Supplementary File 1: First draft (v.0) of the target product profile prepared by KP, SD, RS, ZK, FM, and GLM and shared prior to the FIND/WHO workshop in November 2018

SCOPE GENERAL			
CHARACTERISTIC	**MINIMAL REQUIREMENT**	**OPTIMAL REQUIREMENT**	**COMMENT**
Intended Use	The toolkit, comprised of an electronic clinical decision support algorithm on mobile device and point of care diagnostic tests, is intended to increase evidence-based treatment decisions by capturing diagnostic test results, patient clinical data (i.e. temperature, respiratory rate, oxygen saturation) and context specific data (i.e. disease incidence, seasonality) to provide treatment and care recommendations		
Target Population	— Children under 59 months of age presenting at health facilities, or — Children 2 - 59 months of age presenting at health facilities, or — Adolescents presenting at health facilities, or — Adults presenting at health facilities	Anyone presenting at a health facility	The minimal requirements are based on currently available WHO clinical care guidelines that have been developed for specific age groups. The optimal requirement allows for anyone who shows up at a health facility to be assessed using an appropriate algorithm.
Setting (level of implementation in the healthcare system)	First level primary care settings where no or minimal laboratories are available (Level 1)	Same, and community settings outside health facilities (Level 0)	Healthcare level is defined as in Ghani *et. al*., 2015[i]
Targeted End User	Health care worker at first-level primary care settings (includes nurses, clinical officers, medical and physician assistants)	Same, and community health care workers	A healthcare worker, depending on the setting, can be a laboratory technician or a nurse and both can be using the toolkit- especially in places where diagnostic testing is performed in a laboratory and the consult by a nurse

SCOPE TOOLKIT COMPONENTS			
CHARACTERISTIC	**MINIMAL REQUIREMENT**	**OPTIMAL REQUIREMENT**	**COMMENT**
Diagnostic Tests and Other Relevant Medical Devices	POCs[1] or other relevant medical devices prompted for use by the app shall be locally relevant, i.e. recommended by EDL or relevant national equivalent, or country program	Same and newly emerging diagnostic tools and medical devices relevant for the targeted settings	
Algorithm/Decision Logic	Based on a WHO guideline decision tree (i.e. IMNCI[2], iCCM[3], IMAI[4]) adaptable to country context and use cases	New decision logic (such as probabilistic algorithms) adaptable to different country context and use cases, and approved by the local government	
Therapeutic Guidelines	Therapeutic recommendations shall be compliant with national treatment guidelines and national EML[5]	Same and the app shall provide recommendations that support antimicrobial stewardship	
Compatible Devices	— Smartphone — Tablets — Computers		Computers are included as it may be necessary for health facility supervisors to access data collected at the facility level to make informed decisions (i.e. restocking medical supplies)
Compatible Operating Systems	Android for smart phones and tablets and windows for computers	OS[6] agnostic	

[1] POC : Point of Care diagnostics
[2] IMNCI: Integrated Management of Neonatal and Childhood Illness
[3] iCCM: integrated Community Case Management
[4] IMAI: Integrated Management for Adolescent and Adult Illness
[5] EML: Essential Medicines List
[6] OS: Operating System

FUNCTIONAL CHARACTERISTICS			
CHARACTERISTIC	**MINIMAL REQUIREMENT**	**OPTIMAL REQUIREMENT**	**COMMENT**
External Interface	The electronic clinical decision-support algorithm is accessible through an App downloaded on the compatible target devices		
Data Access and Transparency	All data collected via the App is visible to the App owner (i.e. the healthcare programme or research establishment) and available for transmission. The owner has control over the destination and content of all transmissions (no hidden data feeds to other opaque destinations).		
Access	The App should have publicly available standards based interface to allow transmission of data to user configured destinations (such as in-country lab information management systems	Open source	Open source: the software code is available for use and modification
Interoperability (Ability for systems to exchange data and subsequently present data to the user)	Data is structured, and uses commonly used, machine readable formats		The app shall ideally interoperate with country relevant systems such as HIS, EHRs, national registries and surveillance systems. However, interoperability will vary from one country to the next. Therefore the data needs to be accessible and formatted for integration into different systems
Configurability	— Language: UN official languages — Local time — Local weights and measures	— Language: option to customise into country official language — Local time — Local weights and measures — Other country preferences	Language can be a major barrier for the proper use of the tool for patient management and can lead to errors and misinterpretation
Clinical Data Entry	Manual entry by the operator	Automatic upload—allows integration with built-in and third party Apps and devices	This allows external integration of other modules, Apps and devices
POC Data Inputs	Qualitative data such as positive/negative/invalid lateral flow test results	Same and quantitative data such as white blood cell count	This covers data from POCs that are inputted in the algorithm (i.e. RDTs, medical devices, biosensors)
Regulatory	POC diagnostic tests are regulatory approved and implemented in compliance with local regulations	All toolkit components are regulatory approved	

Machine Learning	None. The algorithm is static	Predictive model on cloud running in the back-end and not changing the decision logic Gating mechanisms are in place to trigger decisions for a change in the algorithm to go live	Minimal: Data is collected for ML[7] but the decision logic is not adapting. A new validated logic would be versioned and downloaded for use. Optimal: A gating mechanism is in place to allow a change in the algorithm to go live. Example: an alert algorithm for dengue is triggered based on historical surveillance data. The district officer approves the implementation of the change in the algorithm across the district
Updates and Versioning	Manual update of new App version	— Automatic re-synchronisation with the new App version in the back-end without disrupting the user workflow — Any algorithmic logic in the App can change without updating the whole App — Approved peripherals can change without updating the whole App	
Workflow	Sequential: begin and end one consultation before starting a new one	Simultaneous: start a new consultation while one is ongoing	Ideally the health care worker can send patient 1 to the lab for diagnostic testing and can begin consulting Patient 2. Patient 1's consult resumes when lab tests are available
Navigation	Sequential: the user follows a strict sequence of data input to reach a final recommendation	Non-sequential: the user can move in any direction through an assessment and change input data to reach a final recommendation	
Task Management	— No multitasking	— Multiple patient windows can be opened at a time by one user — Patient profile can be recovered based on user access rights — Task shifting capability (i.e. move from one age-specific algorithm to another)	
Follow up	Ability to retrieve patient information using patient registration information (i.e. anonymous patient ID)	Same and built-in function to send patient reminders via SMS or phone call	

[7] ML: Machine Learning

PERFORMANCE and SCALABILITY			
CHARACTERISTIC	**MINIMAL REQUIREMENT**	**OPTIMAL REQUIREMENT**	**COMMENT**
Evidence of Impact	1) Equivalent clinical outcome compared to existing guidelines, if changes are made to previously validated clinical algorithms, and/or 2) Equivalent adherence to clinical guidelines compared to existing guidelines, if previously validated algorithms are digitised	1) Improved clinical outcome compared to existing guidelines, if changes are made to previously validated clinical algorithms and/or 2) Improved adherence to clinical guidelines compared to existing guidelines if previously validated algorithms are digitised	
Disease Risk Likelihood	Based on pre-test probability	Based on a pre-test probability **and** POC positive/negative predictive values	Minimal: application of a test is based on prevalence, patient data and assumptions on the population that increases the likelihood of having a particular disease. Optimal: disease risk is based on both pre-test probability and diagnostic positive/negative predictive values
Patient Management Recommendation	Consultation data is summarised and actionable recommendations provided (treatment, referral, home care or follow up)	Consultation data is summarised and actionable recommendations provided (treatment, referral, home care or follow up) **and** the recommendation is captured	Optimal: the user can select and submit the treatment and care provided. This data is recorded and can be used to evaluate guideline adherence (agreement between diagnosis and treatment) and monitor antimicrobial use
Scalability	The App should allow high transaction volumes with complex workflows to cover primary care workforce at national scale		

DATA CHARACTERISTICS			
CHARACTERISTIC	**MINIMAL REQUIREMENT**	**OPTIMAL REQUIREMENT**	**COMMENT**
Data Capture	Text, numeric, image, audio, video	Same, and GPS, barcode, biometric	
Data Storage	Data is stored in a server/cloud accessible to high-level country authority on a web interface	Data is stored in a server within the country	
Data Flow	De-identified output data can be exchanged with different authorities with authorization by local authorities	De-identified output data can be exchanged with different authorities	
Data Reporting	Data export available from all target devices	Pre-built data reporting, analytics and dashboards are available with the App	The level of data manipulation, aggregations and reporting, should be sensitive to the device the App is running on. i.e. The computer App can be rich in functionality, the mobile App is optimised for data collection and transmission only
Data Provenance	Included	Same	Provides origin and processes applied to output data. When data is downloaded or shared, the version of the model is tagged so it is always clear how the data was obtained
Data Dictionary	Available, referencing standards used		Ensures indicators reported are uniform across different programs
Data Security & Privacy	The App shall operate under secure connectivity, which meet data protection and regulations of individual countries to avoid loss and corruption of sensitive data, and mitigate cyber-attacks, whether data is at rest or in transmission. Conforms to national privacy laws. Includes processes such as: — Two factor authentication — Authorization/Access Control — De-identified data — Data encryption		Encourages GDPR[8] (should no national data security policies exist) to ensure a system that: — preserves data integrity — identifies and mitigates risks — provides relevant parties clear security processes
Standards and Terminologies	Conforms to currently recognised ICT[9] standards such as HL7[10] and FHIR[11] and disease and health terminologies such as SNOMED[12] and ICD[13]		

[8] GDPR: General Data Privacy Regulation
[9] ICT: Information Communication Technology
[10] HL7: Health Level Seven International 7
[11] FHIR: Fast Healthcare Interoperability Resources
[12] SNOMED: Systematized Nomenclature of Medicine
[13] ICD: International Classification of Diseases

OPERATIONAL CHARACTERISTICS			
CHARACTERISTIC	**MINIMAL REQUIREMENT**	**OPTIMAL REQUIREMENT**	**COMMENT**
Training	— Live training for the App — Live training for POCs by local authority	— Remote training and/or remote "Train the Trainer" for the App component — Live training for POCs by local authority	Health care workers may already be trained to use POCs but the input of the test result in the algorithm and interpretation of results may require additional training
User Access Rights	Provides access to specific data and App features for users with different roles		Roles may include: data manager (facility supervisor) or data entry person (nurse)
Expert Support	None	Built-in access to online/remote expert advice to assist in patient consultation via SMS, audio call, video conferencing	
Internet Availability	— Functions with zero connection — Allows automatic resynchronisation	Same and trigger alerts on user device when data has not been synchronised for a long time	Internet connection can be very instable therefore the tool should work in offline mode so as to not disrupt the workflow of the user

COST, LICENSING, PROCUREMENT CHANNELS			
CHARACTERISTIC	**MINIMAL REQUIREMENT**	**OPTIMAL REQUIREMENT**	**COMMENT**
Procurement Model	— Individual components of the toolkits can be procured directly by a MoH[14] and through global procurement agencies — Maintenance support services — End-of-Life services	— Toolkit components are bundled and available via global procurement agencies[15] — Maintenance support services — End-of-Life services	

[14] MoH : Ministry of Health

[15] Examples of Global procurement agencies: UNICEF Supply Division, ASRAMES DRC, and CHMP Kenya

References

[i]Ghani AC, Burgess DH, Reynolds A, Rousseau C. Expanding the role of diagnostic and prognostic tools for infectious diseases in resource-poor settings. Nature. 2015;528(7580):S50–2. Epub 2015/12/04. pmid:26633765.