WHO SMART Guidelines Overview

13 November 2024

Department of Digital Health and Innovations

As countries move forward with digital transformation, there is a need for guidance for technology parties to ensure quality of digital health solutions

WHO develops guidelines using global evidence base.

Ministry of Health *[Health programme managers]* adapts global guidance into national policy, procedures, protocols, and data requirements.

Technology partners *[Digital health teams within Ministry of Health, Digital transformation agency, external vendor]* translate national policies into digital solutions.

Health workforce delivers health services and conducts reporting according to national policies.

Health service users access person-centered care according to national policies

- **Difficult to scale**

- **Systems are not interoperable**

- "**Black box**" digital systems become **difficult to maintain** and unsustainable

- **Lack of a shared language** for programme needs for digital systems

- Systems not designed in a human-centred way

Components of digital health implementations

**Determined by health programmes
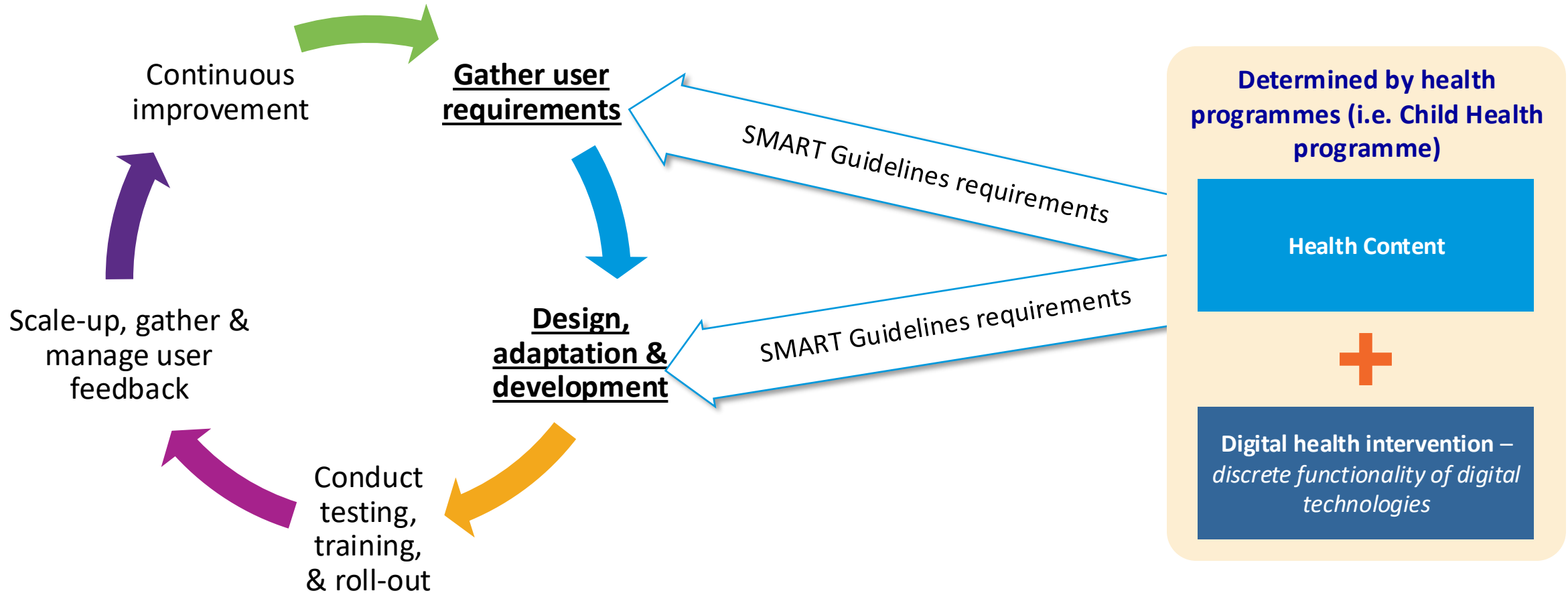(i.e. Child health programme)**

Health Content

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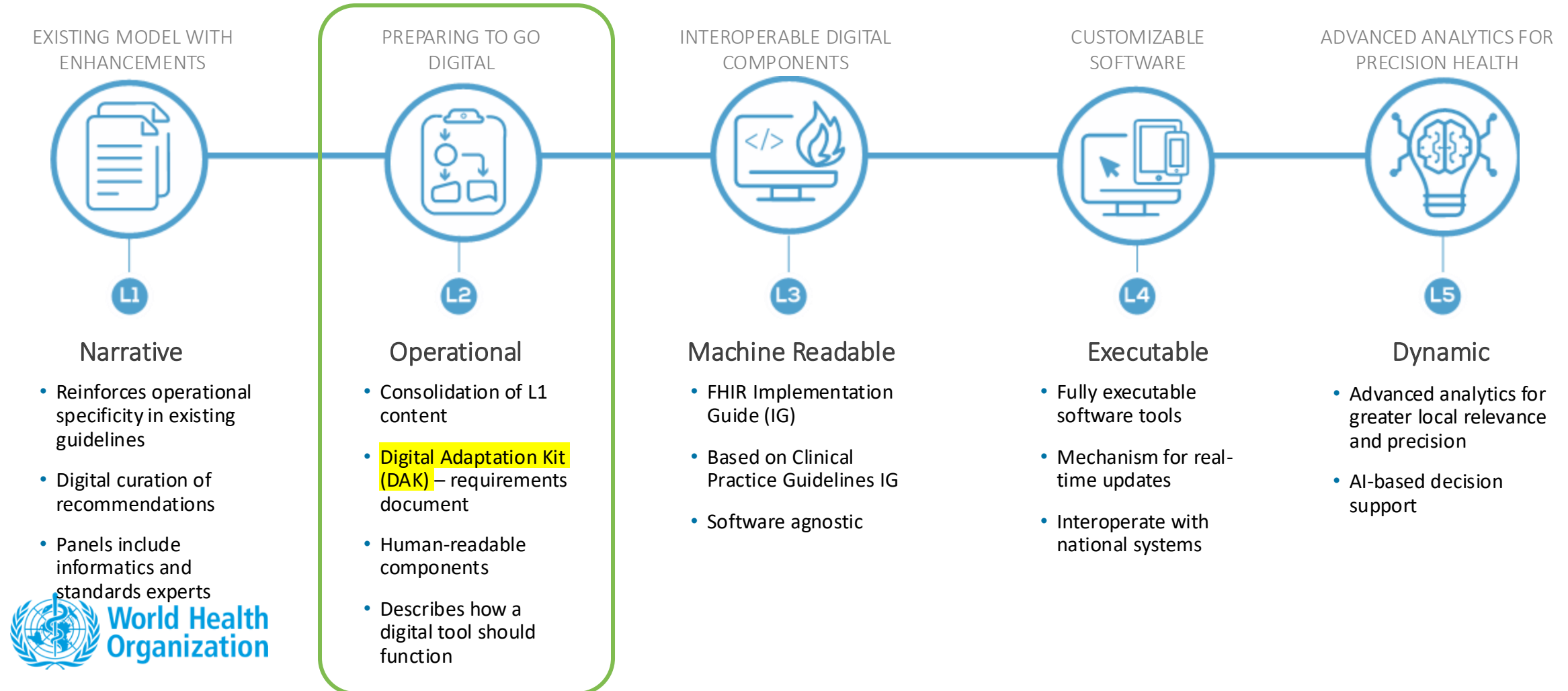**Digital health intervention** – *discrete functionality of digital technologies*

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Digital services & applications *– digital channel for delivery of the implementation*

World Health Organization

SMART Guidelines intervene at critical steps in the software development lifecycle moving from duplicative development to "building blocks"

Continuous improvement

Gather user requirements

Scale-up, gather & manage user feedback

Design, adaptation & development

SMART Guidelines requirements

SMART Guidelines requirements

Conduct testing, training, & roll-out

Determined by health programmes (i.e. Child Health programme)

Health Content

+

Digital health intervention – *discrete functionality of digital technologies*

*The software development lifecycle is the same for any and every technology, in any industry

World Health Organization

SMART Guidelines are a new approach to representing WHO content as digital health components to preserve fidelity and accelerate uptake

**S**tandards-based, **M**achine Readable, **A**daptive, **R**equirements-based, **T**estable

EXISTING MODEL WITH ENHANCEMENTS	PREPARING TO GO DIGITAL	INTEROPERABLE DIGITAL COMPONENTS	CUSTOMIZABLE SOFTWARE	ADVANCED ANALYTICS FOR PRECISION HEALTH
L1	L2	L3	L4	L5
Narrative	**Operational**	**Machine Readable**	**Executable**	**Dynamic**

- **Narrative**
  - Reinforces operational specificity in existing guidelines
  - Digital curation of recommendations
  - Panels include informatics and standards experts

- **Operational**
  - Consolidation of L1 content
  - Digital Adaptation Kit (DAK) – requirements document
  - Human-readable components
  - Describes how a digital tool should function

- **Machine Readable**
  - FHIR Implementation Guide (IG)
  - Based on Clinical Practice Guidelines IG
  - Software agnostic

- **Executable**
  - Fully executable software tools
  - Mechanism for real-time updates
  - Interoperate with national systems

- **Dynamic**
  - Advanced analytics for greater local relevance and precision
  - AI-based decision support

World Health Organization

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Scenarios of use

- Provide a **shared language** among stakeholders

- **Establish benchmark** and standards for systems in countries

- Kick start the requirements gathering process to design the system - **reduce time and resources**

- **Update and align within existing systems** content to WHO standards and guidance,
including **interoperability**

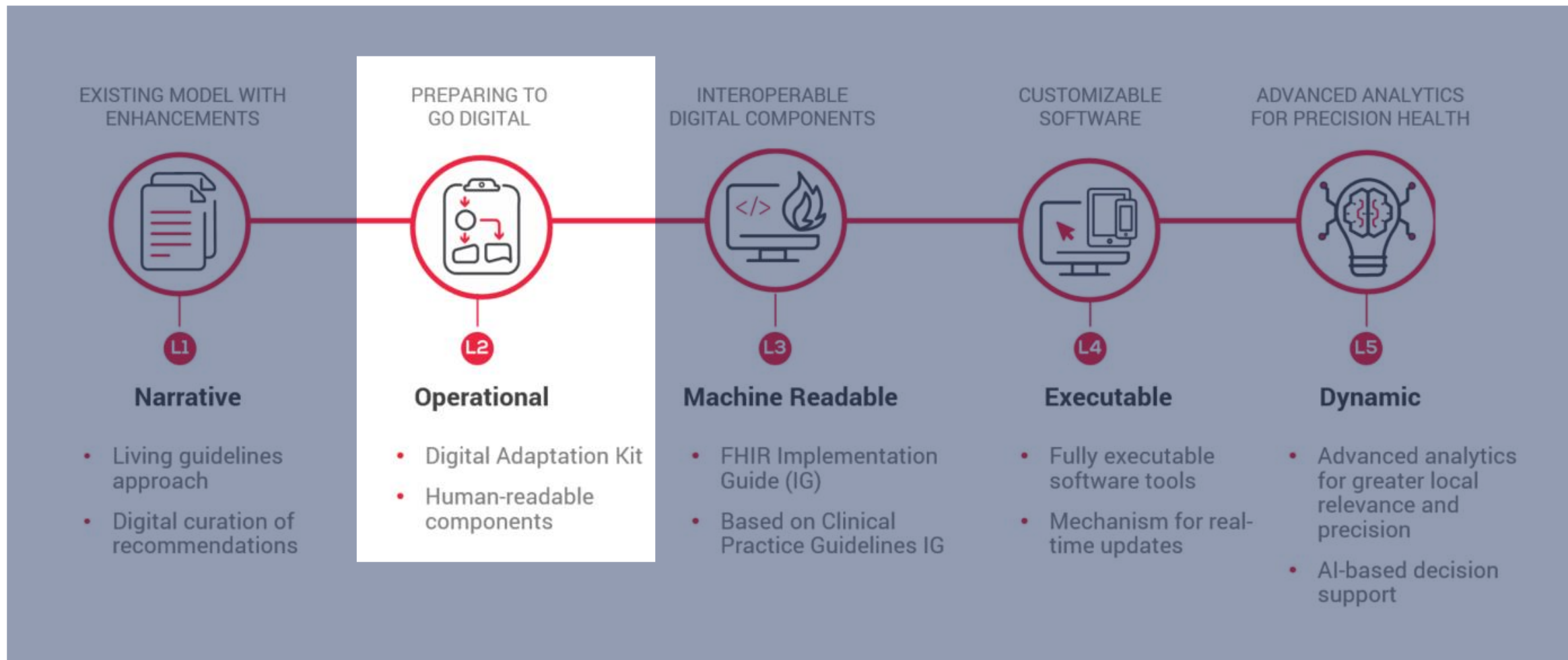- Update content to **improve efficiencies of analog processes** – reducing data collection

WHO SMART guidelines approach
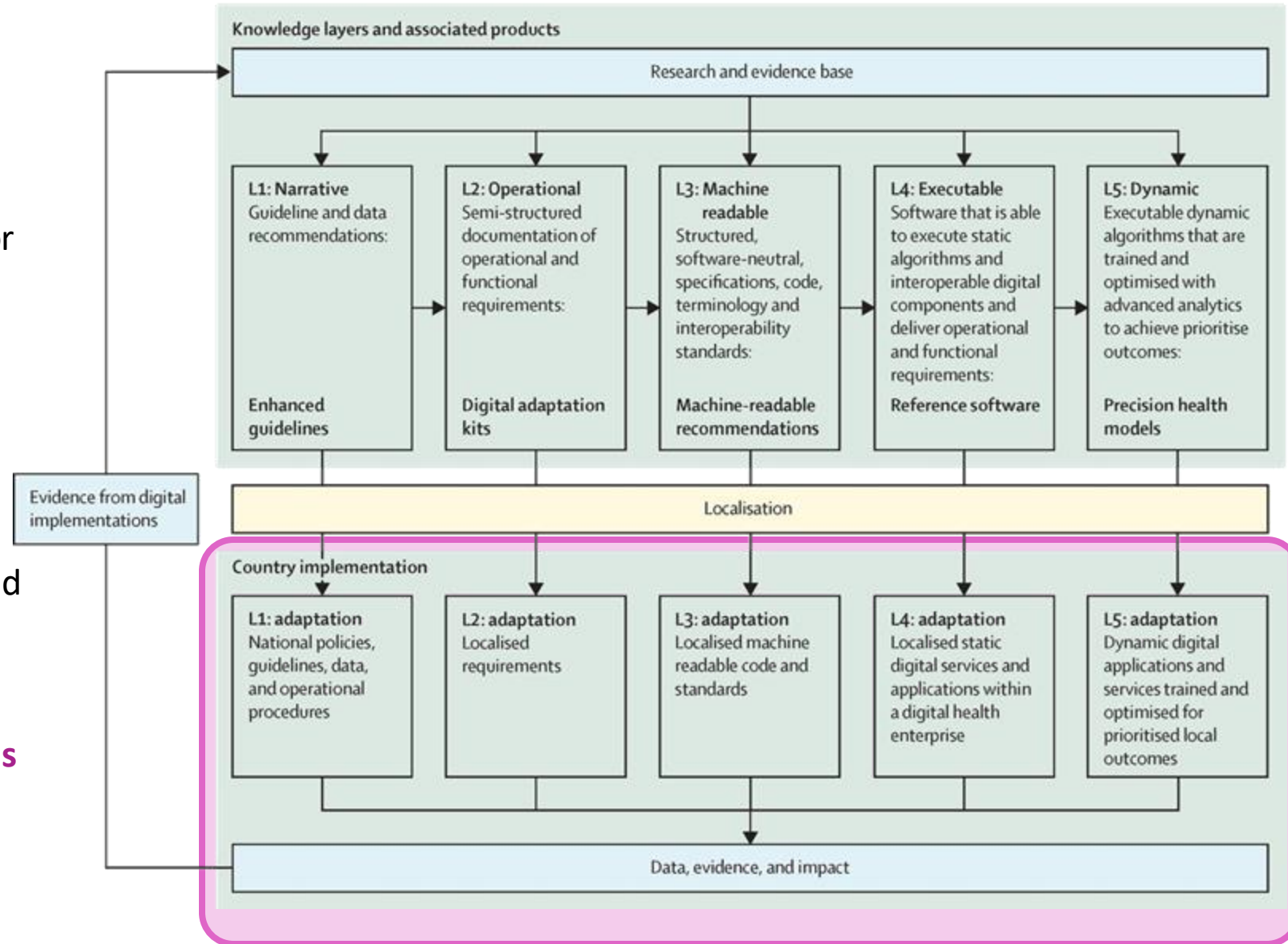
Thank you

This presentation has been designed to be accessible, for a positive and inclusive user experience for all.

For more information, please contact:
SMART@who.int

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SMART guidelines – Layer 2 DAK

Background to the DAK

- Part of '**Clinical Care in Crises**', with the goal:
  - to develop a WHO digital platform and reference application, to support **dissemination and implementation of WHO guidance** to improve health and development outcomes of **vulnerable populations in emergency settings**

SMART GUIDELINES

Digital adaptation kit for child health (0–59 months) in humanitarian emergencies

Operational requirements for implementing WHO recommendations in digital systems

World Health Organization

www.who.int/publications/i/item/9789240089907

Components of the DAK

Component 1.	**Health interventions and recommendations**
Component 2.	**Generic personas**
Component 3.	**User scenarios**
Component 4.	**Business processes and workflows**
Component 5.	**Core data elements**
Component 6.	**Decision-support logic**
Component 7.	**Indicators and performance metrics**
Component 8.	**High-level functional and non-functional requirements**

- Initial scope centred on assessment & management of sick children 0-59 months

- Based on IMCI

- Complemented by elements of other WHO guidelines

  - Incl. ETAT, Pocket book of hospital care for children, Wasting guidelines, Newborn care guidelines

Chart booklets

Integrated Management of Childhood Illness

Chart Booklet

World Health Organization — March 2014

INTEGRATED MANAGEMENT OF CHILDHOOD ILLNESS

MANAGEMENT OF THE SICK YOUNG INFANT AGED UP TO 2 MONTHS

2019 — unicef for every child — World Health Organization

Training materials

INTEGRATED MANAGEMENT OF CHILDHOOD ILLNESS

Participant Manual

MANAGEMENT OF THE SICK YOUNG INFANT AGE UP TO 2 MONTHS

2019

unicef for every child — World Health Organization

IMCI INTEGRATED MANAGEMENT OF CHILDHOOD ILLNESS

DISTANCE LEARNING COURSE

Introduction

Self-study modules

World Health Organization

- Description of end-users (health workers) & other relevant stakeholders
- Generic – based on WHO core competencies – to be contextualised by setting

Occupational title	Description	Different names	ISCO code *(24)*
Nursing professionals	Nursing professionals provide treatment, support and care services for people who need nursing care because of ageing, injury, illness or other physical or mental impairment, or potential risks to health, according to the practice and standards of modern nursing. They assume responsibility for the planning and management of the care of patients, including the supervision of other health workers, working autonomously or in teams with medical doctors and others in the practical application of preventive and curative measures in clinical settings.	Health worker Facility health worker	2221
Paramedical practitioners	Paramedical practitioners (including clinical officers and related) provide advisory, diagnostic, curative and preventive medical services more limited in scope and complexity than those carried out by medical doctors. They work autonomously	Clinical officer Primary care paramedic	2240

Name	Description	Different names (if relevant)	ISCO code (if relevant) *(24)*
Infant	Infants are less than 12 months old. A young infant refers to an infant younger than 2 months. They are the primary clients receiving health services from the targeted health worker personas. While this is a diverse population with different demographics and health needs, they generally have the following expectations: maintaining a healthy life for mother and baby (including preventing and treating risks, illness and death); maintaining physical and sociocultural normality; achieving positive infant health. The content specifications for infants and their carers will become even more important as additional client-side digital functionalities, such as targeted client communication (reminders), reporting of health system feedback and personal health tracking, are incorporated.	Infant/client/child	N/A
Child	A child is aged from 12 months up to 5 years. They are the primary clients receiving health services from the targeted health worker personas. While this is a diverse population group with different demographics and health needs, they generally have the following expectations: maintaining a healthy life (including preventing and treating risks, illness and death); maintaining physical and sociocultural normality; achieving positive childhood health. The content specifications for children and their carers will become even more important as additional client-side digital functionalities, such as targeted client communication (reminders), reporting of health system feedback and personal health tracking, are incorporated.	Child/client	N/A
Carer of infant/child	A person who gives care to an infant or child and can be considered the mother, father, adolescent mother, adolescent father, guardian or carer of the infant or child. They are the secondary clients receiving health services from the targeted health worker personas with respect to their infant or child. While this is a diverse population with different demographics and health needs, they generally have the following expectations: maintaining a healthy life for the infant or child (including preventing and treating risks, illness and death); maintaining physical and sociocultural normality for the infant or child; and achieving positive infant and child health. The content specifications for children and their carers will become even more important as additional client-side digital functionalities, such as targeted client communication (reminders), reporting of health system feedback and personal health tracking, are incorporated.	Caregiver	N/A
Medical secretaries	Medical secretaries, using specialized knowledge of medical terminology and health-care delivery procedures, perform several communication, documentation, administrative and internal coordination functions to support health workers in medical facilities and other health care-related organizations. They schedule medical appointments, record and review medical charts and correspondence, interview patients to complete case histories, prepare health insurance claims and acquisition orders, and supervise the work of other office support workers.	Facility staff	3344
Community health workers (CHWs)	CHWs provide health education, referral and follow-up, case management, and basic preventive health care and home visiting services to specific communities. They provide support and assistance to individuals and families in navigating the health and social services system.	Community health aide Community health promoter Village health worker Kaders (community volunteer)	3253

- Narrative description, illustrating how the tool is envisaged to be used in various examples relevant to 'real-world' contexts

Key personas	Mother : Aisha Child: Abbas Health worker

Aisha is a 23-year-old woman who has brought her two and a half year old son, Abbas, into a primary health care facility because Abbas has been sick for the last few days. The health worker asks Aisha if this is Abbas's first visit to this facility. Aisha says she took Abbas to this facility before when he was younger and had a different problem. The health worker asks the reason for today's visit and Aisha reports that Abbas has had a cough for a few days. The health worker looks for Abbas in the registered patients list in the tool, using his name and date of birth, and finds his profile. Abbas's profile already includes his basic demographic information, as well as information about Aisha and Abbas's father. The health worker selects Abbas's profile and starts a new consultation for Abbas.

The health worker now checks for any danger signs of severe illness that Abbas may be experiencing, as prompted by the tool. Abbas does not have any danger signs, so they proceed with the consultation. The health worker measures Abbas's temperature, weight, MUAC and height as prompted by the tool. The tool calculates the weight-for-height z-score and the weight-for-age z-score; both are normal (z-score = 0). The health worker is now prompted by the tool to check for symptoms of illness. Abbas has a cough, and when the health worker enters this into the tool, the tool suggests an additional question regarding the duration of the cough. The health worker asks Aisha how long Abbas has been coughing, and enters 4 days into the tool, based on Aisha's response. The rest of the symptoms are absent or normal. The next questions relate to the prevention and health promotion services Abbas has received. The health worker asks Aisha for her child's health record to determine his history of HIV counselling and testing, vaccination status, last doses of vitamin A and deworming. The health worker now looks for signs of illness by conducting a physical examination. The tool reminds the health worker to evaluate specific signs based on Abbas's age and his symptoms. These include respiratory rate and oxygen saturation. The health worker observes that Abbas is wheezing when he breathes. When the health worker measures his oxygen saturation, it is 89%. When the health worker enters this into the tool, a pop-up highlights that Abbas's oxygen saturation is very low and reminds the health worker to make sure that the measurement was performed correctly, to give oxygen if available and to quickly complete the assessment not to delay referral of the child. Once all the data and signs are entered in the system, the tool suggests that Abbas has severe pneumonia with wheezing. Based on what the health worker has observed, they agree with this diagnosis.

Pre-referral for treatment using intramuscular ampicillin and gentamicin and a fast-acting bronchodilator is suggested. The health worker arranges for Abbas to be referred. The health worker explains to Aisha that they believe Abbas has severe pneumonia and should be referred to the hospital for further treatment. He asks Aisha if she has any questions or concerns. The health worker saves the information about Abbas's visit in the tool.

Corresponding business processes (see **Component 4**)	This scenario refers to the following business processes: A. Search for the existing child B. Access and classify the child C. Treat the child

green *Functional / non-functional requirements*

yellow *Key data elements to be recorded / calculated*

blue *Decision-support logic automated by the system*
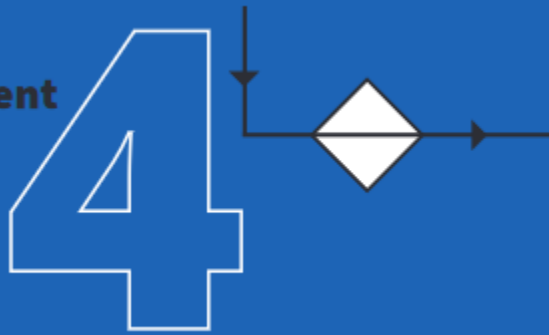
- Difference in workflow structure c.f. IMCI
  - Which goes back and forth between 'ask' to 'look, listen, feel' to 'classify' and 'treat' for each syndrome

- Workflow structured with grouping of elements
  - Life-threatening illness / danger signs
  - Measurements
  - Symptoms
  - Health promotion
  - Signs
  - Assessments & tests
  - Classification
  - Management
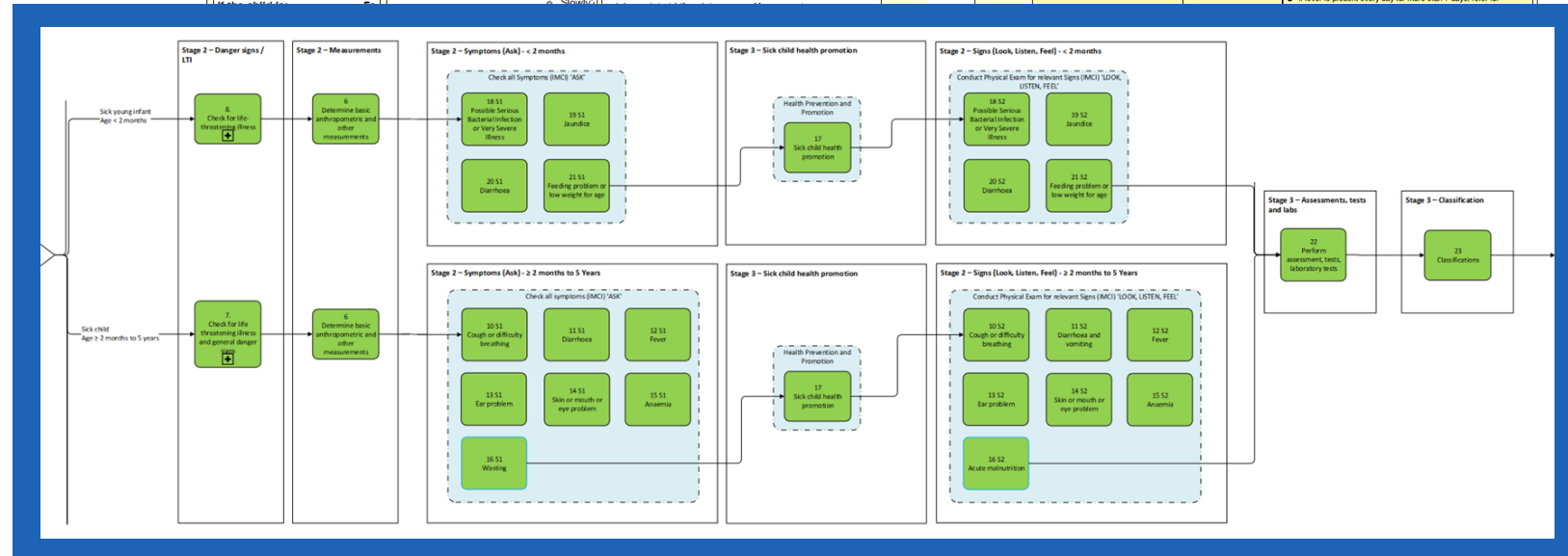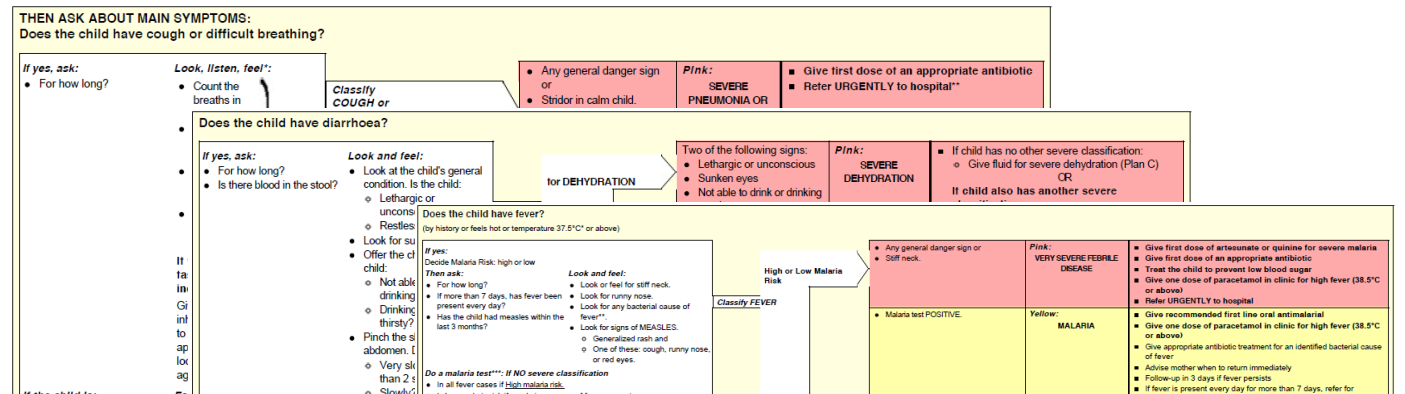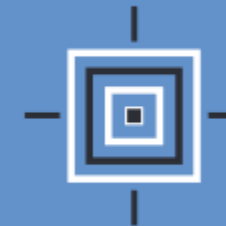
Core data elements

- Detailed, structured tables of all data elements, including:
  - Description / information
  - Type of data element (yes / no, multiple choice, select one)
  - Validation conditions
  - Required vs. optional
  - Conditional logic
  - Mapped (where possible) to ICD-11 / -10, LOINC, SNOMED CT
- Entered vs. derived
  - E.g. RR vs. fast-breathing

Data element label	Description and definition/user information	Data type	Input options	Calculation
Respiratory rate (breaths per minute)	**Count the number of breaths the child takes per minute** to determine if fast breathing is present. It is **very important that the child is calm** and still. If the child is moving or crying, you will not be able to get an accurate breath count. **To count the breaths per minute**, use a watch with a second hand or a digital watch. Look for the breathing movement anywhere on the child's chest or abdomen. Caution: The rise and fall of the chest or abdomen counts as one breath, not two. The number of breaths for **fast breathing depends on the child's age.** - Under 2 months: greater than or equal to 60 breaths per minute* - 2–11 months: greater than or equal to 50 breaths per minute - 12–59 months: greater than or equal to 40 breaths per minute *In young infants, a second measurement should be taken to confirm, unless there is already another sign of possible serious bacterial infection	Quantity	N/A	N/A
Fast breathing	Fast breathing is auto-calculated based on the respiratory rate and the child's age: - Under 2 months: greater than or equal to 60 breaths per minute* - 2–11 months: greater than or equal to 50 breaths per minute - 12–59 months: greater than or equal to 40 breaths per minute *In young infants, a second measurement should be taken to confirm, unless there is already another sign of possible serious bacterial infection	Boolean	- YES - NO	IF ("Age" <2 'months' and ("Respiratory rate Second count" ≥60 'breaths per minute') or ("Respiratory rate first count" ≥60 'breaths per minute' and "Respiratory rate Second count not possible" = TRUE) OR ("Age" ≥2 'months' and "Age" <12 'months' and "Respiratory rate" ≥50 'breaths per minute') OR ("Age" ≥12 'months' and "Age" <60 'months' and "Respiratory rate" ≥40 'breaths per minute')

IMCI chart booklet

Ask:
- Is the child able to drink or breastfeed?
- Does the child vomit everything?
- Has the child had convulsions?

Look:
- See if the child is lethargic or unconscious.
- Is the child convulsing now?

IMCI training materials

- ✔ Child is not able to drink or breastfeed
- ✔ Child vomits everything
- ✔ Child has had more than one convulsion or prolonged convulsions, or is convulsing
- ✔ Child is lethargic or unconscious

DAK data dictionary

Convulsion(s) in this Illness	The child has had one or more convulsions. During a convulsion, the child's arms and legs stiffen because the muscles are contracting. The child may lose consciousness or cannot respond to spoken directions. Use words the caregiver understands. For example, the caregiver may call convulsions "fits" or "spasms".
Number of convulsions in this Illness	
One Convulsion	The child has had one convulsion in this illness.
Two or more convulsions	The child has had two or more convulsions in this illness.
Convulsion(s) lasting 15 minutes or longer	The child has had one or more convulsions lasting 15 minutes or longer.

IMCI chart booklet

Does the child have fever?

(by history or feels hot or temperature 37.5°C* or above)

Look and feel:
- Look or feel for stiff neck.
- Look for runny nose.
- Look for any bacterial cause of fever**.

**Look for local tenderness; oral sores; refusal to use a limb; hot tender swelling; red tender skin or boils; lower abdominal pain or pain on passing urine in older children

DAK data dictionary

Pain	The child is reported to have or appears to be in pain. It is important to assess for pain that could be a sign of a source of infection when the child has reported or measured fever.
No Pain	The child is not reported to have any pain and does not appear to be in pain.
Joint or bone pain	The child is reported to have or appears to have joint or bone pain.
Pain or difficulty passing urine or crying when passing urine	The child is reported to have or appears to have pain or difficulty passing urine (in younger children this may appear as crying when passing urine).
Skin problem	The child is reported to have or appears to have painful skin or a skin problem.
Ear pain	The child is reported to have or appears to have ear pain.

Oral Sores or Mouth Ulcer	Examination for oral sores or mouth ulcers should be carried out at the end of the physical examination so as not to upset or aggitate the child before completing other physical examinations.
No sores or mouth ulcer	The child does not have oral sores or mouth ulcers.
Oral thrush	The child has oral thrush.
Mouth sores or mouth ulcers – deep and extensive	The child has mouth sores or ulcers that are deep and extensive (severe, requiring referral).
Mouth sores or ulcers – not deep extensive	

Refusal to use a limb	The child is unable to use a limb (arm or leg) on examination. It is important to assess for refusal to use a limb, which could be a sign of a bone or joint infection when the child has reported or measured fever.
Warm, tender or swollen joint or bone	The child has a warm, tender or swollen joint or bone, which could be a sign of a infection when the child has reported or measured fever.

Component 6 — Decision-support logic

- Describe how data elements are used together to generate outputs / recommendations within the decision support

IMCI chart booklet

Two of the following signs: • Lethargic or unconscious • Sunken eyes • Not able to drink or drinking poorly • Skin pinch goes back very slowly.	**Pink:** SEVERE DEHYDRATION
Two of the following signs: • Restless, irritable • Sunken eyes • Drinks eagerly, thirsty • Skin pinch goes back slowly.	**Yellow:** SOME DEHYDRATION
Not enough signs to classify as some or severe dehydration.	**Green:** NO DEHYDRATION

Potential 'dead ends'

Criteria from 'severe'	Criteria from 'some'
Lethargic or Unconscious	Skin pinch goes back slowly
Lethargic or Unconscious	Drinks eagerly, thirsty
Not able to drink / drinking poorly	Restless / irritable
Not able to drink / drinking poorly	Skin pinch goes back slowly
Skin pinch goes back very slowly	Restless, irritable
Skin pinch goes back very slowly	Drinks eagerly, thirsty

DAK decision logic

IMCI chart booklet

It WFH/L less than -3 z-scores or MUAC less than 115 mm, then:

- Check for any medical complication present:
  - Any general danger signs
  - Any severe classification
  - Pneumonia with chest indrawing

IMCI training materials

ARE THERE ANY TIMES WHEN AN APPETITE TEST SHOULD NOT BE CONDUCTED?

There are some scenarios where the child is showing signs of severe malnutrition but does not need an appetite test. If a child has any general danger signs, the appetite test is not done. The appetite test is also not done in children who have pneumonia, persistent diarrhoea, dysentery, measles, or malaria. If RUTF is not available for an appetite test, refer.

Other (e.g. 2013 Malnutrition guidelines)

Hypothermia, fever ≥38.5°C; Eye signs of Vitamin A deficiency; Some or severe dehydration; Oedema +++ (vs + / ++)

DAK

- Any general danger sign;
- Any severe classification;
- Pneumonia, persistent diarrhoea, dysentery, malaria, measles;
- Oedema of both feet.

'Derived answers for medical complications:
"Medical complications of severe acute malnutrition" = Yes IF
"Severe acute malnutrition" = TRUE
AND
("Oedema of both feet" = TRUE
OR
"Danger signs" = TRUE
OR
"Stridor in a calm child" = TRUE or "Oxygen saturation" = <90%
OR
"Fast breathing" = TRUE or "Chest indrawing"= TRUE
OR
("Diarrhoea" = TRUE and (two or more of the following): "Lethargic or unconscious" = TRUE/ "Sunken eyes" = TRUE/"Skin pinch of abdomen" = "Skin pinch goes back very slowly (more than 2 seconds)"/"Oral fluid test results" = "Completely unable to drink" or "Oral fluid test results" = "Vomits immediately/everything" or "Oral fluid test results" = "Completely unable to drink or Vomits immediately/everything" or "Oral fluid test results" = "Drinks poorly"))
OR
"Diarrhoea for how long?" = "14 days or more" or "Blood in the stool in this illness" = TRUE
OR
"Stiff neck" = TRUE or "Malaria test" = "Malaria-positive"
OR
"Measles rash" = TRUE or ("Measles within the last 3 months" = TRUE and ("Clouding of the cornea" = TRUE or "Oral sores or mouth ulcers" = "Mouth sores or mouth ulcers – Deep and extensive"))
OR
"Tender Swelling behind the ear" = TRUE
OR
"Palmar pallor" = "Severe palmar pallor"
OR
"Refusal to use a limb" = TRUE or "Warm tender or swollen joint or bone" = TRUE
OR
("Clouding of the cornea" = true and "Is clouding of the cornea a new problem" = "Yes")
OR
("Abscess" = TRUE and ("Deep or extends to muscle" = TRUE or "Measured temperature" = "High/very high"))
OR
("Cellulitis"= TRUE and "Rapidly spreading, extensive, or not responding to oral antibiotics" = "Yes")
OR
("Ringworm (tinea)" = TRUE and "Extensive ringworm" = "Yes")
OR
("Herpes zoster" = TRUE and "Eye involvement" = "Yes")
OR
("Impetigo/folliculitis" = TRUE and
("Signs of severe impetigo/folliculitis" = "Skin infection extends to muscle" OR "Measured temperature" = "High/very high"))
OR
"Severe seborrhoea" = TRUE
OR
"Type of skin problem" = "Stevens–Johnson syndrome – Severe reaction due to cotrimoxazole or nevirapine (NVP) involving the skin as well as the eyes and the mouth. Might cause difficulty in breathing"
OR
"Oral sores or mouth ulcers" = "Mouth sores or mouth ulcers – Deep and extensive")

Indicators and performance metrics

- Generic indicators to be automatically generated based on data elements
- Potential to integrate into other national information systems, such as DHIS2

Indicator ID	Indicator name	Definition	Numerator definition	Denominator description	Disaggregation
CHE.IND.1	Severe illness, all children	Proportion of consultations with infants and children up to 5 years old with severe disease/severe illness	Number of consultations with infants and children aged 0–59 months meeting the criteria for any severe illness/severe disease classification	Number of consultations with infants and children aged 0–59 months	Age (<2months, 2–59 months), sex, facility, area/region, time period
CHE.IND.2	Possible serious bacterial infection (PSBI), young infants	Proportion of consultations with young infants under 2 months old with signs of PSBI or very severe disease	Number of consultations with infants under 2 months of age who meet the criteria for PSBI classification	Number of consultations with infants under 2 months of age	Age (<7 days, 7–27 days, 28 to <59 days), facility, sex, area/region, time period
CHE.IND.3	Danger signs, children aged 2–59 months	Proportion of consultations with children aged 2 months and up to 5 years with danger signs	Number of consultations with infants and children aged 2 months to 5 years with one or more danger signs	Number consultations with children aged 2–59 months	Sex, facility, area/region, time period
CHE.IND.4	Pneumonia, all children	Proportion of consultations with infants and children aged up to 5 years with pneumonia	Number of consultations with infants and children aged 0–59 months who meet the criteria for pneumonia classification	Number of consultations with infants and children aged 0–59 months	Age (<2months, 2–59 months), sex, facility, area/region, time period
CHE.IND.5	Pneumonia, children with a cough/difficulty breathing	Proportion of consultations with children aged 2 months up to 5 years with a cough or difficulty breathing with pneumonia	Number of consultations of infants and children aged 2–59 months who meet the criteria for pneumonia classification	Number of consultations with children aged 2–59 months with cough or difficulty breathing	Age (<2months, 2–59 months), sex, facility, area/region, time period
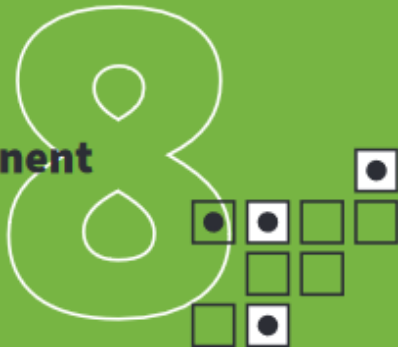
# High-level functional and non-functional requirements

- Functional requirements are those that are needed to meet user needs

  - E.g. highlight abnormal values to identify critical health issues or data entry errors

- Non-functional requirements are more generic features needed to ensure usability within technical / physical environment

  - E.g. ability to use offline; password protection

As a ...	I want to ...	So that ...
Health worker or clerk	be able to gather unique identifier number/ information pertaining to the client that does not include personal information	I do not have to deal with personal information management regulations/laws
Health worker or clerk	be able to gather unique identifier number/ information pertaining to the client that includes personal information	I can identify the client using personal information within personal information management regulations/laws
Health worker or clerk	search if the client is already in the system (using at least two identifiers) (including information pertaining to the child's caregiver)	I can check if this is a new or existing client

Category	Non-functional requirement
Security – confidentiality	Provide password-protected access for authorized users
Security – confidentiality	Provide a means to ensure confidentiality and privacy of personal health information
Security – confidentiality	Provide ability for allowed users to view confidential data

Adapting the DAK to national guidelines

- WHO DAK offers starting point for standardised approach to digitalisation of child health guidelines

- Accelerates process whilst supporting fidelity to underlying recommendations

- Estimated ~ 20% need for adaptation to align with national guidelines

SMART GUIDELINES

Digital adaptation kit for child health (0–59 months) in humanitarian emergencies

Operational requirements for implementing WHO recommendations in digital systems

World Health Organization

Component 1.	Health interventions and recommendations
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Component 8.	High-level functional and non-functional requirements

Future directions

- Further adaptations, piloting & implementation

- Additional specifications / detail for treatment decision support logic

- Expansion to provide more comprehensive support for e.g.:
  - Additional presentations
  - Health prevention & promotion
  - Older children, other populations
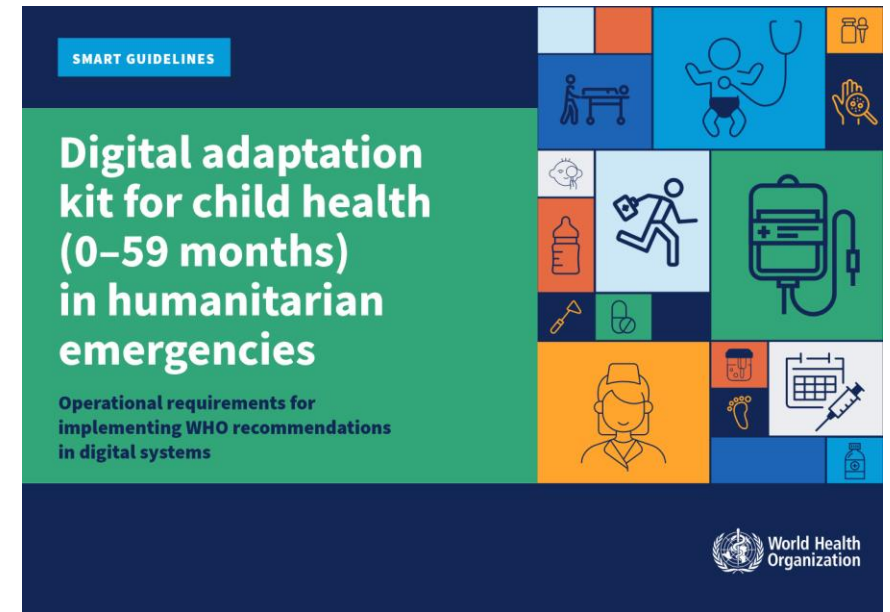
Thank you

On behalf of the WHO & Swiss TPH teams, and many other contributors

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Digital Adaptation Kit for Child Health in Humanitarian Emergencies: Application and future plans

13 November 2024

Origins of the project

- **50%** of maternal, newborn and under five mortality occur in humanitarian settings

- Existing WHO guidance on child and newborn care is not sufficiently adapted and/or field tested in emergencies

- Current narrative guidelines have a number of limitations

Solution and benefits

Solution

Publish associated **requirements documentation** and **standards-based machine readable code**, to enable integration and execution in partner systems.

and

Using the WHO SMART guidelines approach, create a digital solution called **Frontline** for healthcare workers in emergency settings

Benefits

For the healthcare worker:
- Improve the speed and accuracy of diagnosis at the point of care
- Add confidence that their clinical care follows WHO recommendations
- Enable easier provision of continuity of care for follow-up visits

For the patient:
- Assurance they are receiving the best possible care using WHO guidance

For Ministries of Health:
- Support wider national digital health strategy through promotion of international norms and standards (e.g. HL7 FHIR)
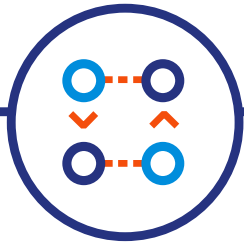
EXISTING MODEL WITH ENHANCEMENTS

PREPARING TO GO DIGITAL

INTEROPERABLE DIGITAL COMPONENTS

CUSTOMIZABLE SOFTWARE

ADVANCED ANALYTICS FOR PRECISION HEALTH

L1

Narrative

Living guidelines approach

Digital curation of recommendations

Panels include medical informatics experts

L2

Operational

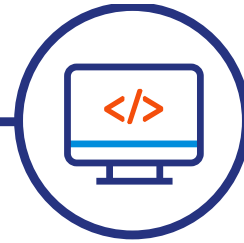Human-readable operational components

Digital Adaptation Kit (8 components)

L3

Machine Readable

Software specifications in a computable format

Uses HL7 FHIR ®

L4

Executable

Fully executable software tools

Mechanism for real-time updates

L5

Dynamic

Advanced analytics for greater local relevance and precision

AI-based decision support

Digitalised child health clinical algorithms (IMCI)

Digital adaptation kit (L2) and open-source coding (L3)

- Digital representation of clinical algorithms using standardized approaches

- Adopts international norms and standards (e.g. HL7 FHIR)

- Full documentation of processes

- Consistent with current WHO recommendations

- Can link with district health and supply chain management reporting systems

- Can be adapted locally and expanded

- Open-source coding that can be executed on other mobile apps

Frontline Mobile App (L4)

- Prototype mobile app that executes everything included in L2 and L3 coding

- Available for testing and use in clinical settings

Iraq Phase 1 Pilot

- **Objective:**
  - Assess feasibility and usability of the Frontline app

- **Methods**:
  1. Direct observation of clinical consultations (before and during pilot)
  2. Collection of consultation data (during sick child visits)
  3. User feedback surveys (post-training and end of pilot)

- **Implementation:**
  - Training
  - Pilot data collection(26 days)
  - 35 HCWs in 10 PHCCs, in 2 directorates of health

Sick child consultations conducted in Frontline

Number of consultations per day, all pilot PHCCs

Total number of consultations:	**597**
Total number of consultation days:	26
Average consultations/day:	23
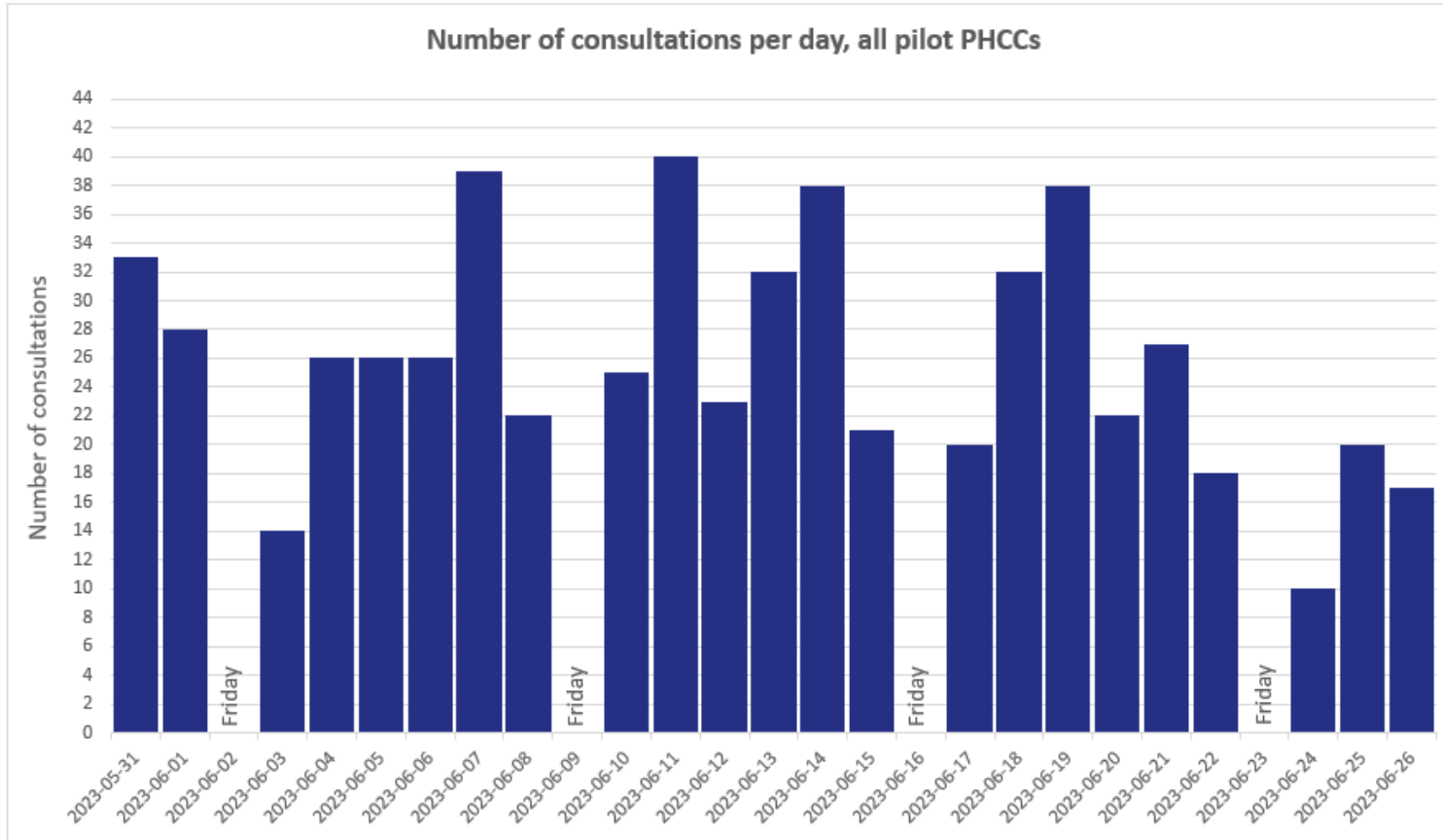
Number of consultations by age group

- 0-2m: n=71, 12%
- 2-59m: n=526, 88%

Number of consultations by sex

- female: n=296, 50%
- male: n=301, 50%

User feedback survey

- **81%** (n=21) of healthcare workers found Frontline very easy or easy to use

- **77%** (n=20) felt comfortable in their ability to use Frontline appropriately

- **84%** (n=22) found Frontline to be extremely or moderately useful in supporting them to provide care for sick infants and children

- **73%** (n=20) felt it was very feasible or feasible to implement Frontline in routine practice

- **88%** (n=23) strongly trust or trust the classifications in Frontline; and **92%** (n=24) strongly trust or trust the treatments

Observation of consultations by supervisors

- Of 46 observations (2-59m), **93%** (n=43) used the app <u>during</u> the consultation and **98%** (n=45) completed the full consultation in the app

- **68%** (n=26) of caregivers felt very comfortable or comfortable with the healthcare worker using the app during the consultation
  - 21% (n=8) were neutral/had no opinion
  - 10% (n=4) felt uncomfortable (largely due to the amount of time taken)

Consultation time

- On average, **65%** (n=17) of health care workers reported that the time spent in the consultation a lot longer or little longer with Frontline compared to without

- During observation, a consultation using Frontline took on average **2 minutes 24 seconds longer** than without (total of 11 mins 57 seconds)

Stage	Mean	Median	Mode	Max	Min
Before	0:09:33	0:10:00	0:10:00	0:25:00	0:02:00
During	0:11:57	0:09:00	0:07:00	0:37:00*	0:04:00

* Observations using the app also skewed by outliers. Median and mode consultation times were shorter when using the app, compared to before

- Analysis of which stages of the consultation take the most time still to be analysed from the consultation data

Did Frontline improve adherence to guidelines?

Children 2–59 months	Pre-intervention (n=31)		During pilot (n=40)	
	n	%	n	%
Assessed for all danger signs	10	32%	34	85%
Assessed for cough	25	81%	35	88%
Assessed for diarrhoea	21	68%	31	78%
Assessed for history of fever	21	68%	28	70%
Weight measured	21	68%	39	98%
Temperature measured	25	81%	37	93%
Respiratory rate measured*	3/5	60%	13/14	93%

* among those with cough or difficulty breathing

Problems identified during observation visits

- **40%** (n=16) reported a problem using Frontline, and a total of 22 problems were reported

Problems reported with use of Frontline

Key constraints
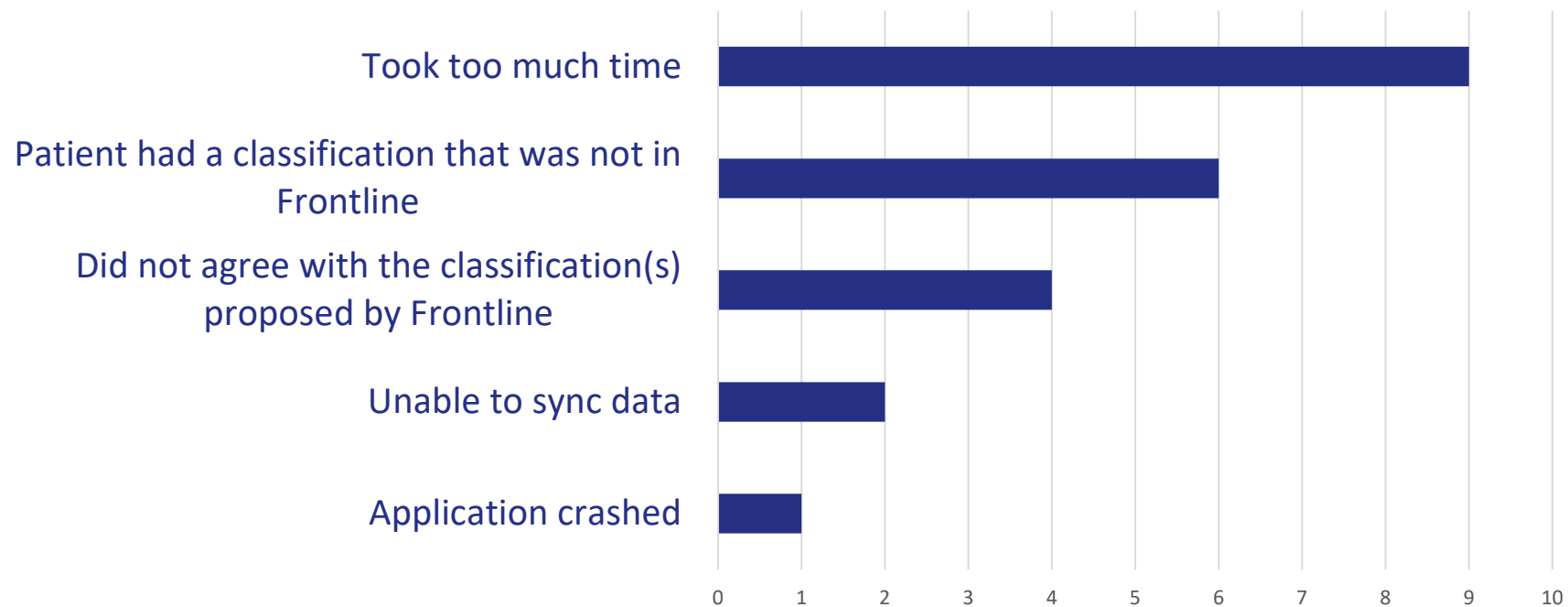
- ## Sample size

  - Relatively small sample sizes used for this Phase 1 pilot

  - Need research that is sufficiently powered for future stages

- ## Independence

  - Observation findings are based on data gathered by supervisors

  - Will be important to use independent researchers in future stages

Summary of main findings

- ## User feedback was positive
  - Healthcare workers found the app to be **easy** to use, **feasible** to implement in routine care, and they **trusted** the clinical decision support it provided

- ## Key issues identified
  - **Speed** of the application, which caused consultations on average to take longer with the app
  - **Sync of data** from the phone to the server
  - **Clinical algorithm issues** arising from a combination of L2, L3, L4 constraints

- ## High priority areas for improvement
  - Add '**advanced' treatments** (e.g. weight-based dosing, qualifier-based treatments)
  - Add **tasking** (i.e. registration, basic measurements)
  - Add **multi-media** (e.g. photos/video for diagnosis of skin conditions)

Summary of main findings

- Digital Landscape

  - Unable to fully assess other benefits (e.g. promotion of HL7 FHIR/standards-based architecture; interoperability with other systems)

  - Iraq investing heavily in digital health, largely product driven (e.g. DHIS2, HeRAMS)

  - Warrants a more through landscaping and digital investment approach

Future directions

- Scale-up country adoption
  - Promote use of L2 and L3 content in partner systems
  - Identify local partners for implementation in new settings

- Expand clinical scope around mother-child dyad
  - Integrate additional content (well child; ECD; advanced treatments; immunization)
  - Adapt for routine settings
  - CCC content updated + published as v2 (e.g. w inclusion of referral not possible; new IMCI updates)

- Contribute to digital health at national level
  - Promote HL7 FHIR® as a common interoperability standard for health within national digital health strategies
  - Demonstrate how a common digital format can support other health system functions (e.g. surveillance, programme monitoring, supply chain management)

Thank you

On behalf of all the collaborating partners including the Ministry of Health, Iraq.