessing journals, publications, and reports, we found few relevant literatures were either locked or had limited access.

2. Challenges in accessing tools/mobile applications

Since some of the tools were not available on the App store/Play store, team was not able to test the functionality and user friendliness of the tools. Few of the applications that were either paid or needed Patient IDs from pediatrician, could also not be tested.

3. Limited information about the mobile applications

Information around usage, implementation, and effectiveness of mobile applications and its regulatory status are limited to information available in the public domain.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Section 3: Landscape Assessment of the AFI Tools

3.1. Classification of AFI Tools

The desk research identified **36 tools** based on functionality of severity assessment/triaging of fever and their ability to provide guidance for appropriate treatment at home, need for medical intervention or referral to a higher-level health facility. The tools are primarily classified according to 2 key user-segments i.e., tools used by **healthcare workers at primary care level** (18 tools) and tools used by **patients/caregivers at homes** (18 tools).

Tools are further classified based as paper based, mobile apps and eCDA as shown in the Figure 3 while Table 1 shows the tools selected for the study.

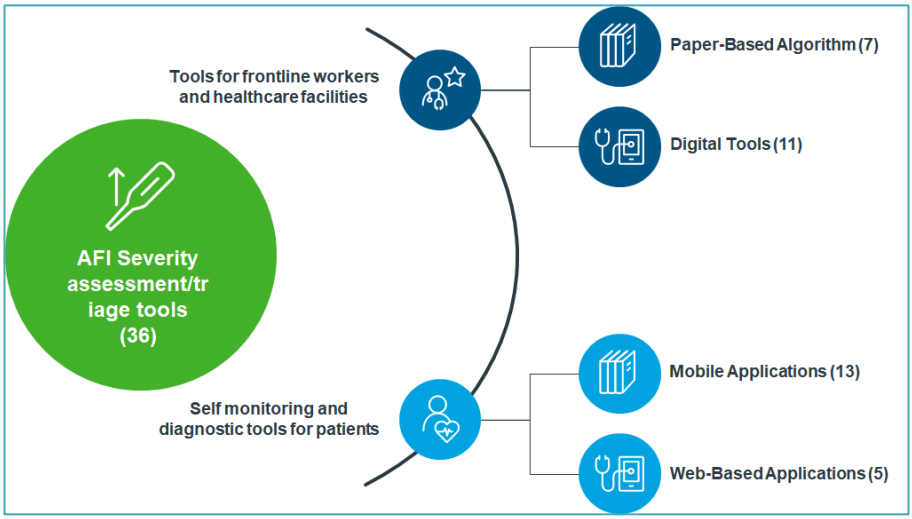


Figure 3: Mapping of Tools Types

Table 1: List of Tools Selected for the study

Name of the Tool	Type of the tool	Name of the Tool	Type of the tool	Name of the Tool	Type of the tool
Tools for Use by Frontline Workers and Healthcare Facilities					
Pediatric Early Warning System (PEWS)	Paper-Based	e-POCT	Digital	Niger Electronic iCCM	Digital
Pocket book of hospital care for children	Paper-Based	e-POCT+	Digital	Integrated e-Diagnosis Approach (IeDA)	Digital
Caring for the sick child, caring for newborns and children in the community	Paper-Based	APE app	Digital	SL eCCM App	Digital
Integrated Management of Childhood Illness (IMCI) chart booklet	Paper-Based	MSFeCARE	Digital	MEDSINC	Digital

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Queensland Pediatric Guidelines	Paper-Based	Malawi iCCM App	Digital	Fever Dx	Digital
Integrated Management of Adolescent and Adult Illness (IMAI)	Paper-Based	ETAT	Paper-based	ALMANACH	Digital
Self-Monitoring Tools for Patients/ Caregivers					
Ada Check your health	Digital	WebMD Symptom Checker	Digital	Buoy's API	Digital
Babylon	Digital	Doctor31	Digital	Thermia	Digital
Healthily with Dettol	Digital	Fever App	Digital	Isabel Symptom checker	Digital
Kids Doc Symptom Checker	Digital	Avey	Digital	Everyday Health-Symptoms Checker	Digital
Mediktor	Digital	Fever Coach	Digital	Symptify	Digital
Symptomate	Digital	Doctor Diagnose (USA)	Digital	Doctor Ai	Digital

a. **Current Status**: Most of the tools are currently in use, except for 2 eCDAs developed for healthcare workers (Niger Electronic iCCM and SL eCCM App). These two tools were part of funded projects and ceased operation due to lack of funds.

b. **Year of Origin/Implementation of the Tools:** Most of the selected tools for this study have been implemented between 2010-2014 while the information about year of existence of two tools was not available in the public domain.

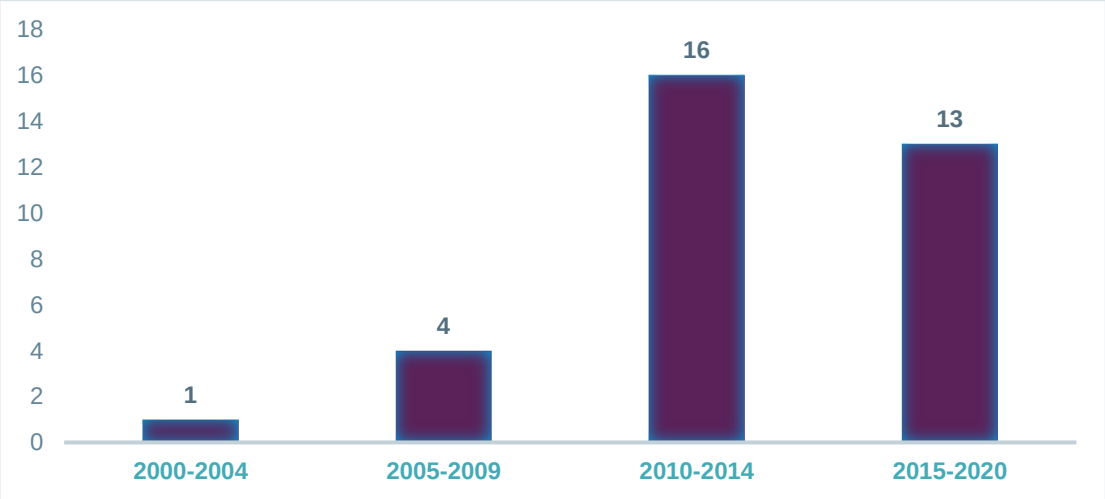


Figure 4: Year of Implementation of AFI tools

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

3.2.Tools for use by Frontline Workers and Healthcare Facilities

3.2.1. Paper-Based Tools for Healthcare Providers

Seven paper-based tools were studied as part of this project/assessment. The following tools were selected based on their fever triaging/severity assessment functionality and suitability for use in LMICs.

Table 2: List of Paper Based Tools in the study

1. Emergency Triage Assessment and Treatment (ETAT)	2. Pocket Book of Hospital Care for Children	3. Integrated Management of Childhood Illness (IMCI) Chart Booklet	4. Integrated Management of Adolescent and Adult Illness (IMAI)
5. Pediatric early warning system (PEWS)	6. Caring for the sick child, caring for newborns and children in the community	7. Queensland Pediatric Guideline	

Some of the features of these eight paper-based tools are as follows: -

a. **Geography:** Most of the paper-based tools were designed to be implemented in low-resource settings except for one tool - Febrile illness: Emergency management in children. This tool was developed for use in emergency settings in Queensland, Australia but can be implemented in low resource settings.

b. **Pilot Tested:** All of the paper-based tools have been piloted before being scaled and adapted.

c. **Developer/Owner:** Five out of the seven tools were developed by WHO and UNICEF and have been implemented in LMICs in collaboration with ministries of health. The other two, 'PEWS tool' was developed by Brighton and Sussex University Hospitals and has been implemented in LMICs, while 'Queensland Pediatric Guideline was developed by Queensland Emergency Care of Children Working Group, Queensland Government and has been implemented in Australia only

d. **Target Patients and Disease:** Most of the paper-based tools are designed for management of illness in children, except IMAI which is developed for the management of common illness of adolescents and adults. All the tools target common diseases except for "Queensland Pediatric Guideline" which has been specifically developed for management of febrile illness.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

e. **Key Users:** These tools are designed to be used at primary healthcare facilities by healthcare workers in LMICs. These tools require basic medical knowledge and can be used by doctors and nurses.

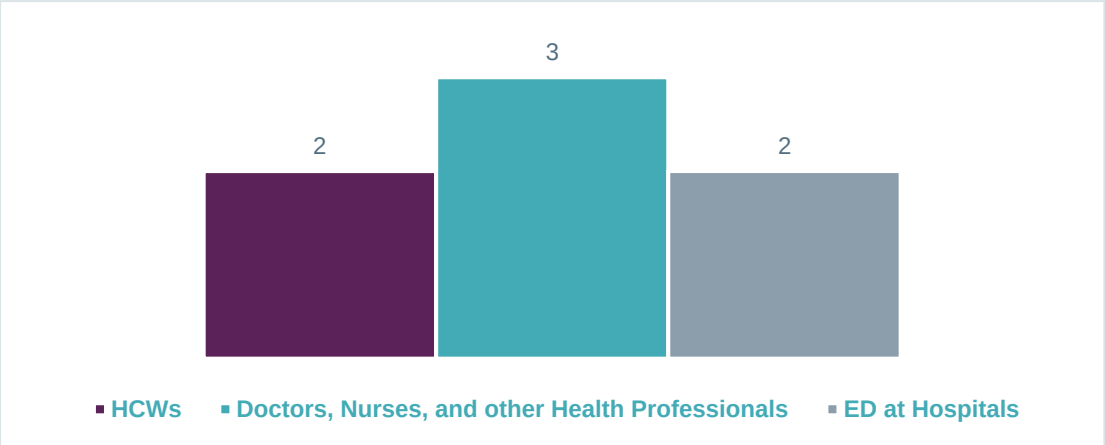


Figure 5: Key Users of Paper-Based Tools

f. **Triage System:** Paper-based tools guide healthcare providers in the initial assessment, triaging, diagnosis, and treatment of patients. It allows healthcare providers to assess patient's symptoms correctly and recommend appropriate treatment. There are three types of triage system that have been observed in the assessed tools: -

- **Different levels of emergency** – Emergency is categorized under three heads i.e. "Urgent and require referral to higher healthcare facility", "urgent but can be treated" and "non-urgent cases that can be managed at home by the support of healthcare providers". Four of the tools i.e. Pocket book of hospital care for children, caring for the sick child, caring for newborns and children in the community, Queensland Pediatric Guideline and Integrated Management of Adolescent and Adult Illness (IMAI) have this classification.
- **Color-code system** – It includes the stated colors i.e. Red for Immediate care needed, Orange/Yellow for urgent cases who should be directed to the 'priority' queue and Green for non-urgent cases. Two tools i.e. Emergency triage assessment and treatment (ETAT) and Integrated Management of Childhood Illness (IMCI) chart booklet follow color-code system.
- **Mix of scoring system and color-code system**: Only Pediatric early warning system (PEWS) tool uses this system.

g. **Training and capacity building:** Most of the paper-based tools require intense training especially for healthcare workers with non-medical background.

3.2.2. Digital tools: eCDAs/Mobile Applications for Healthcare Providers

This study assessed 11 eCDAs/ Mobile apps available for use by the healthcare providers. The tools were selected on the basis of presence of functionality on management of febrile illness, triage, and suitability of implementation in LMICs; the selected tools are:

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

1. ALMANACH	2. e-POCT	3. MSFeCARE	4. Niger Electronic iCCM	5. SL eCCM App	6. Integrated e-Diagnosis Approach (IeDA)
7. APE app	8. e-POCT+	9. Fever Dx	10. Malawi iCCM. App	11. MEDSINC	

a. **Geography:** Most of the eCDAs are implemented in the African region.

b. **Developer/Owner:** Six tools were developed by not-for-profit organizations in collaboration with funding agencies and five tools were developed by private organizations.

c. **Ability to work off-line:** Most of the tools (6) have the ability to work both online and offline which enables healthcare workers to work in poor network areas as all the data gets synced to the main server at the availability of network connection, except for 1 tool (ePOCT+) which works only online. The information about three other tools was not available in the public domain.

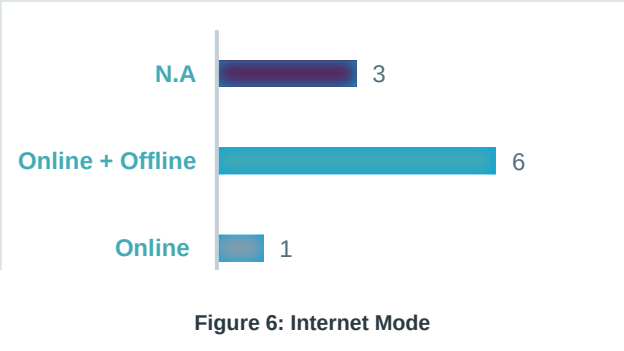


Figure 6: Internet Mode

d. **Target Patients:** Most of the tools are developed to treat children and infants except one tool (Fever Dx App) which can be used for both children and adults.

e. **Key users:** All eCDAs are developed to be used by healthcare workers/community healthcare workers to facilitate patient consultation.

f. **Triage system:** Triage system in most of the digital tools is based on existing guidelines and algorithms especially IMCI (3 tools) and ICCM (4 tools).

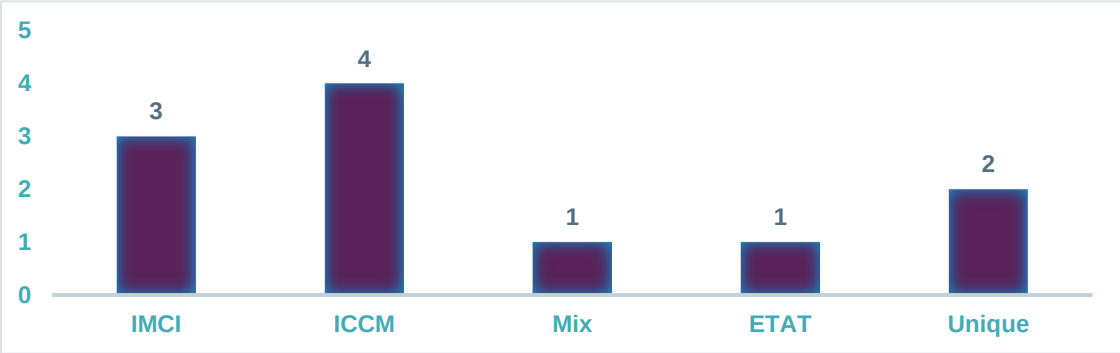


Figure 7: eCDAs' Triage System

g. **POCTs and Data storage:** Most of the assessed digital tools have additional features such as integration of point of care tests and storage of patient data that can be used for follow-up visits, supervision of HCWs performance and data surveillance. Since all the tools are designed to be used in low-resources settings, they guide HCWs to refer patients requiring higher level of healthcare.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

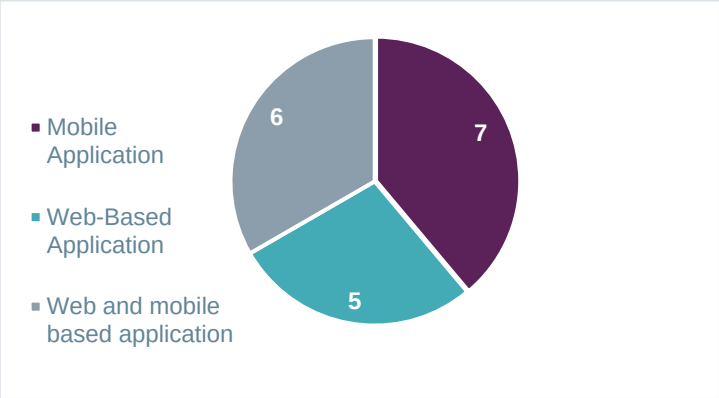
h. **Training and capacity building:** Three eCDAs (ePOCT+, IeDA and SL eCCM APP) have eLearning module. Majority of the tools (8) require intense training either on the algorithm or on how to use the digital tool, while one tool requires basic medical knowledge and information is not available for one.

3.3. Self-Monitoring Tools for Patients/ Caregivers

Study assessed 18 self-monitoring tools/ applications that can be used by patients or caregivers to guide them on how to manage their health at home and when to reach out for healthcare providers' assistance. These tools were selected based on the following features: adaptability to LMICs, fever as one of the components and availability of information in public domain. The selected tools are as follows-

1. Ada	2. Kids Doc	3. WebMD	4. Avey	5. Buoy's API	6. Everyday Health
7. Babylon	8. Mediktor	9. Doctor31	10. Fever Coach	11. Thermia	12. Symptify
13. Healthily	14. Symptomate	15. Fever App	16. Doctor Diagnose	17. Isabel	18. Doctor Ai

Some of the key features of these tools are:



a. **Technology:** These are mobile or web-based applications developed to support patients to have a general assessment of their symptoms and recommend to them the needed action. It includes **7 mobile applications**, **5 web-based applications** and **6 tool** that is accessible by both web-based and mobile applications.

b. **Key users:** Out of the 18 tools, 4 are specifically designed for management of symptoms in children, which are (Kids Doc Symptom Checker, Fever App, Fever Coach and Thermia) while 2 tools were designed to provide symptoms checking for adults only (Healthily with Dettol and Symptomate). The rest of the tools can provide information and symptoms assessment for any patient regardless of their age.

Tools specifically for children's symptoms – 4	Tools specifically for adults' symptoms – 2	Tools for all patients' types- 12

Figure 8: Types and Number of Patients tools

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

c. **Countries of Use:** Majority of the tools (9) can be used in any country and are implemented in LMICs, (4) tools are available in USA and the rest are used only in the country of origin.

d. **Operating system platform:** Out of the 13 mobile application tools, 7 are available in play store for Android and 1 from app store in IOS while rest 5 tools are available in both.

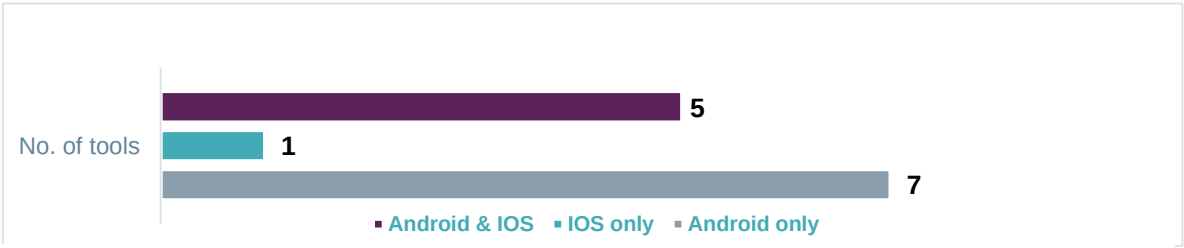


Figure 9: Technology specifications of patients' tools

e. **Storage of patient health records:** Out of the 18 tools, majority (15) of the tools allow users to register patient profile including age, sex, medical information, family history, etc. It also saves the consultation history for patient's reference and can be shared with healthcare provider if needed.

f. **Appointment Scheduling Based on Location**: Seven of these tools capture the user's location and can schedule an appointment with the nearest healthcare provider and choose best healthcare services according to users' insurance plan in the specific countries.

g. **Triage system:** Few of commonly found triaging mechanisms are:

- **Recommendations on the next steps** which usually range between homecare, seek medical service at earliest and seek emergency room immediately.
- **Color-code system (4 tools)** which include: **Red** to guide user to seek emergency immediately, **Orange/Yellow** to guide user to seek medical advice (including seeking medical advice from a doctor (a) within the next 2-3 days or (b) the next few hours and **Green** for the cases that can be managed at home.

h. **Cost of the tools:** Majority of the studied tools are available for free (14), 2 tools require one-time subscription and 2 tools include paid services such as telemedicine.

i. **User volume:** The top 3 tools which have been downloaded the maximum number of times are:

Table 3: Top three high user volume mobile applications

Tool Name	No. of Users/downloads	Operational Scope
Ada Check your health	10+ million users 20+ million assessments completed	Global
WebMD Symptom Checker	10+ million users	USA
Mediktor	40,00,000+ assessment 50,000+ downloads	Global

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

3.4. Comparative Matrix

Tools for use by frontline workers and healthcare facilities

Paper-Based tools

Name	Developer/Owner	Key Users	Target Patients	Country of Use	Triage System	Disease Area
Emergency triage assessment and treatment (ETAT)	World Health Organization			LMICs	ABCD concept + Color-code	Serious Infection & Severe Malnutrition
Pediatric early warning system (PEWS)	NHS University Hospitals Sussex NHS Foundation Trust				Score + Color-Code	Pediatric illness
Pocket book of hospital care for children	World Health Organization			LMICs	3 different signs: emergency signs, priority signs, and non-urgent cases.	Children illness in LMICS
Caring for the sick child, caring for newborns and children in the community	World Health Organization, unicef for every child			LMICs	3 different signs: A danger sign, Sick but no Danger Sign and Sign of illness (that are not danger signs)	Children aged 2-59 months illness in LMICs
Integrated Management of Childhood Illness (IMCI) chart booklet	World Health Organization			LMICs	Color-Code	Children aged 2-59 months illness in LMICs
Febrile illness: Emergency management in children	Queensland Government				Measures temperature, investigates any toxic presentation, checks the vital signs and treatment based on the diagnosis	Febrile illness in Children
Integrated Management of Adolescent and Adult Illness (IMAI)	World Health Organization			LMICs	3 different signs: emergency signs, priority signs, and Non-urgent cases.	Adolescent and Adult Illness in LMICs

Doctors, Nurses, and other Health Professionals | ED Healthcare Providers | HCWs | Children | Adults | Malawi, Guatemala, Brazil, Thailand, Uganda, Tanzania, Canada, and USA | Australia

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

eCDAs/Mobile Application

Name	Developer/Owner	Key Users	Target Patients	Country of Use	Triage System	Disease Area	Internet Mode	POCTs	e-learning module	Currently in use
ALMANACH	Swiss TPH				IMCI	Children aged 2-59 months illness in LMICs		mRDT, urine dipstick	✗	✓
e-POCT	Swiss TPH				IMCI	Children aged 2-59 months illness in LMICs	N. A	mRDT, oximeter, haemoglobin, glycaemia, CRP, procalcitonin	✗	✓
e-POCT+	unisanté				ETAT	Serious Infection & Severe Malnutrition		Hemoglobinometer, Pulse oximeter, Rapid diagnostic tests (Malaria, HIV, C-reactive protein), Urine dipstick	✓	✓
APE app	malaria consortium				ICCM & MOH policies	Children aged 2-59 months illness in LMICs		N. A	✗	✓
MSFeCARE	MEDECINS SANS FRONTIERES				MSF	Children aged 2-59 months illness in LMICs		mRDT, urine, dipstick, oximeter	✗	✓
Malawi iCCM App	d.tree				Malawi iCCM	Children aged 2-59 months illness in LMICs	N. A	mRDT	✗	✓
Niger Electronic iCCM	World Vision				Niger iCCM	Children aged 2-59 months illness in LMICs	N. A	mRDT	✗	✗
Integrated e-Diagnosis Approach (IeDA)	Terre des hommes				IMCI	Children aged 2-59 months illness in LMICs		mRDT	✓	✓

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Name	Developer/Owner	Key Users	Target Patients	Country of Use	Triage System	Disease Area	Internet Mode	POCTs	e-learning module	Currently in use
SL eCCM App					ICCM	Children aged 2-59 months illness in LMICs		mRDT	✓	✗
MEDSINC					Bayesian pattern & WHO IMCI-ICCM	Children aged 2-59 months illness in LMICs		N. A	✗	✓
Fever Dx					Fever Dx Patient Evaluation algorithm	Fever management & surveillance		N. A	✗	✓

Description:

Tanzania	Afghanistan	Nigeria	Rwanda	Mozambique	Mali	Niger	Chad	Kenya	Central African Republic (CAR)	Malawi	Burkina Faso	Ecuador	Bangladesh	Columbia	Adult + Children	Online only	Online + Offline	Available	Not Available

Self-Monitoring and Diagnostic Tools for Patients

Mobile Applications/Web-based Applications

Name	Developer/Owner	Target patients	Country of use	Triage system	Disease area	Tech	Type of tool	PHR	languages	Cost	Additional features
Ada Check your health	ada			Color-Code	Common Diseases	Android & IOS		✓	Multi languages	Free	Education Health Information
Babylon	babylon			6 steps of triage	Common Diseases	Android & IOS		✓	English	One cost £35	Education Health Information, Telemedicine, Locate Pharmacists

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Name	Developer/Owner	Target patients	Country of use	Triage system	Disease area	Tech	Type of tool	PHR	languages	Cost	Additional features
Healthily with Dettol	Your.MD			Color-Code	Adult Diseases	Web-Based & Android		✓	English	Free	Locate nearby HCP & Pharmacists
Kids Doc Symptom Checker	American Academy of Pediatrics			General	Children Diseases	Web-Based & IOS only		✗	English	One cost $1.99	Body Map Index, Locates nearby HCP
Mediktor	mediktor			Color-Code	Common Diseases	Web-Based & Android & IOS		✓	Multi languages	Free & paid services	Telemedicine, Locates nearby HCP
Symptomate	Infermedica Artificial Intelligence in Medicine			Score System	Common Diseases	Web-Based & Android & IOS		✓	Multi languages	Free	Body Map Index, Telemedicine
WebMD Symptom Checker	WebMD			General	Common Diseases	Web-Based & Android & IOS		✓	English	Free	Body Map Index, Drug Information
Doctor31	Doctor31			General	Common Diseases	Android & IOS		✗	English	Free	Integrates Lab tests
Fever App	universität Witten/Herdecke			Color-Code	Febrile illness	Android & IOS		✓	English + German	Free	Education Health Information
Avey	rimads Reimagining healthcare.			General	Web-Based & Android & IOS	Android & IOS		✓	English + Arabic	Free	Telemedicine, Locates nearby HCP
Fever Coach	md Mobile Doctor			Color-Code	Febrile illness	Android & IOS		✓	Multi languages	Free	Telemedicine, Locates nearby HCP

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Name	Developer/Owner	Target patients	Country of use	Triage system	Disease area	Tech	Type of tool	PHR	languages	Cost	Additional features
Doctor Diagnose (USA)	Apps Collider			General	Common Diseases	Android & IOS			English	Free	N. A
Buoy's API	buoy			General	Common Diseases	Web-Based only			English	Free	Telemedicine
Thermia	Boston Children's			Color-Code	Febrile illness	Web-Based only	URL		English	Free	Education Health Information, Dose calculator
Isabel Symptom checker	isabel			Color-Code & Score	Common Diseases	Web-Based only	URL		English	Free	N. A
Everyday Health-Symptoms Checker	EVERYDAY HEALTH			General	Common Diseases	Web-Based only	URL		Multi languages	Free	Body Map Index
Symptify	Symptify Symptoms Simplified			General	Common Diseases	Web-Based only	URL		English	Free	Locates nearby HCP
Doctor Ai	DOCTOR AI			General	Common Diseases	Android only			English	Paid services range from $1 to $40	Telemedicine

UK	Rwanda	Ireland	India	USA	Germany	Qatar	South Korea	China	Japan	Global	Mobile App	Web App	Mix

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

3.5. Ranking of the AFI tools

The digital tools used by the healthcare providers and patients were ranked for their preference of implementation and use in LMICs. Paper-based tools only included clinical guidelines published by the WHO, UNICEF and few other agencies and did not have many differentiating factors, and hence were not ranked.

To differentiate and select the best suited digital tool, we established a selection matrix and ranked these tools based on the parameters that define the ease of implementation of these tools in LMICs. Tools used by healthcare providers and patients were ranked separately. The indicators used for scoring and ranking the digital tools for HCWs are as follows:

- Implemented in LMICs
- Used specifically for fever management and triaging
- Works both offline and online
- Tool is implemented in multiple countries
- Availability of e-learning module
- Tool is currently in use
- Tools is available in open source
- Tools with additional feature of integrating POCTs (at least mRDTs)
- Tools following IMCI/ICCM guidelines
- Years of existence

The detailed scoring of the AFI tools is given in Annexure 5.3. Based on the scoring, the top 3 three tools are IeDA, Almanach and SLeCCM App. Table 4 shows the ranking of the Digital tools for HCWs.

Table 4: Ranking of the Digital tools for HCWs

Sl.no	Name of the tool	Overall Score	Rank
1.	**ALMANACH**	**9**	**2**
2.	e-POCT	8	3
3.	e-POCT+	7	4
4.	**APE app**	**8**	**3**
5.	MSFeCARE	6	4
6.	Malawi iCCM App	6	4
7.	Niger Electronic iCCM	6	4
8.	**Integrated e-Diagnosis Approach (IeDA)**	**10**	**1**
9.	SLeCCM App	9	2
10.	MEDSINC	5	5
11.	Fever Dx	6	4

Since the SLeCCM App is not in use currently we picked the tools ranked 3 i.e ePOCT and APE app. We believe APE is the better application as it has additional features and has been recently implemented in Mozambique and has shown good acceptance. Thus, the top three applications selected by this study are: -

1. ***IeDA***: It has extensive child healthcare management, fever management algorithms and fever triaging functionality. App also Includes a comprehensive e-learning module that provides coaching to improve quality of care provided by HCWs.
2. ***ALMANACH:*** It is a well-tested app implemented in multiple countries. ALMANACH also provides diagnostic integration with malaria, urinary tract infection, typhoid fever tests, and skin diseases. It can also be translated into users' local language.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

3. ***APE app:*** Features of this application include guidance on management of pneumonia, malaria, diarrhea, malnutrition, and immunization plan for children under five. A respiratory timer called Breath Counter is also integrated.

The following indicators were used for scoring and ranking the digital tools for patients and caregivers, the detailed scoring of the AFI tools is given in Annexure 5.4.

- Implemented in LMICs
- Used specifically for fever management and triaging
- Free to use
- Provide educational information
- Technology Platforms
- Operating systems (Android/iOS)
- Telemedicine
- Multi Languages

Table 5: Ranking of digital tools for patients and caregivers

Sl.no	Name of the tool	Overall Score	Rank
1.	**Ada Check your health**	**6**	**2**
2.	Babylon	5	3
3.	Healthily with Dettol	4	4
4.	Kids Doc Symptom Checker	2	6
5.	**Mediktor**	**7**	**1**
6.	**Symptomate**	**7**	**1**
7.	WebMD Symptom Checker	4	4
8.	Doctor31	4	4
9.	Fever App	6	2
10.	Avey	6	2
11.	Fever Coach	6	2
12.	Doctor Diagnose (USA)	5	3
13.	Buoy's API	3	5
14.	Thermia	4	4
15.	Isabel Symptom checker	2	6
16.	Everyday Health-Symptoms Checker	3	5
17.	Symptify	1	7
18.	Doctor Ai	3	5

Based on the scoring above, the top 3 applications are:

1. Symptomate
2. Mediktor
3. Ada

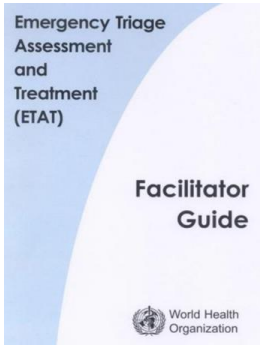
Even though Symptomate and Mediktor have the same score, the study rates Symptomate as the top tool as it is easy to navigate. Among Ada, Fever App, Fever coach and Avey, Ada was selected as it can be used globally and can be used for both adults and children. Also, it is worth noting that the utility of the app has been published in several peer reviewed journals.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

3.6. Brief Tool Profile

Tools for use by healthcare workers at first healthcare facility level

Paper-Based tools



Emergency Triage Assessment and Treatment (ETAT)

Developed by	Launch Year	Key Users	Originated in
World Health Organization	2005	HCPs, CHWs	Malawi

Introduction: ETAT is a paper-based algorithm used to treat sick children. It supports healthcare providers in providing emergency care based on ABCD protocol, highlighting priority signs and symptoms, and suggesting correct treatment. It has helped reducing child mortality by guiding HCPs. As per the evaluation study by Red Cross in 2007-09, it helped in providing effective care by correctly identifying many critically unwell children in high caseload settings[6].

Triaging Mechanism: The guideline provides necessary knowledge and capacitates health workers to triage all sick children when they arrive at a health facility to three categories i.e. immediate, priority or non-urgent cases using a **color-code system** such as **Red for immediate care** needed, **Orange** for children with urgent problems who should be directed to the '**priority' queue** and **Green** for **non-urgent** cases that can wait to be seen later.

Facts and Features: An updated version of (ETAT) guideline was developed in 2016. The new version includes guidance in three areas of clinical care i.e., oxygen therapy for critically ill children, fluid management in critically ill infants and children and management of children presenting with seizures and altered consciousness". It is field-tested in Angola, Brazil, Cambodia, Indonesia, Kenya and Niger, South Africa.

Pediatric Early Warning System (PEWS)

Developed by	Launch Year	Key Users	Country of use
NHS University Hospitals Sussex NHS Foundation Trust	2005	ED at hospitals	

Introduction: PEWS was developed by Allan Monaghan and his team to support in the management of pediatric patients by alerting healthcare providers about deterioration in pediatric patients at the earliest possibility to quickly intervene and reduce mortality.

Triaging Mechanism: The triage system is based on numbers/color codes to score PEWS, where the number (0 to 6+) represents the total score added from the domains and the colors (**Green, Yellow, Orange, and Red**) are easily understandable "cautions" that can be easily recognized to help facilitate urgency and in some care settings, communication with patients.

[6] Robertson, M. A., & Molyneux, E. M. (2001). Triage in the developing world—can it be done? Archives of disease in childhood, 85(3), 208-213.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Facts and Features: Although there is limited data on the use of PEWS in resource- limited settings, the available evidence, however, suggests that successful implementation of PEWS is possible in these settings, and may enable reduction in clinical deterioration events and hospital mortality[7].

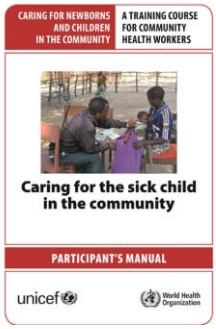
Pocket Book of Hospital Care for Children

Developed by	Launch Year	Key Users	Country of use
World Health Organization	2005	HCPs	LMICs

Introduction: Guidelines for the management of common childhood illnesses was developed to be used for both inpatient and outpatient care in hospitals with basic laboratory facilities and essential medicines. The tool focuses on the management of major causes of childhood mortality including fever and covers the management of *Malaria, Meningitis, Measles, Septicemia, Typhoid, Ear infections, Urinary tract infection, Septic arthritis or osteomyelitis, Dengue and Rheumatic fever*. It was updated in 2013 and in 2016 a digital version was developed by WHO in collaboration with The Royal Children's Hospital, University of Melbourne, and Murdoch Children's Research Institute.

Triaging Mechanism: The triage system is classified into 3 different signs: those with **emergency signs**, who require immediate emergency treatment; those with **priority signs**, who should be given priority in the queue; and **Non-urgent cases.**

Facts and Features: A study conducted in 2013 to determine the worldwide distribution of the tool showed that more than half of all LMICs with high rates of child mortality had reported use of the guidelines which is a considerable achievement given minimal resources available for implementation[8].



Caring for the sick child, caring for newborns and children in the community

Developed by	Launch Year	Key Users	Country of use
World Health Organization unicef for every child	2011	HCWs	LMICs

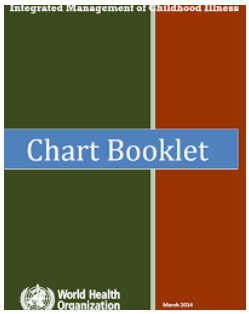
Introduction: The guideline developed by WHO and UNICEF in 2011 assesses and treats sick children aged 2-59 months. The tool assists in identifying and treating children with danger signs such as pneumonia, diarrhea, and fever. The tool also helps in identifying and referring children with severe malnutrition and other problems that need medical attention to a health facility and advises caregivers on how to care for sick child at home.

Triaging Mechanism: The system is classified into three different signs; a **danger sign** indicating that the child is too ill and must be urgently referred to a health facility; **sick but no danger signs** of illness indicating they can be treated at home by medicine and require a follow up until the child is well. **Sign of illness** (that are not danger signs) refers the child to a health facility when the required medicine is not available, or the caregiver is unable to identify the cause of the problem.

[7] Murray, J. S., Williams, L. A., Pignataro, S., and Volpe, D. (2015). An integrative review of pediatric early warning system scores. Pediatric Nursing, 41(4), 165-174.
[8] Li MY, Kelly J, Subhi R, Were W, Duke T. Global use of the WHO pocketbook of hospital care for children. Paediatr Int Child Health. 2013 Feb;33(1):4-17. doi: 10.1179/2046905512Y.0000000017. PMID: 23485489.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Facts and Features: A study conducted in Senegal[9] to test the efficiency of CMM in management of malaria demonstrates the potential to substantially increase access to life saving malarial diagnostics and treatment. However, a study conducted in Ethiopia[10] showed low utilization of CMM because of the long distance between caregivers and health posts.



5. Integrated Management of Childhood Illness (IMCI)

Developed by	Launch Year	Key Users	Country of use
World Health Organization	2014	HCPs	LMICs

Introduction: Developed for the management of children aged 2 months to 5 years and infants aged up to 2 months in low-resource countries to assess illness by cough or breathing difficulty, diarrhea, fever, ear infection, local bacterial infection, and jaundice.

Triaging Mechanism: The triage system is based on a color-coded system which includes **Pink** for urgent hospital referral or admission, **Yellow** for initiation of specific outpatient treatment and **Green** for supportive home care.

Facts and Features: An evaluation study conducted in Namibia, Kenya, Tanzania, and Uganda in 2017 has shown that despite nationwide training on IMCI, the adherence rates for assessment and physical examination remained low. Another study in South Africa showed that HCWs are implementing IMCI, but assessments were frequently incomplete and children requiring urgent referral were missed[11].

Queensland Pediatric Guideline

Developed by	Launch Year	Key Users	Country of use
Queensland Government	2019	ED at hospitals	Australia

Introduction: This guideline was developed by senior emergency department physicians and pediatricians with inputs from epidemiologists. It provides support and clinical guidance for healthcare providers at emergency departments in Queensland on management of children and infants with high risk of febrile illness.

Triaging Mechanism: The process starts by examining the child having fever and investigating for any toxic presentation on the basis of the clinical features concerning serious bacterial infection and checks for vital signs to provide recommendation based on the diagnosis. It also provides separate flowchart for emergency management of febrile children aged <3 months- and ≥ 3 months. The guideline is not applicable for the management of children with an unexplained fever for greater than one week or who have recently returned from overseas travel.

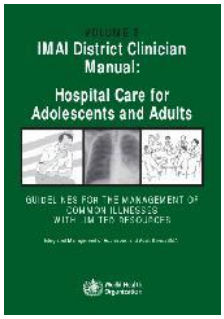
[9] Ndiaye, Y., Ndiaye, J.L., Cisse, B. et al. Community case management in malaria: review and perspectives after four years of operational experience in Saraya district, south-east Senegal. Malar J 12, 240 (2013). https://doi.org/10.1186/1475-2875-12-240

[10] Samuel S, Arba A. Utilization of Integrated Community Case Management Service and Associated Factors Among Mothers/Caregivers Who Have Sick Eligible Children in Southern Ethiopia. Risk Manag Healthc Policy. 2021; 14:431-438 https://doi.org/10.2147/RMHP.S278231

[11] Krüger, C., Heinzel-Gutenbrunner, M. & Ali, M. Adherence to the integrated management of childhood illness guidelines in Namibia, Kenya, Tanzania and Uganda: evidence from the national service provision assessment surveys. BMC Health Serv Res 17, 822 (2017). https://doi.org/10.1186/s12913-017-2781-3

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Facts and Features: This guideline is being used across Queensland by the Queensland Emergency Care of Children Working Group in partnership with the Queensland Emergency Department Strategic Advisory Panel and the Healthcare Improvement Unit.



Integrated Management of Adolescent and Adult Illness (IMAI)

Developed by	Launch Year	Key Users	Country of use
World Health Organization	2004	HCPs	LMICs

Introduction: IMAI was developed to support healthcare providers in screening, diagnosing, and managing malaria, HIV/AIDS, STIs, pneumonia, diarrheal disease, and tuberculosis.

Triaging Mechanism: The triage mechanism for fever in the Acute Care Guidelines includes checking the most common emergency signs. It then classifies the case into three different levels as, 'patient has high malaria risk', 'low malaria risk' and 'no malaria risk', and according to the classification, it recommends the treatment. However, the triage system in IMAI District Clinician Manual includes four different steps for the district clinician - 1) assess the emergency signs, 2) treat and act according to the first line emergency treatments, 3) follow the protocol for the trauma if exists, and 4) follow further urgent medical treatments to manage the severely ill patient.

Facts and Features: It contains 8 different modules, out of which the Acute Care Guidelines (Guidelines for first-level facility health workers at health center and district outpatient clinic) was developed in 2009. IMAI District Clinician Manual: Guidelines for The Management of Common Illnesses with Limited Resources Hospital Care for Adolescents and Adults was developed in 2011.

eCDAs/Mobile Applications

ALMANACH (ALgorithms for the MANagement of Acute Childhood illnesses)

Developed by	Launch Year	Key Users	Country of use
Swiss TPH Swiss Tropical and Public Health Institute	2015	HCWs	

Introduction: ALMANACH was developed both as a paper-based booklet and an eCDA by Swiss TPH in 2015. It guides HCWs in the management of children in low-resource settings, as well as provides diagnostic procedures for malaria, urinary tract infection, typhoid, and skin diseases.

Triaging Mechanism: The Triage mechanism is structured into 3 steps namely Assessment, Classification and Treatment. It follows the IMCI color-coded triage system and provides 3 charts. The first chart for the assessment of general danger signs and severe illnesses, the second chart for patients with fever, and the third chart for patients without fever.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Facts and Features: According to study in 2018 in Nigeria[12] in Adamawa state, ALMANACH has contributed in increasing the assessment of danger signs in children by 60% and decreasing antibiotic prescription by 8%. Also, in Somalia[13] in 2020, it has helped in reducing antibiotics prescription for upper respiratory tract infections by 15%.

Electronic Point of care (ePoCT)

Developed by	Launch Year	Key Users	Country of use
Swiss TPH Swiss Tropical and Public Health Institute	2014	HCWs	Tanzania

Introduction: Electronic Point of Care (ePoCT), an advanced version of ALMANACH was developed by Swiss TPH in 2014. The ePoCTs are aimed at triaging children with severe disease who require referral to a higher level of care (oxygen saturation [SaO2], heart rate, blood glucose, and Hb), detecting malaria infection (mRDT), and distinguishing between bacterial and viral diseases (CRP and PCT). It guides the clinician through the entire consultation and recommends management based on a **few clinical elements.**

Triaging Mechanism: The tool detects the prevalence of **malaria infection (mRDT) and** distinguishes it further into bacterial and viral infection through a two-step approach. These include temperature- and age-corrected respiratory rate and CRP for diagnosing bacterial pneumonia and use of CRP and PCT to decide on antibiotic prescription for children with fever without localizing symptoms.

Facts and Features: According to a study conducted to compare the effectiveness ePoCT and ALMANACH in Tanzania between 2014 and 2017, ePoCT has proven to be more effective than ALMANACH. ePoCT improved the clinical outcomes while reducing antibiotic prescription from 30% to 11% and diagnosed 4 times as many patients with severe anemia in comparison to ALMANACH[14].

Electronic Point of care+ (ePoCT+)

Developed by	Launch Year	Key Users	Country of use
unisanté Centre universitaire de médecine générale et santé publique • Lausanne	2019	HCWs	

Introduction: ePoCT+, an advanced version of ALMANACH and ePoCT is being implemented and continuously validated as a part of Dynamic. Dynamic is a 5-year research project led by Unisante's Digital and Global Health Unit and several partners and was started in 2019. The advanced version of e-POCT covers not only febrile children aged 2 months to 5 years (IMCI age range) but the entire pediatric age range (1 day to 14 years).

Triaging Mechanism: It consists of several modules such as, **MedAL-Creator** to allow health workers to create clinical decision supporting algorithm system. **MedAL-Reader** displays the algorithm

[12] Bernasconi, A., Crabbé, F., Adedeji, A. M., Bello, A., Schmitz, T., Landi, M., & Rossi, R. (2019). Results from one-year use of an electronic Clinical Decision Support System in a post-conflict context: An implementation research. PLOS ONE, 14(12), e0225634. https://doi.org/10.1371/journal.pone.0225634

[13] Swiss TPH. (2021). BULLETIN FROM THE PRIMARY HEALTH CARE CENTERS IMPLEMENTING ALMANACH IN SOMALIA. https://blogs.icrc.org/somalia/wp-content/uploads/sites/99/2021/01/ENG-Almanach-Bulletin-DEC-2020.pdf

[14] Keitel, K., Kagoro, F., Samaka, J., Masimba, J., Said, Z., Temba, H., Mlaganile, T., Sangu, W., Rambaud-Althaus, C., Gervaix, A., Genton, B., & D'Acremont, V. (2017). A novel electronic algorithm using host biomarker point-of-care tests for the management of febrile illnesses in Tanzanian children (e-POCT): A randomized, controlled non-inferiority trial. PLOS Medicine, 14(10), e1002411. https://doi.org/10.1371/journal.pmed.1002411

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

(ePOCT+) on the tablet, accepts inputs from the clinical consultation, pulse oximeter and POC test results. **MedAL-monitor** enables HCWs to self-audit their clinical practices and visualize medical and operations data. **MedAL-data** stores patient-level data and **MedAL-outbreak** displays syndromic surveillance and performance indicators of primary healthcare facility. **MedAL ai- EPFL's** machine learning model analyses the anonymized data to propose algorithm improvements.

Facts and Features: A pilot study was conducted in March 2021 with 474 children and adolescents in Tanzania and Rwanda and found that prescriptions dropped from 70% in Rwanda and 63% in Tanzania to 13% and 19% respectively while using ePOCT+[15].

APE App

Developed by	Launch Year	Key Users	Country of use
malaria consortium	2009	HCWs	Mozambique

Introduction: It was developed in 2009 by Malaria Consortium as part of *inSCALe project* in Mozambique to provide an android application for the use of healthcare workers in disease management of children under five years. The application is based on the ICCM protocols in addition to MoH polices for assessment of diarrhea, pneumonia, malaria, and malnutrition.

Triaging Mechanism: The HCW enters the symptoms and based on the assessment, the application provides the diagnosis and an easy-read description about it (which the patient can listen to in audio) in addition to recommendation of necessary medicines with details of doses. It also prompts CHWs with a checklist of danger signs exhibited by pregnant women, newborns, and children for appropriate referral and follow-up, while also providing family planning education and services, including condoms, pills, and injections.

Facts and Features: An evaluation conducted in 2014 showed that 68% of CHWs were using this application in their daily consultation and many stated that it supported them in their daily consultation.[16]

MSFeCARE

Developed by	Launch Year	Key Users	Country of use
MEDECINS SANS FRONTIERES	2015	HCWs	

Introduction: This tool was developed by Medicins Sans Frontiers to be used in low-resource contexts to improve management of acute illnesses for children aged 2 months to 5 years in primary care facilities by healthcare workers. MSFeCARE includes **PED (Pediatric)** which was the first module created and is now deployed in six countries which are Mali, Niger, Chad, Kenya, Central African Republic (CAR), and Tanzania. **STI (Sexually Transmitted Infections)** was the second module created and was piloted in DRC in 2019, and **COVID-19** is the most recent eDSS module which is currently in use.

[15] DYNAMIC: New Clinical Decision Support Tool Reduces Antibiotic Prescription in Children by a four-fold: Press Release by Unisante & Swiss TPH dated June 14, 2021
[16] Malaria Consortium. (2019). Field study report UpScale Project https://www.odess.io/files/documents/enquetes/2.%20Reportage%20UPSCALE%20Mozambique.pdf

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Triaging Mechanism: The tool guides the HCWs through a series of questions during patient consultation to result in a comprehensive diagnosis coupled with treatment recommendations. The software algorithms were developed by MSF and external medical professionals based on fact-based evidence and targeted to MSF low-resource contexts.

Facts and Features: In 2016, a study was conducted in the Central African Republic[17] to assess the effectiveness of the tool in which 24 nurses performed 10,000+ consultations and reported the user-friendliness of the tool. It was evidenced that the tool supported 50% reduction in antibiotic prescriptions. In another study in Tanzania[18] in 2018, a total of 52,053 consultations were conducted using the tool which demonstrated decrease in antibiotic prescription by 10%.

Malawi iCCM App

Developed by	Launch Year	Key Users	Country of use
d.tree Digital global health	2014	HCWs	Malawi

Introduction: It is an android application based on the national iCCM protocol of Malawi developed by D-Tree International in 2014. The guideline enables HCWs to assess, classify and treat children through a series of questions.

Triaging Mechanism: The tool determines the illness and recommends treatment protocols based on the caregiver's responses to the questions. The application also supports CHWs in the calculation of the correct medication dosage, counting of respiratory rate, mRDT, managing drug stock as well as automatically generating reports for evaluation and monitoring of the data.

Facts and Features: An evaluation to assess the impact of the application on quality of care showed that HCWs using the application tended to assess sick children according to iCCM guidelines more often than HCWs using paper-based tools[19].

Niger Electronic iCCM

Developed by	Launch Year	Key Users	Country of use
World Vision	2014	HCWs	Niger

Introduction: This android application was developed by World Vision Canada in 2014 to guide HCWs in treating **diarrhea, malaria, and pneumonia** during patient consultations and follow-up visits and refer children with severe illness to nearby clinics. It also provides automatic reminders to schedule follow-up visits and guide them during these visits. It also includes multimedia education materials for counseling to improve caregiver's behavior and improve treatment adherence.

[17] Report of the 2nd Paediatric Days - Dakar, Senegal. (2017). https://paediatrics.msf.org/sites/default/files/uploaded_files/MSF%20Paeds%20Days%20REPORT_EN.pdf
[18] MSF. (2019). MSFeCARE-Ped, AN ELECTRONIC ALGORITHM TO IMPROVE QUALITY OF PAEDIATRIC PRIMARY CARE: LESSONS LEARNED FROM 50'000 CONSULTATIONS IN NDUTA CAMP, TANZANIA. https://doi.org/10.13140/RG.2.2.33347.86561
[19] Boyce SP, Nyangara F, Kamunyori J. A mixed-methods quasi-experimental evaluation of a mobile health application and quality of care in the integrated community case management program in Malawi. J Glob Health. 2019 Jun;9(1):010811. doi: 10.7189/jogh.09.010811. PMID: 31263554; PMCID: PMC6594718.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Triaging Mechanism: The tool determines the illness and recommends treatment protocols based on the caregiver's responses to the questions. The application also supports CHWs in the calculation of the correct medication dosage, counting of respiratory rate, mRDT, managing drug stock as well as automatically generating reports for evaluation and monitoring of the data.

Facts and Features: An evaluation conducted in 2016, showed that the use of this application led to quality-of-care improvements through better assessment of the sick children and better referral decisions by CHWs[20].

Integrated e-Diagnosis Approach (IeDA)

Developed by	Launch Year	Key Users	Country of use
Terre des hommes	2014	HCWs	

Introduction: The integrated e-Diagnosis approach (IeDA) is a digital solution for management of illness in children under 5-years of age, developed by Terre Des Hommes in 2014. The tool has been implemented in Burkina Faso, Mali and Niger.

Triaging Mechanism: The tool supports HCWs through a digital job aid called Registre Electronique de Consultation (REC) which is based on WHO IMCI guidelines. The tool integrates the collected data with the health information system and an e-learning module for skill development of HCWs.

Facts and Features: While using the digital tool, the community health workers were able to diagnose issues such as diarrhea, dysentery, and malnutrition with almost 20% higher accuracy than those who did not. Additionally, false positive diagnoses of pneumonia were reduced by over 60%, over-prescription of antibiotics fell over 25%, and correct prescriptions for dysentery and malaria more than tripled. In addition to improved care and coverage, IeDA also demonstrated the potential of between US$32 and US$66 in cost-savings per health facility per month.[21]

SL eCCM

Developed by	Launch Year	Key Users	Country of use
Supporting LIFE	2014	HCWs	Malawi

Introduction: SLeCCM is an android application that supports HCWs classify a child's illness and recommend treatment with a focus to diagnose malaria and infantile diarrhea, pneumonia, meningitis, and sepsis. It was developed by Supporting LIFE Consortium in 2014 to provide low-cost, effective, and targeted interventions in Malawi based on ICCM guidelines.

Triaging Mechanism: A vital sign sensor is integrated to capture patient's heart and respiratory rates. It also includes a disease surveillance email which sends daily emails to stakeholders on malaria, pneumonia, and infantile diarrhea cases recorded and syncs in the app.

[20] Zakus D, Moussa M, Ezechiel M, Yimbesalu JP, Orkar P, Damecour C, Ghee AE, MacFarlane M, Nganga G. Clinical evaluation of the use of an mhealth intervention on quality of care provided by Community Health Workers in southwest Niger. J Glob Health. 2019 Jun;9(1):010812. doi: 10.7189/jogh.09.010812. PMID: 31263555; PMCID: PMC6594719

[21] Dimagi. (2017). The Integrated eDiagnostic Approach for Child Health. https://www.dimagi.com/case-studies/mhealth-tdh-burkinafaso/

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Facts and Features: A clinical trial study conducted between 2016 and 2017 to investigate the effectiveness of the tool revealed that referral rates were similar in the intervention and control phases, but re-consultations at village clinics and presentations to higher-level facilities and hospital admissions were higher in the control phase[22]. A feasibility study between July and September 2015 was conducted among Health Surveillance Assistants' (HSAs) from village clinics in Mzimba North, Northern Malawi. HSAs using the SL eCCM App perceived enhanced clinical decision-making, quality of CCM delivery, and work efficiency. Further, the app supported HSAs' many roles in the communities, helped increase communication between colleagues/supervisors, facilitated drug stock-out reporting, and community assessments[23].

MEDSINC

Developed by	Launch Year	Key Users	Country of use
THINKMD	N. A	HCWs	

Introduction: Medsinc is a mobile clinical assessment platform that utilizes proprietary clinical logic to enable anyone anywhere to assess the sickness of a child and provide triage and treatment recommendations. It uses a digital platform that uses Bayesian pattern recognition logic and interprets **42 key clinical data** points based on the WHO IMCI-ICCM guidelines.

Triaging Mechanism: The platform guides users through a complete assessment. The user is prompted to sequentially answer all questions using supportive embedded demonstration and animated gif illustrations to enhance the quality of data point acquisition.

Facts and Features: The tool provides three levels of triage recommendations (standard, immediate, and urgent care) which corresponds with the IMCI-ICCM triage recommendations (green, yellow, and red color codes). A pilot study in Nigeria showed a 41% observable and 50% actual improvement in the ability of front-line workers to appropriately diagnose sick children according to the WHO-IMCI guidelines.[24]

Fever Dx

Developed by	Launch Year	Key Users	Country of use
FUNDACIÓN VALLE DEL LILI	2015	HCPs	Colombia

Introduction: A mobile application to strengthen care processes and facilitate detection and reporting of notifiable surveillance diseases was developed by Clinica Valle del Lili (FVL) in association with Universidad ICESI in Colombia in 2015. The app locally stores clinical data regarding the most frequent fever syndrome's clinical guidelines and supports general practitioners (GPs) in the management of

[22] Hardy, V., O'Connor, Y., Heavin, C. et al. The added value of a mobile application of Community Case Management on referral, re-consultation and hospitalization rates of children aged under 5 years in two districts in Northern Malawi: study protocol for a pragmatic, stepped-wedge cluster-randomized controlled trial. Trials 18, 475 (2017). https://doi.org/10.1186/s13063-017-2213-z
[23] Chirambo, G. B., Hardy, V., Heavin, C., O'Connor, Y., O'Donoghue, J., Mastellos, N., ... & Thompson, M. (2018). Perceptions of a mobile health intervention for Community Case Management in Malawi: Opportunities and challenges for Health Surveillance Assistants in a community setting. Malawi Medical Journal, 30(1), 6-12.
[24] The American Society of Tropical Medicine and Hygiene, Development, and Initial Validation of a Frontline Health Worker mHealth Assessment Platform (MEDSINC®) for Children 2–60 Months of Age, 2019

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

patients with a fever syndrome and suspected arboviral infection. The app has two modules, namely the clinical guideline and the evaluation modules.

Triaging Mechanism: The clinical module guides the GPs to obtain a *rapid-offline* reference to the clinical practice guidelines (CPGs) for acute febrile syndromes such as Zika, dengue, chikungunya, and other common infections in tropical areas such as leptospirosis. While in the patient evaluation module, an algorithm is integrated to support the approach and management of patients with a febrile syndrome. This algorithm highlights the essential points of patient care such as the evaluation of general symptoms, vital signs, and the alarm signs/severity signs, which include warning signals for dengue, Zika, and chikungunya.

Facts and Features: An evaluation study was conducted between December 2016 to January 2017 to test the application; the results of the app evaluation were (a) 19 out of 20 GPs partially/wholly agreed that the application can increase their knowledge and understanding about the disease (dengue, Zika and chikungunya) and their infection management. GPs found that application provides informative and suitable contents for physicians.[25]

3.7. Self-Monitoring and Diagnostic Tools for Patients

Mobile Applications

Ada Check your Health

Developed by	Launch Year	Key Users	Country of use
ada	2016	Patients	Global

Introduction: Ada mobile application uses an artificial intelligence technology to support users to check their symptoms and generates a set of differential diagnosis for a given clinical case. The application consists of different modules such as: ***Symptom Checker*** helping to check symptoms and discover what might be causing them. An assessment report summarizing the potential cause and recommended steps is generated at the end, which can be shared and also be deleted by the user. ***Symptom Tracker*** prompts the user to record symptoms based on severity - on a scale of 1-10 (not severe, severe to very severe). The ***Condition Library*** provides an overview of a particular disease or condition including risks involved, symptoms, diagnosis, treatment, prevention, and prognosis.

Triaging Mechanism: The tool has a color-coding triage system such as **red** to seek emergency care immediately, **orange** to seek medical advice within 2-3 days or within the next few hours and **green** for the cases that can be managed at home.

Facts and Features: According to a study conducted in 2020 in UK and Germany to test the efficiency of the tool before and after COVID-19, Ada's advice was found to be safe in 97% of cases in comparison to Babylon's advice in 95.1% of cases. Ada provided 99% condition coverage and achieved 70% accuracy for top 3 suggestion fit compared to the WebMD's average of 38%[26].

[25] Rodríguez, S., Sanz, A. M., Llano, G., Navarro, A., Parra-Lara, L. G., Krystosik, A. R., & Rosso, F. (2020). Acceptability and usability of a mobile application for management and surveillance of vector-borne diseases in Colombia: An implementation study. *PloS one*, *15*(5), e0233269.
[26] Gilbert, S., Mehl, A., Baluch, A., Cawley, C., Challiner, J., Fraser, H., ... & Novorol, C. (2020). How accurate are digital symptom assessment apps for suggesting conditions and urgency advice? A clinical vignettes comparison to GPs. BMJ open, 10(12), e040269

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Babylon			
Developed by	**Launch Year**	**Key Users**	**Country of use**
babylon	2013	Patients	

Introduction: Babylon mobile application was developed in 2013 to provide patients with relevant health and triage information based on symptoms. The app has features such as **symptom checker** to check symptoms instantly and get the most appropriate assessment, **health information** to provide updated medical information about diseases, **health records** to help its user access their records, prescriptions, and health information that is stored securely in the app. It has the **health check feature** to help assess current health and predict about future disease risks. Additionally, it also provides Health check assessments for nutrition, activity, and mood.

Triaging Mechanism: The Babylon Triage and Diagnostic System is designed to identify one of the six mutually exclusive triage recommendations: "call an ambulance", "go to A&E/ER", "urgent GP" (within 6 hours), "non-urgent GP" (within a week), "pharmacy" and "selfcare at home."

Facts and Features: An evaluation identified that the app was successful even in spotting serious conditions such as a heart attack, and that the app was fast and easy to use and helped in avoiding 23% of ER or urgent care visits and achieved 15% to 35% acute care savings in the NHS[27].

Healthily with Dettol			
Developed by	**Launch Year**	**Key Users**	**Country of use**
Your.MD	2020	Patients	India

Introduction: Healthily with Dettol earlier referred as Healthily by Your.MD uses AI to provide users with personalized advice about their medical complaints. Further, Dettol partnered with the self-care app Healthily in 2019 to help millions across India take control of their health and its new brand came into existence in 2020. Launched in 2020, this app helps users build new habits, spot patterns, and create lasting changes, and track coughing, dizziness, fever, headache, nausea, and stomach-ache. However, it doesn't support information for infants, children under 15 years of age, and pregnant women. The application also helps in locating nearby doctors and health professionals, pharmacy and provides the Coronavirus risk assessment.

Triaging Mechanism: The triage mechanism is structured in a color-coding system that provides recommendations based on the user's symptoms. The color codes are ***red*** to call emergency immediately, **orange** for cases that need medical attention with 12 hours and **green** for cases that can be managed at home.

Facts and Features: In reference to the latest work by the app developers with Imperial College showed that the app gives safe advices 90% of the time on an individual's best next step to take.[28]

[27] https://uk.pcmag.com/health-fitness/91098/feeling-sick-consult-your-ai-chatbot
[28] Retrieved from https://www.livehealthily.com/blog/why-we-need-a-global-standard-for-self-assessment-tools

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Kids Doc Symptom Checker

Developed by	Launch Year	Key Users	Country of use
American Academy of Pediatrics	2010	Caregivers	USA

Introduction: Kids Doc Symptom checker is a web-based tool as well as a mobile application provided by the American Academy of Pediatrics. It allows the caregivers to check the most common symptoms such as fever, cough, vomiting, rash, sore throat or head injury and advise them on what level of care is needed and how to provide speedy symptom relief for minor illnesses or injuries. The Kids Doc Symptom checker an iOS mobile app was developed by Self Care Decisions, LLC in 2010.

Triaging Mechanism: The underlying algorithm is derived from clinical protocols used by pediatricians and nurses working in the U.S. and Canada. It comprises of three steps- i) **choosing** the most appropriate symptom care guide, ii) **using** the symptom decision chart to find the recommended action and iii) **following** the self-care advice to make the child more comfortable which may include seeking medical services immediately, seeking medical service within 24h or manage at home.

Facts and Features: The application is available on iOS devices only and it requires one-time subscription of around US$2. It is only available for use only in USA.

Mediktor

Developed by	Launch Year	Key Users	Country of use
mediktor INTELLIGENT ACCESS TO HEALTHCARE	2011	Patients	Global

Introduction: Mediktor is an android and iOS based mobile application developed by TECKEL MEDICAL SL in 2011. The app uses AI algorithm to guide the patient's interrogation in a similar way to how a doctor would do it.

Triaging Mechanism: The triaging mechanism is structured into various levels. It is based on a color-coding level of urgency- **Blue**: Very low urgency, **Green**: low urgency, **Orange**: medium urgency and **Red**: high urgency. Additionally, it indicates intensity of pain on a scale of Mild (1-2), Moderate (3-4), Intense (5-6), Very Intense (7-8) and Very Worst (9-10) as well as level of occurrence (Common, Frequent, and Infrequent). The app comes integrated with a paid telemedicine consultation service which offers choice of doctors across various specialties.

Facts and Features: According to symptom assessment app study, Mediktor provided condition-suggestion coverage for 80.5 % of cases while top 3 suggestion accuracy was provided for only 36% of cases[29].

Symptomate

Developed by	Launch Year	Key Users	Country of use
Infermedica Artificial Intelligence in Medicine	2014	Patients	Global

[29] Gilbert S, Mehl A, Baluch A, et alHow accurate are digital symptom assessment apps for suggesting conditions and urgency advice? A clinical vignettes comparison to GPsBMJ Open 2020

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Introduction: Symptomate is a web-based and mobile application developed by Infermedica, a Polish medical and technology company, to assist patients with preliminary diagnosis using artificial intelligence and guide them to the appropriate medical services. The mobile app based on android and iOS platform was launched in 2014. The app has a body map as well as a symptom box option to allow the patient to select the target body part and display the associated symptoms.

Triaging Mechanism: The triaging mechanism provides recommendations based on the user's symptoms. The recommendations provided by the app are *emergency ambulance* (calling ambulance), *emergency* (visiting an emergency department, but if unable to visit ER, the patient can call emergency ambulance), *consultation within 24 hours* (patient should see a doctor in next 24 hours), *consultation* (patient may require medical evaluation and may need to schedule an appointment with a doctor), and visiting *a doctor and self-care* (a medical consultation is advised but not strictly required). The application also rates the entered symptoms on a scale of 1-10 from mild to unbearable. Further, it categorizes the cases based on the seriousness of reported observations and the severity of likely conditions as well as the occurrence of any alarming symptoms or risk factors. The app provides an assessment report which includes a classification of the case provided, a list of serious observations, and a root cause explaining the assessment and level of the triage and recommendations.

Facts and Features: The symptom checker is designed to be used for the symptoms checking of adults only around the world.

WebMD Symptom Checker

Developed by	Launch Year	Key Users	Country of use
WebMD	2018	Patients	USA

Introduction: The WebMD Symptom Checker is an android and iOS based mobile application developed by WebMD Health Corp in 2018 to provide easy and quick access to trusted medical information. The application includes different features such as:

- **Symptom Checker** to support users in learning about potential conditions and the recommended treatment and care options,
- **Doctor Directory** to locate the closest doctors and specialists,
- **WebMD Rx** which offers medicines at an affordable rate,
- **Medication Reminders** to send reminders about the prescription schedules and instructions,
- **Conditions** to offer information about diseases, causes, treatments, and related symptoms.
- **Drug Interaction Checker** to help in finding and identifying potentially harmful and unsafe combinations of prescription medications.

Triaging Mechanism: As part of the app's triage system the users enter their information such as age and gender and location. Post that, the user can choose the corresponding location on a body map, select the relevant symptoms, and answer a list of questions to define the symptoms more clearly. The app will then display a list of diseases corresponding to the symptoms with detailed information about the disease, how common the disease is, possible treatment methods, when to see a doctor, how to go about self-care, and risk factors.

Facts and Features: The app is also used to assess COVID-19.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Doctor31

Developed by	Launch Year	Key Users	Country of use
Doctor31	2019	Patients	Global

Introduction: The mobile application is based on android and iOS platform developed by NETTER ADVICE SRL in 2019. Using an AI based algorithm, the app accesses the medical knowledge of doctors from 31 different specialties. The app provides access to extended knowledge about the user's medical condition and provides a premedical opinion, quick answers for the users' symptoms, and interpretation of lab tests that can help making a more informed decision

Triaging Mechanism: The triage system of the app asks a simple set of questions and upon completion of the questionnaire, the user will receive a probable diagnosis and recommended treatment including if a medical emergency is recommended.

Facts and Features: The app considers the geographical area users lives or has travelled in the last 6 months while assessing the condition and suggesting referral actions.

Fever App

Developed by	Launch Year	Key Users	Country of use
universität Witten/Herdecke	2020	Caregivers	Germany

Introduction: This application was developed for fever and febrile illnesses management in children by University of Witten / Herdecke gGmbH in 2020. The app includes the following features:

- **Parent/caregiver profile** for the parent or caregiver who is using the app and entering the information
- **Child profile** for each child within the family and can be distinguish by different colors
- **Illness Tracking** helps track fever episodes from the date of onset till the date the child feels healthy
- **Alarm clock** to set a reminder to measure the child's temperature at periodic intervals
- **Scanning medication** to scan the barcode of the medication and also allow the user to enter the medications details
- **Info Library** which consists of tips and articles about fever and topics related to fever

Triaging Mechanism: As part of the app's triage system, the caregiver can record the child's fever episodes, answer a set of questions, based on which the app provides a short explanation and a suggestion which may include an advice to c**ontact a doctor immediately** or **seek care at home.**

Facts and Features: The application is only available via individual access codes distributed by the pediatric practices in Germany during the routine check-up and vaccination visits. In total, 6300 pediatricians were invited in 2020 for this registry through the BVKJ for at least the next 5 years[30]. Once the users download the app they are made aware about the research purpose.

[30] Retrieved from https://bmcmedinformdecismak.biomedcentral.com/articles/10.1186/s12911-020-01269-w on 3/6/2021

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Avey- Your medical AI Pal

Developed by	Launch Year	Key Users	Country of use
rimads Reimagining healthcare.	2020	Patients	Qatar

Introduction: Avey is an android and iOS based application developed by Rimads QSTP-LLC in 2020 to provide users in Qatar with personalized symptom assessment on Women's Health, Mental health, Family and Kids' Health, Skin Care, Nutrition, and Physical Activity. The users can also access informative content while reading through these sections.

Triaging Mechanism: For the triage system, the application asks the users simple questions, analyzes the answers, and provides a personalized report that shows the possible causes of the symptoms, level of its severity, risk factors, treatment and recommended specialist or care at home advice.

Facts and Features: The application offers the users to create multiple profiles and connect with a doctor by scheduling virtual or physical appointments. The app also helps its users to find the right specialist. It also lists out all the upcoming sessions with the doctor and a cure section to save the prescriptions by the doctor.

Fever Coach

Developed by	Launch Year	Key Users	Country of use
md Mobile Doctor	2015	Caregivers	

Introduction: Fever Coach is an android and iOS mobile app designed to help parents and caregivers manage fever in young children, currently mainly serviced in South Korea. The app analyzes data entered by a caregiver and provides tailored information for care of the child based on the child's age, sex, body weight, body temperature, and accompanying symptoms. The app also integrates telemedicine consultation and can be paired with the Fever Coach thermometer. The app generates alerts when parents need to check temperatures or give antipyretics and so on.

Triaging Mechanism: The triaging mechanism starts by entering the child's body temperature, symptoms and vaccination history, based on which the application provides an assessment if the child has a fever, the type and amount of fever-reducing medication to use, as well as the necessity of a hospital visit depending on the child's temperature and how it changes over time. Based on the data, the app can also potentially predict the type of illness the child may have contracted, including flu, bronchitis, pneumonia, laryngitis, or adenovirus infection and how to administer antipyretics, and information on whether or not to visit the hospital.

Facts and Features: According to a usability study conducted in 2019 for participatory influenza surveillance, Fever Coach app successfully collected data from 7.7% of the target population over a 1-year period, which is remarkably higher than participation rates of previously reported Web- or mobile-based participatory surveillance systems that reported participation rates between 0.02% and 0.13%[31].

[31] Kim, M., Yune, S., Chang, S., Jung, Y., Sa, S. O., & Han, H. W. (2019). The fever coach mobile APP for participatory influenza surveillance in children: usability study. *JMIR mHealth and uHealth*, *7*(10), e14276.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Doctor Diagnose (USA)

Developed by	Launch Year	Key Users	Country of use
Apps Collider	2013	Patients	Global

Introduction: This android application was developed by App Colliders in 2013 to support in assessment of the medical symptoms. It guides the users step-by-step through all the symptoms and offers advice and information about possible medical conditions.

Triaging Mechanism: The app provides a quick assessment and asks its users to select the symptoms from the list of symptoms embedded into it. At the end of the assessment, it provides the possible occurrence of a disease and further suggestions.

Facts and Features: Information about this tool was not available in public domain.

Web-Based Applications

Buoy's API

Developed by	Launch Year	Key Users	Country of use
buoy	2014	Patients	Global

Introduction: Buoy API is a symptom-checking and triage engine developed by Buoy, a Boston-based digital health company that uses AI technology to provide personalized clinical support for individuals with health concerns. It was developed out of the Harvard Innovation Labs by a team of doctors and data scientists in 2014.

Triaging Mechanism: The web-based application records user's health information and enters the symptoms and following recommendations are given by the app: Emergency care, Urgent care, Specialist care, Primary care, Telemedicine, Wait or self-treat, Unsure, Something else and None of the above.

Facts and Features: Buoy's artificial intelligence (AI) relies on an algorithm that's informed by medical models built on epidemiological data points.

Thermia

Developed by	Launch Year	Key Users	Country of use
Boston Children's	2014	Caregivers	Global

Introduction: Thermia is a fever and febrile illnesses management web-based application developed by Boston Children Hospital in 2014. It educates parents about potential underlying causes of symptoms, provides information on supportive treatment that parents can deliver at home, and uses the anonymized data to track disease and better understand population health.

Triaging Mechanism: The triage system includes entering the temperature of the child, age, weight, and other symptoms along with the current location, travel history and also considers questions related

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

to COVID-19. The app produces recommendations on whether to visit a doctor or stay at home and proceed with home care. It also lists all the home remedies one can take and the dose of medicines depending on the age of the patient.

Facts and Features: It can calculate the dosage based on age, weight, etc. The user can measure the correct amount of Tylenol or Ibuprofen to be given to the child.

Isabel Symptom Checker

Developed by	Launch Year	Key Users	Country of use
isabel	2012	Patients	Global

Introduction: Isabel symptom checker is a web-based application developed by Isabel Healthcare Limited in 2012. It has been used by healthcare professionals around the world for the past two decades. It covers over 6,000 diseases and users may include test results and any other chronic conditions such as diabetes or high blood pressure.

Triaging Mechanism: Upon entering the symptoms, a list of possible conditions will show which are linked to reference resources to allow users to learn more about the symptoms. The user then answers seven more questions and based on the answers, the system assigns a score to the condition using a color code system - **Green** implies seek home care, **Yellow** suggests see family physician or urgent care unit and **Red** is for seeking emergency.

Facts and Features: The tool uses machine learning and a training database of 6000 disease presentations. The symptom checker uses evidence-based natural language processing techniques to create a list of likely diagnoses ranked in order of relevance for the symptoms entered.

Symptify

Developed by	Launch Year	Key Users	Country of use
Symptify Symptoms Simplified	2013	Patients	USA

Introduction: Symptify is a web-based application for self-assessment developed by Symptify USA in 2013. It uses a customized algorithmic engine to help users educate themselves about causes of symptoms. It was created by combining the experience of multiple ER doctors.

Triaging Mechanism: The app's triage system allows the users to enter the symptoms as well as their demographic information, then answers series of questions regarding the symptoms and perform self-examination if necessary. At the end, the app produces an assessment report with possible diagnosis and description about it, needed medical tests, recommended treatment. The user can choose and check-in remotely with the best healthcare facility to get care according to their area of residence and the medical insurance plan.

Facts and Features: It helps patients narrow the causes of their symptoms, find the closest healthcare facility to go and can notify the selected facility by sending the patients record and schedule an appointment.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Everyday Health-Symptoms Checker

Developed by	Launch Year	Key Users	Country of use
EVERYDAY HEALTH	N. A	Patients	Global

Introduction: Everyday Health Symptom Checker is a web-based application developed by Everyday Health in partnership with Infermedica. The app assesses more than 1,500 symptoms and 800 conditions. All the medical content and clinical test cases are validated against a diagnostic engine to ensure the stability of the tool and then it is published to the cloud-based API and made available to all users.

Triaging Mechanism: The triaging mechanism starts by checking a set of symptoms at first for each patient which includes - history of pregnancy, obesity, smoking, recent injury, high level of cholesterol and hypertension and travel history in the last 12 months. Further, the user enters the symptoms as free text or select from the list or point at specific part of the body map and a list of symptoms is shown to choose from. The user then answers few more questions which includes a self-examination. At the end, the app produces an assessment report recommending immediate medical attention, self-treatment at home, or prompt medical attention

Facts and Features: Symptoms Checkers is a certified (CE marked class 1) and compliant with the European General Data Protection Regulation (GDPR).

Doctor Ai

Developed by	Launch Year	Key Users	Country of use
DOCTOR AI Diagnosis + Treatment + Cost Effectiveness	2019	Patients	Global

Introduction: Doctor Ai is an android and iOS mobile application developed by Doctor Ai, LLC in 2019. The app is used by both healthcare providers and patients. The app functions as a physician assistant for health care providers and works as a virtual assistant (Genie) for the patients and their families.

Triaging Mechanism: While working as a physician assistant, it rapidly and systematically processes patient symptoms, helps identify the correct diagnosis, suggests appropriate tests and evidence-based treatment, and generates the encounter note for the healthcare provider. While working as a virtual assistant, it allows patients to test their symptoms multiple times during the course of a certain disease development process. However, in case of complex critical medical conditions, patients are asked to visit an emergency room or ambulatory clinics for a face-to-face encounter.

Facts and Features: Along with symptom checking, the application also provides remote patient monitoring and telemedicine.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Section 4: Findings from Primary Research – Product introduction pathways

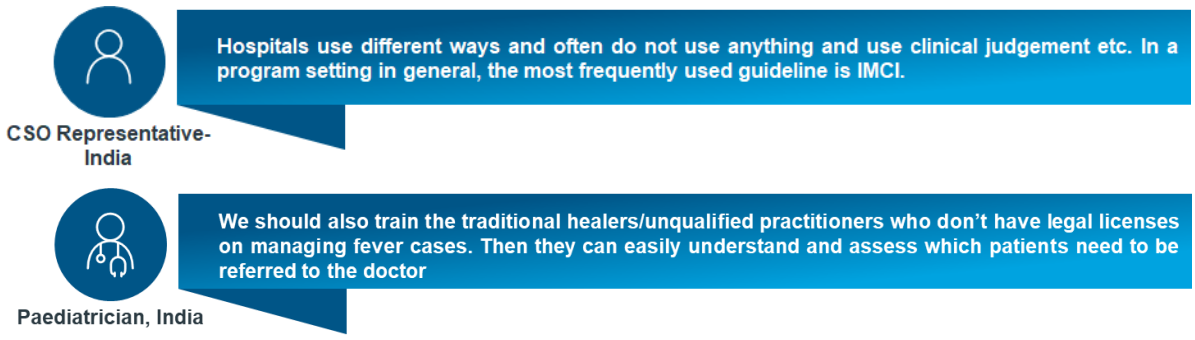
As part of this study, 19 key informant interviews were conducted in selected countries (Nigeria, India, Kenya) and with stakeholders representing international and multi-lateral agencies, local governments, in-country healthcare providers and industry experts. During these interviews, IQVIA assessed the current situation of AFI guidelines & digital tools, current process of implementation of such tools, key challenges, factors to successfully implement new guidelines and digital tools in the country.

4.1. Existing Tools/Guidelines for Severity Assessment and Triage

4.1.1. Current Paper-Based Tools

The assessment of the existing guidelines and digital tools indicates that **IMCI** is the most commonly used guideline not only for fever management but also for the management of the common illness in children. However, there were some differentiations between the selected countries, as highlighted below:

Nigeria	As per stakeholders interviewed, ICCM and IMAI guidelines are considered more practical to use than IMCI; however, IMCI is used more widely as it covers the management of children diseases.
India	IMNCI is the most commonly used guideline and is backed by Indian Council of Medical Research (ICMR). This guideline has been recently updated to focus more on the skill needed at each level, and the new version is about to be implemented.
Kenya	It was found that both IMNCI and ICCM guidelines are commonly used, however these guidelines are not followed in all the facilities due to limited resources of the printed charts needed for the assessment.



4.1.2. Current Digital (Web-based/ Mobile application) Based Tools

Although the results from the secondary research showed the availability of eCDAs tools in the selected countries, none of the study participants were aware about the implemented AFI tools.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Each country uses some digital surveillance or data management system. Although these are not AFI tools, but it is worth mentioning that knowledge about these digital systems were common among the participants. Some of the digital initiatives by the countries are listed below: -

Nigeria	Surveillance Outbreak Response Management and Analysis System (SORMAS platform)[32] is used for the management of infectious diseases in Nigeria to monitor infection outbreaks, follow-up cases and keep a check on the overall numbers and statistics of outbreak responses. The tool provides a complete triage system as well as integrates lab results for the assessment of cases. It also includes a geographic information system (GIS) module for the tracking of diseases outbreak.
India	Integrated Disease Surveillance Program (IDSP) is being used to strengthen the disease surveillance in the country. Under IDSP, a web-based near-real-time electronic information system "Integrated Health Information Platform (IHIP)" is used for data monitoring and managing disease outbreaks. It used by the ASHA and the ANM workers for the report of Malaria and Kala Azar cases.
Kenya	An e-Health strategy supported by e-health Africa has been in place to implement a digital health system DHIS (District Health Information Software) to collect and analyse health data. There is also a Community Health information system to support community health workers in collecting and managing of health data. Further, Kenya has developed TIMNCI tool which is a digital version of IMNCI guidelines.

Key Facts: In India, chemists and pharmacists are often the first point of contact when it comes to immediate healthcare services. This creates a national need to train these providers on IMCI guidelines, as fever patients often reach them first.

4.1.3. Key Users of the Tools and Place of the Implementation

As per the study, it was found that primary healthcare workers and community healthcare workers are the key users of paper-based and digital-based tools, as they are the first point of contact for primary healthcare services, especially in rural areas. They refer patients to secondary and tertiary care facilities based on the severity of the cases. It was noted that IMCI is also used in some of the referral healthcare facilities in Nigeria, India, and Kenya.

In India, IMCI guidelines are used at the facility and community level and key users of the guidelines are doctors, nurses, community health workers (Accredited Social Health Activist [ASHA] and the Auxiliary Nurse Midwives [ANM]).

[32] The SORMAS app was developed at Germany 's Helmholtz Centre for Infection Research in collaboration with international and national partners in response to the Ebola outbreak in West Africa in 2014. The app was also recognized by United Nations in November 2020 and considered to be relevant in efforts to achieve SDG by 2030.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

4.1.4. Process of Trainings of Healthcare Workers

The study showed that trainings for both paper-based, and digital tools are conducted before the implementation of the tools. Trainings are conducted in phases starting from national level stakeholders and cascade to sub-national level followed by community level. However, some differentiations in the training process and frequency were observed in the selected countries.

Nigeria	Trainings around clinical guidelines are usually conducted every two years for the new joiners. Refresher trainings are infrequent and are done depending on availability of funding and resources.
India	In case there is an updated version of the guideline, a new training workshop is organized by the MOH for the staff. For the minor updates, healthcare workers and community workers (ASHA and ANM workers) are re-oriented in their monthly meetings by the senior/ facility level staff.
Kenya	Most of the trainings are conducted by the international organizations that are working in the country such as Clinton Health Access Initiative, UNICEF, Global Fund while MOH works on adapting these guidelines to its policies.

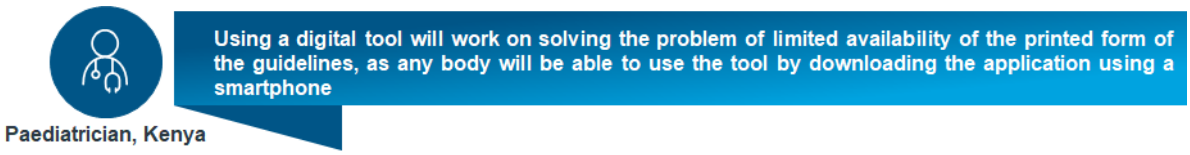
It's worth mentioning that in **Kenya**, there is a movement to develop a digital platform for trainings supported by universities and educational institutions to facilitate the scaling up of trainings across Kenya and overcome the gap in resources availability.

4.2. Implementation of Digital Tools

4.2.1. The Need of (e-CDA) Tools/Mobile Application

The results of the study confirm that healthcare workers expressed the need for digital AFI tools to support the fever case management at primary healthcare level. Most of the respondents also agreed that a user-friendly self-monitoring tool for patients will be helpful. Since access to the health facilities has been restricted due to COVID-19, these digital tools can be instrumental in educating and guiding the community on when to seek timely medical consultation and how to manage fevers at home. In **India**, it is expected that use of the digital tools will improve the capabilities of community healthcare workers (ASHAs) to provide high quality home-based care. While in **Kenya**, tools shall support in skill development of HCWs (by including e-learning features) and will also solve the problem of limited availability of printed forms of paper-based guidelines.

4.2.2. Openness of the Ministry to introduce e-CDA/Mobile application-based Tools for Severity Assessment/Triaging of Fever Cases



All the respondents have confirmed that the government is willing and open to introduce e-CDA/mobile applications-based tools for severity assessment/triaging of fever cases. A potential challenge might be funding of trainings and implementation at the sub-national level. If there is a donor or implementation agency supporting the tool, there should not be any resistance from the government. It was also

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

mentioned that it's imperative to involve MOH at the central level during the early stages for the approval of the guidelines for better acceptance at the sub-national and facility level.

4.2.3. Desired Features to be included in Digital AFI tool for Healthcare Workers

Key features stated by the respondents for successful implementation and sustainability of the tool at primary healthcare level are:

- **Easy to use and understand** regardless of user's level of education and medical background
- Should be **cost effective** as it will ensure the sustainability of the tool
- Based on a **clinical algorithm** to support healthcare providers in assessing, diagnosing and treating cases based on the entered symptoms
- **Severity triaging of cases and subsequent support in referral** of severe cases to higher level of healthcare. Tool should guide healthcare workers on how to manage such cases.
- Ability to work **online and offline** and syncing of the data that has been collected in offline mode whenever the network is available
- Application should be able to record body temperature of the patient over time and guide the healthcare worker on when and how frequently to measure body temperature. The tool should offer **next steps in case the temperature doesn't come down**

4.2.4. Desired Features to be Included in Self-Monitoring and Diagnostic Tools for Patients /Caregivers

Key features stated by the respondents, that must be available in the digital tools for self-monitoring tools for patients and caregivers are as follows:

- Should be easy to use and have a **user-friendly interface** that can be used by patients (in both urban and rural areas) with all kinds of smart phones (Android/IOS)
- Support patients/ caregivers in assessing their condition based on the entered symptoms and clearly recommend next steps using **color-based triage system** which may range between homecare, seek medical consultation, and seek emergency care immediately
- Should not promote self-treatment and only guide the patients to seek **timely medical advice**
- Provide **telemedicine** consultation
- Ability to work both **online and offline**
- Should be available in **local language**, not just in English
- For patients' tools, it should be **free** but allow additional paid services to be used by all socio-economic users

4.3. Current Process of Triaging and Severity Assessment of Fever by Healthcare Providers

Study highlights that ICMI/INCMI guidelines are used for fever management for children in primary healthcare facility, while at the community level, iCCM guideline is used by the community health workers. When a child with fever is brought at the PHC, healthcare provider examines and assess the illness based on the guidelines, then checks the vital signs like presence of skin rashes or whether the child is hydrated and observes gastrointestinal and respiratory functions. Based on the assessment, healthcare provider treats the child or guides the caregiver for homecare or refers to higher level of healthcare if needed.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

CSO Representative- India

So, if a child comes with whatever symptoms, you still ask them for fever, for cough or diarrhea, for skin conditions etc. Irrespective of the presenting complaint so a checklist is used. For instance, if the child has cough, then counting the respiratory rate is the next step- CSO Representative- India

It's worth mentioning that in **Kenya**, in hospitals, the most used guideline is WHO ETAT which is used for triaging emergency cases according to three different levels (Emergency, Priority and non-Priority cases)

4.4. Critical Bottlenecks or Roadblocks

4.4.1. Critical Bottlenecks for Implementation and Scale-up of AFI Tools in LMICs

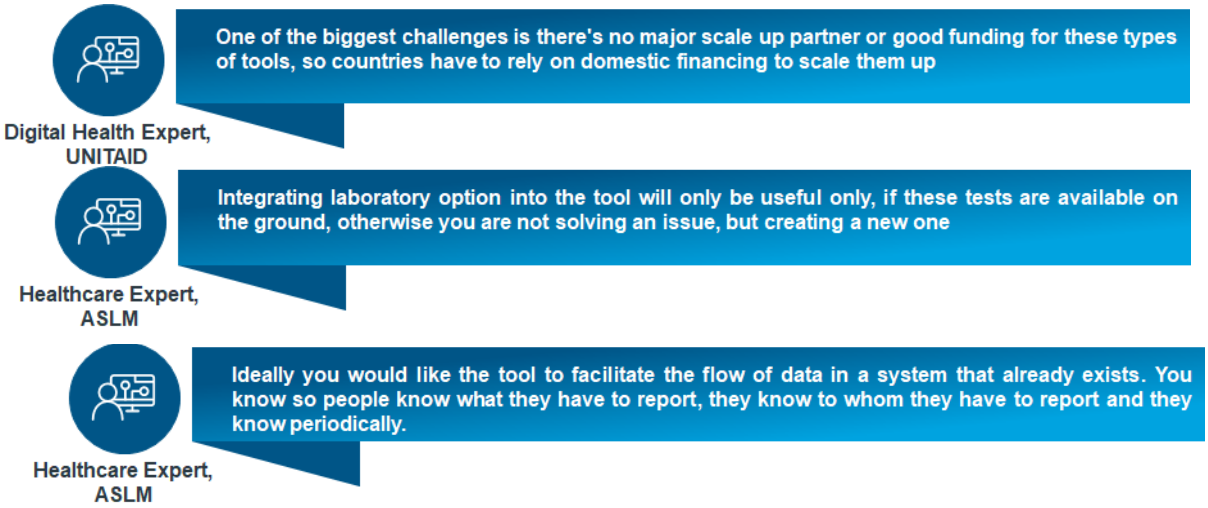
Key challenges are categorized into the following parameters:

Limited Awareness and Trainings	○ Lack of regular and refresher trainings for healthcare providers ○ Lack of awareness about the tool's objectives and goals ○ Lack of coordination and support from the Center ○ Lack of supportive supervision of healthcare workers in the field ○ Lack of funding to conduct the trainings at a large scale ○ Trainings disrupts services delivery in remote areas as number of healthcare providers are limited ○ Poor technical knowledge sharing/handover between the tool's developers and the local MOH IT team responsible for maintenance of the tool ○ Poor acceptance of any new tool among healthcare workers. Due to lack of trainings, they don't understand how it will improve case management. They also feel uncomfortable transitioning away from the existing processes
Lack of Manpower and Resources	○ Shortage of manpower, especially in remote areas ○ Limited availability of smartphones & internet, especially in rural areas ○ Lack of funding to support such projects and ensure its sustainability ○ Lack of IT infrastructure availability at healthcare facilities ○ Shortage of hard copies of paper-based tools ○ Complexity of paper-based guidelines for HCWs ○ Shortage in smartphones, internet connectivity among rural communities which limits the scaling up of implementation of home-based tools
Restricted Access to Higher Healthcare Services	○ In some rural and remote areas, access to secondary and tertiary care is limited ○ Shortage of well-trained healthcare providers
Conventional and Orthodox Community Behaviors	○ Attitude and acceptance of the community, as people in certain community prefer the traditional medicine than visiting doctors ○ Late presentation of the patients is one of key challenges at healthcare facilities, as caregivers tend to start treatment at home first and then if the fever continue, they bring the patient to the facility ○ Unwillingness of the community to use digital tools, especially the religious communities that provide healthcare services for large number of people

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Data Privacy Issues	○ The digital tool implemented in one state in India, faced issues around data privacy, as the tool captured a lot of information while assessment. So, this resulted in concerns regarding the implementation of the tool.
Poor Regulation and Planning	○ Lack of regulatory framework for the implementation of the digital tool which leads to discontinuity of the tool in the long-term ○ No partnership with MOH to implement the tool which makes the project stay in pilot phase and restricts any efforts towards scaling-up.

4.4.2. *A selection of quotes from the international organization regarding the key challenges of the implementation of tools*



Additional Factors Determining the Success of Introducing a New Tool

A. Stakeholder Engagement:

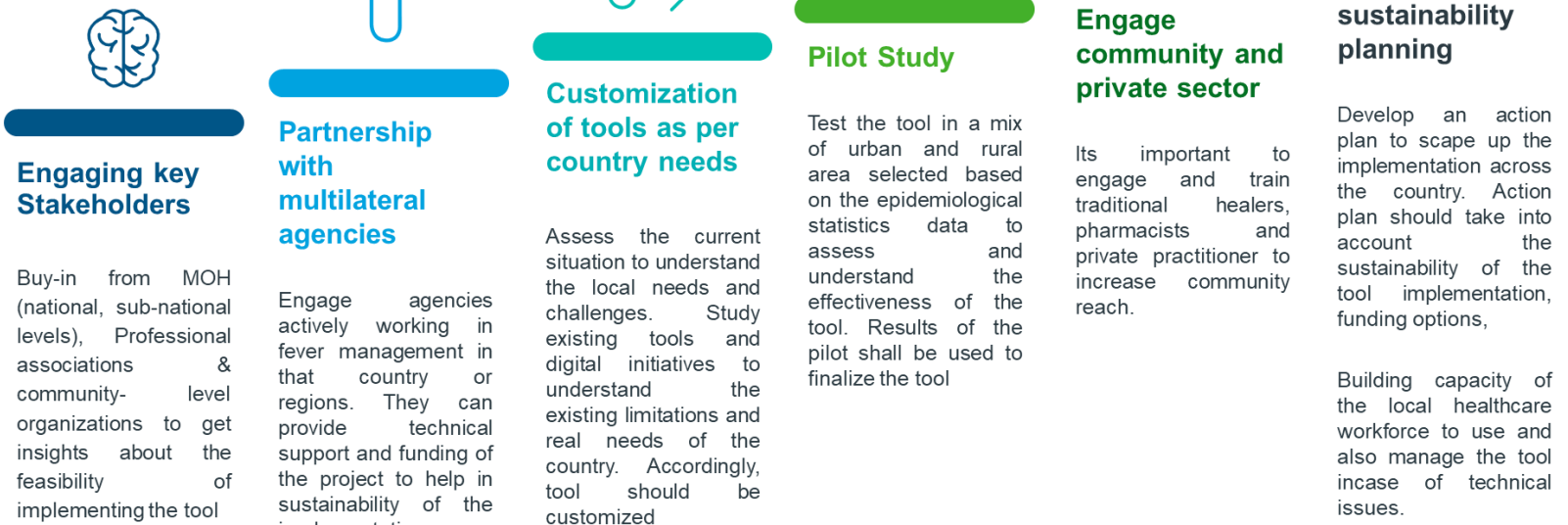
- Engaging with the private sector should be under regulations and framework to ensure the sustainability of the process.
- Engaging with healthcare stakeholders such as WHO Afro, and African CDC to provide the necessary support for tool implementation
- Communicating with health care provider associations/clinical associations who have worked in the field of AFI in the last few years is crucial. It might be equally critical to approach the WHO country offices and understand their willingness to digitize and simplify the ICCM guidelines.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

4.5. Product Introduction Pathway for an AFI Tool at a Country Level

4.5.1. Process of Introduction of a Product in a Country

Product Introduction Pathway suggested by the global and country level stakeholders



© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

4.5.2. Implementation Plan and Location:

- The pilot phase should be initiated in an urban area which has a rural area attached to it, to be able to gather different point of views and feedback as this will help gauge the level of demand of the tool.
- Progressive states or regions within the countries should be approached to check if they can model these tools around the management of fever and pilot them.

According to an expert from ASLM, "One of the key factors for successful implementation and scaling up of the tool is to customize the tool according to the epidemiology profile and needs of each country, as for example, the needs for West Africa is different from South Africa.

Further, the maturity degree of the healthcare system which includes the distance between the healthcare facility and patients, and the patients load, plays a huge role in designing the triage system of the tool."

It is recommendable to have the open source version of any such tool for countries to customize and implement them as desired.

B. Manpower and Work Resources:

- Upskill the healthcare workers especially in remote and rural areas; ensure regular and frequent trainings to increase the awareness about the tool's objectives, goals, and role in improving healthcare services
- Include the tool/guideline algorithm as a curriculum/course for undergraduate students
- Use train-the-trainer model to ensure the sustainability of trainings at the local level
- Ensure that the technology used to design the tool should be open source so the country can scale it up
- Simplify the training plans for the tools and depend on online trainings and e-learning platforms, in addition to frequent monitoring and support for healthcare providers
- Ensure that the tool is integrated into the existing healthcare system such as national health information system
- Provide on-the-job trainings and mentorship support to ensure consist monitoring and evaluation of the process
- Improve work environment in remote areas to increase manpower in these areas
- Ensure a stable electricity source for charging the digital devices in remote areas
- Promote behavior change communication activities to ensure increased usage of the tools among healthcare providers
- Create a link between primary healthcare level, secondary and tertiary level to share knowledge and impart management skills to healthcare workers around how to manage severe cases where there is limited access to secondary and tertiary care
- Increase the capacity building of local IT team on the algorithm and the technology used in designing the tool to ensure proper handover to the government and independency of the tool

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Conclusion

Several fever management guidelines/ paper-based algorithms and digital tools have been developed by WHO/UNICEF/ international donor agencies and other private providers to help in management of fever cases among sick children and triaging patients. However, there is lack of detailed information around the existing tools, their features and applicability in LMICs. This study provides comprehensive landscape analysis of the existing tools used for fever management in LMICs. Study also includes the tools patients and caregivers can use for homebased self-monitoring of AFIs.

Secondary research was conducted to map the existing AFI tools and understand the product/ introduction pathway in the LMICs. As per the results of the secondary research, 36 AFI tools were identified for detailed study (18 tools for healthcare workers at primary care level and 18 tools used by patients/caregivers at homes). Tools were further classified into paper based (7) and digital tools (29). Digital tools were further detailed and ranked to identify the most suitable tools for implementation in LMICs. Tools for healthcare workers and patients were ranked separately. For HCWs tool, the top 3 tools were **IeDA, ALMANACH and APE** while for patient tools, the top 3 tools were **Symptomate, Mediktor and Ada Check your health**

The secondary research was followed by primary research to understand the implementation process of these tools and guidelines, key barriers and enablers and key considerations while implementation in LMICs. Representatives from international and multilateral agencies and in-country stakeholders from Nigeria, India, Kenya were selected for interviews. Findings from the primary research has shown that **IMCI** guidelines are most commonly used in primary healthcare level. When assessing the current situation of the digital tools, it was found that although some digital initiatives currently exist for enhancing diseases management in the selected countries, there **is no awareness** about specific digital tools for AFI management.

The overall study has confirmed the **need for digital tools for AFI management** for both healthcare facilities and at patients' self-care level. However, there were a number of challenges that may affect the implementation and scaling up of these tools, such as, lack of resources and funding to ensure sustainability of the tool, shortage in skilled manpower because of poor trainings plans, poor internet connection in rural areas which limit the implementation of these tools and poor coordination between the interest/agenda of healthcare of the local government and the implementation organizations of the digital tools.

To overcome these challenges, innovative tools should be implemented to support the HCWs in LMICs. IQVIA team has drafted product introduction pathways based on the key results from primary research. The process of introducing a new tool in a country includes identification and engaging with relevant stakeholders, partnership with multilateral agencies, assessment of current need, implementation of pilots in urban areas than in rural areas and developing an action plan to scale up the implementation across the country. The additional factors determining the success of the product introduction includes upskilling healthcare workers, ensuring that the tool is integrated into the existing healthcare system such as national health information system, ensuring a stable electricity source for charging the digital devices in remote areas and promoting behavior change and communication activities among healthcare providers.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Section 5: Appendices

5.1. Scoring Process for selection of country

5.1.1. Indicator Description

Category	Indicator	Description
Usage of AFI tools	**Indicator 1:** Number of AFI Tools implemented by each country	The indicator shows that these countries are working on improving the fever case management with the help of existing technologies. They have experienced tool implementation process and can provide us with interesting insights on product implementation pathways, its key enables and barriers and may suggest the key requirements from AFI tools. They might be interested in adapting a new relevant technology.
Disease Burden	**Indicator 2:** Malaria incidence per 1000 population as risk **Indicator 3:** Children aged <5 years with Pneumonia symptoms taken to a healthcare provider.	Countries with high burden of fever and pneumonia are the ones where these tools will most useful. Prioritizing these countries will provide us with better insights on the key requirements from the AFI tools, current gaps in the existing tools and how to improve or build upon the existing technologies/ processes in these countries.
Political will and capacity of ministry of health	**Indicator 4:** Existence of health technology (medical device) national policy **Indicator 5:** Unit in the MOH responsible for management of medical devices	Existing national IT policy and departments in the MoH dealing with the medical divide implementation informs the country's willingness to accept and implement new and relevant technologies to improve the patient care. Selection of such countries will provide us with inputs on the key enables and barriers countries face when trying to implement digital initiatives.
Access to healthcare	**Indicator 6:** Health service delivery (hospital beds per 10000 population**)**	Countries with better health service delivery or hospital beds has been prioritized as we expect them to have a better referral mechanism. It's important to have higher referral units once the person is diagnosed or triaged by the AFI tool used by the patients or health care workers at the primary healthcare centers.
Deficit on skilled healthcare workers	**Indicator 7:** Skilled health workers per 10000 population	AFI tools support in guiding the patients at home where access to healthcare workers is limited. Further, these tools help the community health workers in the low resource settings areas to triage patients, conduct severity assessment and provide better care. Thus, the implementation will be more

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

		meaningful in countries with skilled healthcare worker deficit. This indicator has been selected to prioritize countries with deficit or low availability of skilled health workers.
Funding available for implementation of AFI tools	**Indicator 8:** GDP Per Capita (in USD) **Indicator 9:** External resources for health as a percentage of total expenditure on health	These indicators inform us about the funding capacity of these countries in case new tools has to be launched in these geographies. Prioritizing these countries for the primary research will support our investigation around funding mechanisms of the tool.
Readiness of population to accept digital AFI tools	**Indicator 10:** % of population using internet (2016)	It's important to understand the level of adoption of technology by general population. Understanding the trends of internet usage by population provides us as a good proxy to the countries level of acceptance in case a digital or online tool is launched. We prioritized countries with better internet usage as these could generate relevant insights on the tool implementation pathways.
Existing priority countries of find	**Indicator 11:** Countries of interest for FIND	Since FIND is currently working in many countries to improve the fever case management. It makes sense to pick countries where FIND has existing connects and intel about the country's requirements.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

5.1.2. Indicator Ranking Process

S.no	Indicator name	Ranking system	Sources
1	**I1**: # Number of AFI tools implemented in the country	As per the findings of IQVIA Landscape analysis, country with a greater number of AFI tools implemented were given the higher rank. Country with the highest number of tools identified was ranked 1 and rest with higher ranks subsequently.	As per the findings of landscape analysis by IQVIA
2	**I2:** Malaria incidence per 1000 population at risk	Country with high incidence of malaria prevalence, was given the highest rank (1) and country with low incidence of malaria was given the lowest rank (10)	World malaria report 2020
3	**I3:** Children aged <5 years with Pneumonia symptoms taken to a healthcare provider	Country with high prevalence of pneumonia symptoms was ranked the highest (1) while the country with low prevalence of pneumonia symptoms was given the lowest rank (10).	The Global Health Observatory, WHO
4	**I4:** Existence of health technology (medical device) national policy & **I5:** Unit in the MOH responsible for management of medical devices	Countries with an existing health technology national policy and Unit in MoH were ranked 1 Countries with either an existing health technology or Unit in MoH were ranked 5 Countries with no health technology national policy and no unit in MoH were ranked 10	The Global Health Observatory, WHO
5	**I6:** Health service delivery (hospital beds per 10000 population)	Country with highest hospital beds availability was given the highest rank (1) while the country with lowest hospital beds availability was given the lowest rank (10)	The Global Health Observatory, WHO
6	**I7:** Skilled health workers per 10000 Population	Country with least number of skilled health workers was given the highest rank (1) while the country with high skilled health worker was given the lowest rank (10)	The Global Health Observatory, WHO
7	**I8:** GDP Per Capita (in USD)	Country with high per capita GDP was given the higher rank (1) while the country with low per capita GDP was given the lowest rank	World Development Indicators, The World Bank
8	**I9:** % of population using internet (2016)	Country with highest internet usage among its population was given the highest rank (1) while the country with the lowest internet usage among its population was given the lowest rank (10)	World Development Indicators, The World Bank
9	**I10:** External resources for health as a percentage of total expenditure on health	Country with highest funding was given the highest rank (1) while the country with lowest funding was given the lowest rank (10)	The Global Health Observatory, WHO
10	**I11:** Countries of interest for FIND	Countries of FIND's interest were given rank 1 while the others were given rank 10.	IQVIA-FIND Project Meeting dated 19/05/2021

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

5.1.3. Country Selection Framework

Country	Regions	I1		I2		I3		I4 & I5			I6		I7		I8		I9		I10		I11		Total Score and Final Rank	
		Value	Rank	V	Rank	Value	Rank	Value	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	SUM	Overall Rank	Regional rank
Tanzania	**East Africa**	7	1	111	7	37	9	Yes	Yes	1	29	1	4	3	1122	5	14	9	35.9	3	Yes	1	40	**2**	**2**
Rwanda	**East Africa**	2	5	366	2	45	7	Yes	Yes	1	16	2	9	7	820	7	20	3	46.2	2	Yes	1	37	**1**	1
Malawi	**East Africa**	5	2	208	6	77	1	Yes	Yes	1	13	4	4	2	411	10	11	7	73.8	1	No	10	44	**3**	3
Kenya	**East Africa**	3	4	57	8	63	4	No	Yes	5	14	3	18	8	1817	4	17	5	27.6	5	No	10	56	5	4
Nigeria	**West Africa**	2	5	303	5	69	2	No	Yes	5	5	7	18	9	2223	1	26	1	6.7	9	Yes	1	45	4	**1**
Burkina Faso	**West Africa**	2	5	387	1	44	8	No	No	10	4	8	7	5	787	8	14	6	25.3	6	Yes	1	58	6	2
Mali	**West Africa**	2	5	334	4	58	6	No	Yes	5	1	10	5	4	879	6	11	8	27.8	4	No	10	62	7	3
Niger	**West Africa**	4	3	343	3	59	5	No	Yes	5	4	9	2	1	554	9	4	10	21.3	7	No	10	62	7	3
Bangladesh	**Asia**	2	5	1	10	31	10	No	No	10	8	5	8	6	1855	3	18	4	11.8	8	No	10	71	8	2
India	**Asia**	2	5	4	9	69	3	Yes	Yes	1	5	6	29	10	2099	2	22	2	1.0	10	Yes	1	49	5	**1**

All the Indicators are ranked based upon their value.

All the Ranks were then summed up to create an overall score and ranking

Separate Ranking for each region was created
One country is selected from each region for the primary interviews; except in east Africa, where Rwanda scored highest, but we picked Kenya as it has implemented good number of tools as per IQVIA desk research findings. Another reason of shortlisting Kenya in East Africa region is that IQVIA has an operational presence in the country .

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

5.2. Details of the Respondent

Sl.no	Country	Designation of the respondent	Designation
1	HQ Level	Director- Science and New Initiatives	Director- Science and New initiatives - ASLM
2		Technical Officer- Strategy Team	Strategy Team - UNITAID
3	Nigeria	Sub-National Program Manager- Malaria Program	Ministry of Health, Nigeria
4		Chairman	Association of Community Health Practitioners (State Chapter)
5		Child Health/Digital Health Units	WHO Nigeria
6		Pediatrician and member	Pediatric Association of Nigeria
7		Member	e-Health Africa
8	India	Pediatrician	Max hospital
9		CSO Representative (Co-founder)	Basic Healthcare services
10		Consultant	Gates Ventures
11		Senior Manager, Healthcare Information Technology and Telehealth	Sri Sathya Sai Central Trust
12		Consultant	World Health Organization, India country office
13		Deputy Director- Health & Nutrition	Save the Children
14	Kenya	Pediatrician & Clinical Epidemiologists	KEMRI
15		Health Specialist	UNICEF Kenya Country Office
16		Program Manager	Newborn Child and Adolescent Health Unit, MoH Kenya
17		Chair	Kenya Pediatric Association
18		Associate Director	Evidence Action
19		IT & Management Consultant	Division of National Malaria Programme, MoH Kenya

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

Global agencies working in AFI.	• **Existing guidelines/eCDA implemented in the country** • **Need for implementation of AFI tool** • **Need of better fever management tools to be implemented across LMICs** • **Key feature of tools to implemented across LMICs** • **Countries where these guidelines should be implemented** • **Level of implementation of such a solution** • **Critical bottlenecks for implementation and scale-up of AFI tools in LMICs** • **Critical bottlenecks for implementation of AFI tool for home users** • **Ideal approach if one wants to implement such tools in an LMICs** • **Factors determining the success of tools across the LMICs.**

5.3. Indicators/ parameters used for scoring and ranking the digital tools for HCWs

Sl.no	Indicator	Scoring criteria	Reason for selection
1.	Implemented in LMICs	Yes – 1 No – 0	Tools which are currently in use in LMICs will be easier to customize
2.	Used specifically for fever management and triaging	Yes – 1 No – 0	Tools designed specifically to manage fevers are more comprehensive and easier to customize
3.	Works both offline and online	Yes – 1 No – 0	As health facilities in LMICs may not be equipped with internet, having an offline tool makes the implementation easier
4.	Tool is implemented in multiple countries	Yes – 1 No – 0	If the tool is already implemented in multiple countries, it proves its ease of use and acceptance among the HCPs
5.	Availability of e-learning module	Yes – 1 No – 0	Tools with inbuilt learning modules are easier to implement as users can self-train themselves. It helps save training cost
6.	Tool is currently in use	Yes – 1 No – 0	Some of the tools assessed are not in use due to lack of funding by the government and developer. The tools currently in use are more reliable for selection
7.	Tools is available in open source	Yes – 1 No – 0	Tools available as open source are much cheaper and easier to implement.
8.	Tools with additional feature of integrating POCTs (atleast mRDTs)	Yes – 1 No – 0	Malaria being the common cause of fever in LMICs and mRDTs being the basic of fever diagnosis, this feature is useful for AFI applications
9.	Tools following IMCI/ICCM guidelines	Yes – 1 No – 0	Tools following the standard treatment guidelines and algorithms are preferred as these algorithms are more reliable.

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.

10.	Years of existence	Pilot Phase- 0 0-2 years - 1 2+years - 2	Tools which have already been implemented for two years more are more reliable as they have been used, tried and tested by the countries

5.4. Indicators/ parameters used for scoring and ranking the digital tools for patients and caregivers

Sl.no	Indicator	Scoring criteria	Reason for selection
1.	Implemented in LMICs	Yes – 1 No – 0	Tools which are currently in use in LMICs will be easier to customize
2.	Used specifically for fever management and triaging	Yes – 1 No – 0	Tools designed specifically to manage fevers are more comprehensive and easier to customize
3.	Free to use	Yes – 1 No – 0	Free tools will be accepted more easily by the population in LMICs
4.	Provide Educational information	Yes – 1 No – 0	Tools with in-built educational content are more effective as they better equip patients to manage fevers and childhood illnesses
5.	Technology Platforms	Web and mobile based application - 2 Mobile application only- 1 Web-Based only – 0	Tools on multiple platforms have better reach to the population, that's why they are scored higher
6.	Operating systems (Android/IOS)	Both Android and IOS -1 Either Android or IOS- 0	Tools available on both android and IOS are scored higher due to better population reach
7.	Telemedicine	Yes – 1 No – 0	Tools providing referral channels and doctor's appointment over app are preferred as they complete the treatment cycle.
8.	Multi Languages	Yes – 1 No – 0	Tools supporting multiple languages are preferred due to better reach

© 2021. All rights reserved. IQVIA® is a registered trademark of IQVIA Inc. in the United States, the European Union, and various other countries.