Digital implementation investment guide (DIIG): integrating digital interventions into health programmes

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PATH
UNFPA
unicef for every child
human reproduction programme hrp research for impact
UNDP-UNFPA-UNICEF-WHO-WORLD BANK

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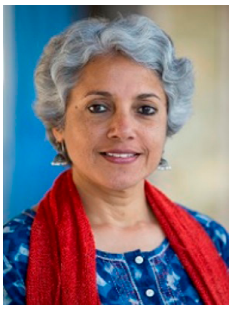

The transformative nature of digital technologies for health is undeniable. Today, over half of the world's population have access to a mobile phone. Increasing access to mobile technologies has radically changed the way in which people may manage their own health, as well as the way in which health services are delivered. Health systems recognize that digital health technologies are critical for accelerating progress towards the achievement of the Sustainable Development Goals. Greater investment, however, will be needed to elevate the role of digital health in health systems, so that the positive impact on health of individuals and populations can be fully realized.

The large-scale digital transformation of a health system is neither a quick nor a simple task. Rapid advancements in digital technologies have made it easier to build individual technologies than to invest in and implement them such that they function in a harmonized and complementary manner. Long-term systemic changes are needed, including a change in the culture of using data. Investment must be carefully and thoughtfully coordinated for equitable access to meet the full spectrum of health needs.

At the Seventy-First World Health Assembly, WHO's Member States requested WHO not only to develop a global strategy on digital health, but also to provide guidance for scaling up the implementation of digital health in line with WHO's Thirteenth General Programme of Work. In 2019, WHO launched the first *WHO Guideline Recommendations on Digital Interventions for Health System Strengthening* to ensure that Member States use of digital health is informed by the evidence for "what works". This *Digital implementation investment guide (DIIG): integrating digital interventions into health programmes* provides guidance on how to practically invest in and implement the recommendations outlined in the WHO guideline according to national contexts, health sector needs and state of digital maturity. Investment must be both effective and sustainable, with clearly anticipated health benefits for all.

Digital technologies are improving rapidly. Building a digital foundation that can be responsive to the diversity of programme needs, but which also anticipates innovation is key. Under the framework of the emerging Global Strategy on Digital Health, WHO, HRP, UNICEF, UNFPA, and PATH have developed the *DIIG* document to provide guidance on investing in programmatic implementations for digital transformations of health systems in a systematic manner. Such strategic investments allow for long-term sustainability on a national scale. Informed by experience across multiple regions and agencies, the DIIG provides practical methods for approaching needs assessment, planning, investment and implementation of digital health systems.

The lure of exciting new technologies and gadgets is ever present, but ultimately these technologies should be promoting health, keeping the world safe, and serving the vulnerable. If implemented in a strategically harmonized manner, leveraging the key principles and messages presented in the *DIIG*, these digital health systems are powerful tools that will help us achieve the ultimate goal of health and well-being for all.

Dr Soumya Swaminathan
Chief Scientist
WHO

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List of abbreviations

ADB	Asian Development Bank
AEHIN	Asia eHealth Information Network
BID	Better Immunization Data
CRDM	Collaborative Requirements Development Methodology
CRVS	civil registration and vital statistics
DHA	Digital Health Atlas
DHI	digital health intervention
DIIG	Digital Implementation Investment Guide
DPPI	Directorate of Planning, Policy and Information
EIR	electronic immunization application
EPI	Expanded Programme on Immunization
FHIR	Fast Healthcare Interoperability Resource
HIS	health information system
HL7	Health Level 7
HMIS	health management information system
HSC	health system challenge
ICD	International Classification of Diseases
ICT	information and communications technology
ITU	International Telecommunication Union
LMIS	logistics management information system
M&E	monitoring and evaluation
MNO	mobile network operator
MOH	Ministry of Health
MOHS	Ministry of Health and Sanitation
NGO	nongovernmental organization
OPENHIE	Open Health Information Exchange
RE-AIM	Reach, Effectiveness, Adoption, Implementation and Maintenance
RFP	request for proposals
TOGAF	The Open Group Architecture Framework
UAG	user advisory group
UHC	universal health coverage
WHO	World Health Organization

CHAPTER

01 INTRODUCTION

This Digital Implementation Investment Guide (DIIG) aims to help governments and technical partners plan a digital health implementation that focuses on one or more health programmes to support national health system goals.

The Guide is designed to walk users of the document step-by-step through planning, costing and implementing digital health interventions within a digital health enterprise. This consists of selecting digital health interventions that are aligned with identified health needs, appropriate to a specific country context and integrated with existing technologies and the broader digital architecture. Users of the Guide will learn from diverse experiences deploying digital health technologies over the past decade and will be guided through a systematic approach to designing, costing and implementing meaningful digital health interventions that are part of a digital health enterprise.

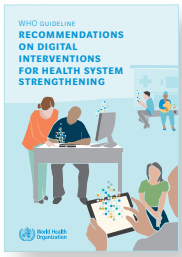
A digital health enterprise comprises the business processes, data, systems and technologies used to support the operations of the health system, including the point-of-service software applications, devices and hardware and the underlying information infrastructure (such as the digital health platform) that deliver health services accelerated and amplified by digital and data technologies. Digital health enterprise architectures have varying degrees of maturity and institutionalization within the broader ecosystem. This document makes a distinction between siloed digital health system architectures and exchanged digital health system architectures that contribute to a national digital health enterprise architecture. Siloed digital health system architectures are disconnected applications that aim to fulfil a project goal. These siloed digital health implementations are implemented in the context of a time-bound, stand-alone digital health project, usually to demonstrate proof of concept, findings from which may eventually contribute towards a government-sponsored digital health implementation.

Exchanged digital health system architectures, on the other hand, consist of multiple applications leveraging standards and connected through a health information exchange to address needs across various health programmes, operating in a coordinated manner within a national digital health enterprise architecture. Additionally, this Guide acknowledges the existence of siloed, integrated and ball-of-mud architectures and steers the user towards planning and investing in cumulative and modular enterprise digital health implementations that result in collective benefit across the health system. This Guide focuses on the implementation of exchanged digital health system architectures that are modular in nature and support one or more programmes across the health sector and, potentially, even beyond the health sector.

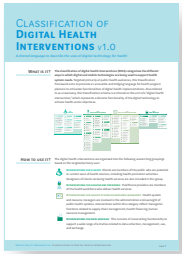
This Guide serves as a companion to the *WHO guideline: recommendations on digital interventions for health system strengthening (1)* and provides a pragmatic process for reviewing WHO guideline–recommended digital health interventions and incorporating them into harmonized plans grounded in national systems and policy goals. Additionally, this document builds on *Planning an information systems project: a toolkit for public health managers (2)*, commissioned by Optimize: Immunization Systems and Technologies for Tomorrow, a previous collaboration between the World Health Organization (WHO) and PATH. Since the publication of *Planning an information systems project* in 2013, countries have considerably increased their use of technologies for health, reflecting a growing expectation across the globe that digital health interventions be part of established health programmes to address persistent gaps in the performance of health systems. This growth introduces new challenges in ascertaining the right functionality relative to identified needs, comparing the relevance of competing technologies and ensuring that investments have the desired sustainable impact – all challenges that this updated publication aims to address.

Several key WHO sources have also informed the content and processes of this Guide.

+ **The WHO and International Telecommunication Union (ITU) National eHealth strategy toolkit** *(3)*, which provides for government agencies a framework and method for developing a national eHealth vision, an action plan and a monitoring framework. A national eHealth or digital health strategy specifies high-level goals and outcomes for the health system that drive a country's eHealth priorities. This Guide can help translate that national-level strategy into specific digital health implementations that can support the broader digital health vision (see *section 2.2*).



+ **The WHO Guideline: recommendations on digital interventions for health system strengthening** *(1)* provides evidence-based recommendations on how specific interventions can address identified gaps in the health system. This resource represents the first official guidelines from WHO exclusively on digital health and enables policy-makers, managers and other stakeholders to understand the implications of prioritized digital health interventions. This Guide provides a facilitated process for incorporating the recommended interventions within a health programme area, aligned to identified health system challenges (see *Annex 5.3*).



+ **The WHO Classification of digital health interventions** *(4)* groups the various ways technologies support health system needs into four categories: clients, health workers, health system managers and data services. This Guide uses the classifications to categorize various health system challenges and digital health intervention solutions (see *Chapters 3 and 4*).

+ **The World Health Assembly WHO Resolution on Digital Health** represents global recognition from WHO Member States on the potential of digital technologies to advance the Sustainable Development Goals and support health systems. The resolution includes a request that countries "consider, as appropriate, how digital technologies could be integrated into existing health systems infrastructure and regulation, to reinforce national and global health priorities by optimizing existing platforms and services" *(5)*.

+ **The WHO Global strategy on digital health** *(6)* serves as a global call to action and operational plan for WHO and Member States to effectively implement and benefit from digital health for health systems to achieve global and national goals.

The process outlined in the Guide is also informed by the **Principles for Digital Development**, which help stakeholders effectively and appropriately apply digital technologies in their health programmes (*digitalprinciples.org/principles*). Core tenets of these nine principles will be referenced throughout this Guide.

Design with the User: User-centered design starts with getting to know the people you are designing for through conversation, observation and co-creation.

Understand the Existing Ecosystem: Well-designed initiatives and digital tools consider the particular structures and needs that exist in each country, region and community.

Design for Scale: Achieving scale requires adoption beyond an initiative's pilot population and often necessitates securing funding or partners that take the initiative to new communities or regions.

Build for Sustainability: Building sustainable programs, platforms and digital tools is essential to maintain user and stakeholder support, as well as to maximize long-term impact.

Be Data Driven: When an initiative is data driven, quality information is available to the right people when they need it, and they are using those data to take action.

Use Open Standards, Open Data, Open Source, and Open Innovation: An open approach to digital development can help to increase collaboration in the digital development community and avoid duplicating work that has already been done.

Reuse and Improve: Reusing and improving is about taking the work of the global development community further than any organization or program can do alone.

Address Privacy & Security: Addressing privacy and security in digital development involves careful consideration of which data are collected and how data are acquired, used, stored and shared.

Be Collaborative: Being collaborative means sharing information, insights, strategies and resources across projects, organizations and sectors, leading to increased efficiency and impact.[1]

1 *Text reproduced from Principles for Digital Development (7).*

1.1 The Guide's role in planning and implementing a digital health enterprise

A fully realized digital health enterprise delivers health in the digital age. The implementation of a digital health enterprise includes the people who design, build, deploy and maintain the systems, accompanied by a governance framework, an enabling policy environment and an operational plan. The process of planning and implementing an appropriate digital health enterprise within the broader ecosystem includes several phases:

1. assessing the current state and enabling environment
2. establishing a shared understanding and strategic planning
3. defining the future state
4. planning enterprise architecture
5. determining health content requirements
6. monitoring and evaluation (M&E) and fostering data use
7. implementing, maintaining and scaling.

Fig. 1.1.1 outlines these steps as well as supporting resources (referenced in *Table 1.1.2*) that will help you successfully navigate the process of planning and implementing an appropriate digital health enterprise. This Guide focuses primarily on defining the future state and highlights appropriate resources associated with the other phases. (See *Box 1.1.3* for resources applied to specific use cases.)

Fig. 1.1.1. Planning and implementing a digital health enterprise: phases, steps and resources.

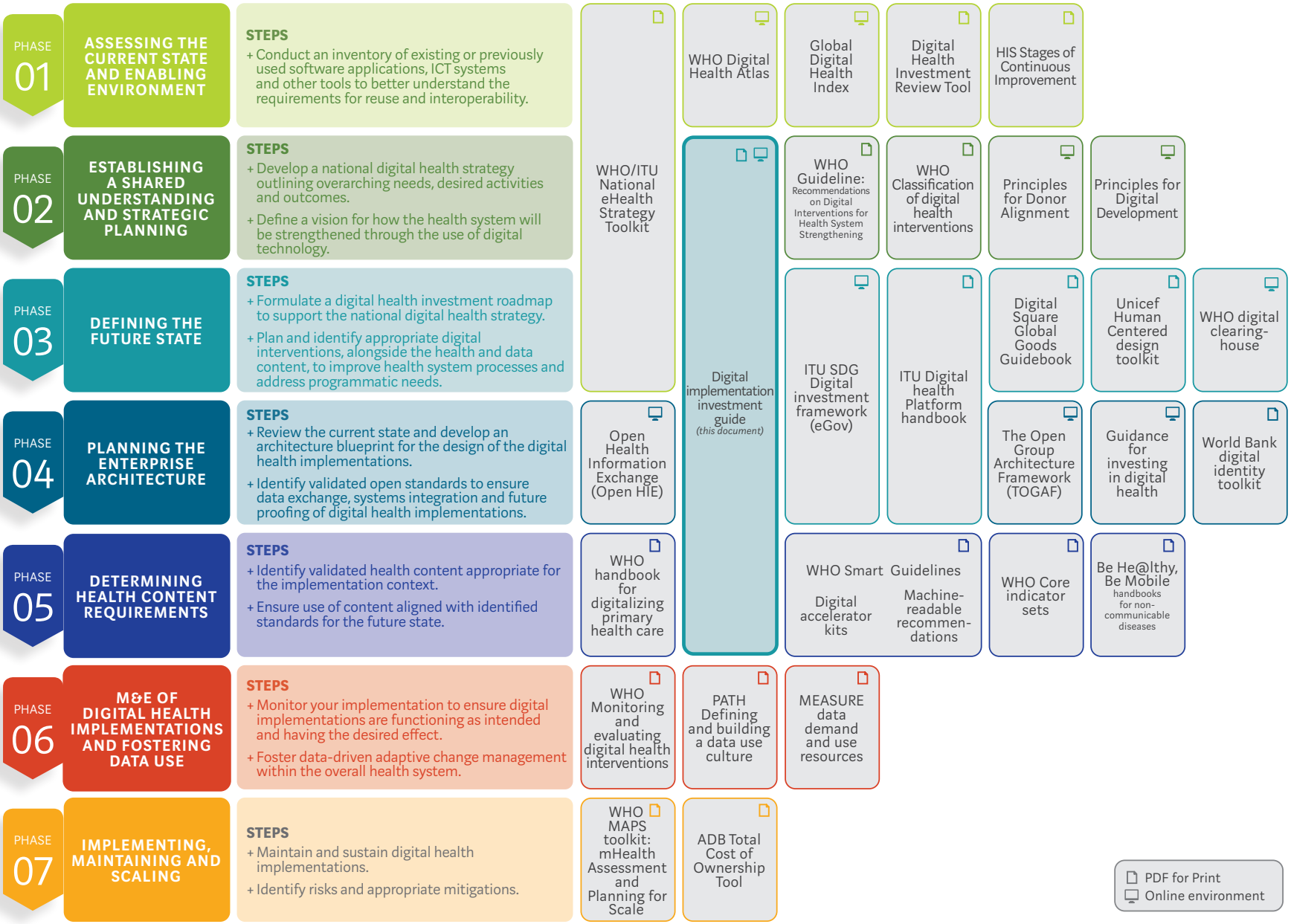


Table 1.1.2. Resources for planning and implementing a digital health enterprise.[2]

Phase	Resources
PHASE 1 Assessing the current state and enabling environment	» WHO/ITU National eHealth strategy toolkit *(3)* » WHO Digital Health Atlas *(8)* » Global Digital Health Index *(9)* » Digital health investment review tool *(10)* » HIS stages of continuous improvement toolkit *(11)*
PHASE 2 Establishing a shared understanding and strategic planning	» Digital implementation investment guide (this document) » WHO Guideline: recommendations on digital interventions for health system strengthening *(1)* » WHO Classification of digital health interventions *(4)* » Principles of Donor Alignment for Digital Health *(12)* » Principles for Digital Development *(7)*
PHASE 3 Defining the future state	» ITU/DIAL SDG digital investment framework *(13)* » ITU Digital health platform handbook *(14)* » Digital Square Global goods guidebook *(15)* » UNICEF Human-centered design toolkit *(16)* » WHO Digital Clearinghouse (*https://clearinghouse.who.int*)
PHASE 4 Planning the enterprise architecture	» World Bank Digital identity toolkit *(17)* » Open Health Information Exchange (OpenHIE) *(18)* » The Open Group Architecture Framework (TOGAF) Standard *(19)* » Guidance for investing in digital health *(20)*
PHASE 5 Determining health content requirements	» WHO Handbook for digitizing primary health care *(21)* » WHO Smart Guidelines: + WHO Digital accelerator kits *(22)* + WHO Machine-readable recommendations + WHO Fast Healthcare Interoperability Resource (FHIR) implementation guides *(23)* » Be He@lthy, Be Mobile handbooks for noncommunicable diseases *(24)* » WHO 2018 global reference list of 100 core health indicators *(25)* » Content for specific health domains (see *Box 1.1.3*)
PHASE 6 M&E of digital health implementations and fostering data use	» WHO Monitoring and evaluating digital health interventions *(26)* » Defining and building a data use culture *(27)* » MEASURE data demand and use resources *(28)*
PHASE 7 Implementing, maintaining and scaling	» The WHO MAPS toolkit: mHealth assessment and planning for scale *(29)* » Asian Development Bank (ADB) Digital health investment costing tool *(30)*

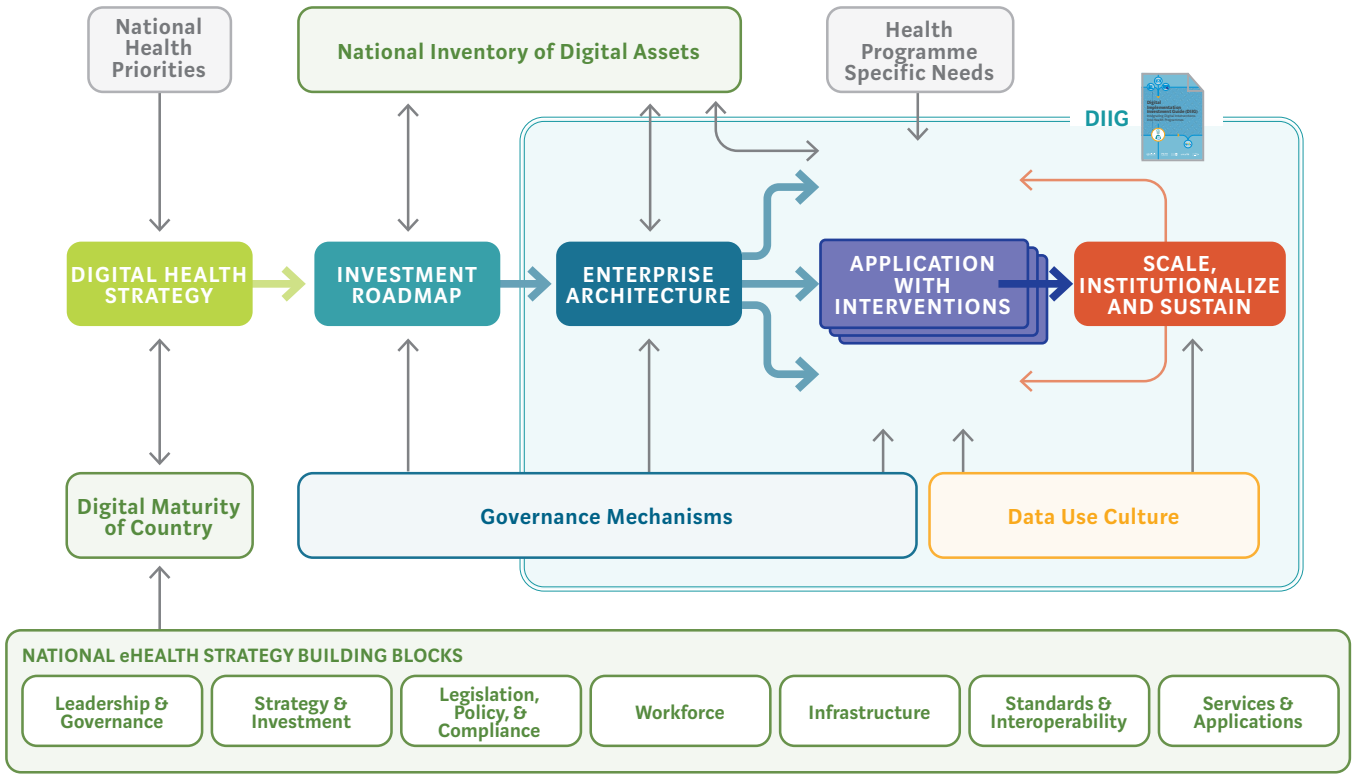
2 *Additional resources for further reading included in Annex 1.2.*

Box 1.1.3. Resources detailing content for specific health programme areas.

+ Civil registration and vital statistics (CRVS) digitisation guidebook *(31)*
+ Common requirements for maternal health information systems *(32)*
+ Electronic immunization registry: practical considerations for planning, development, implementation and evaluation *(33)*
+ Electronic recording and reporting for tuberculosis care and control *(34)*
+ Mobile solutions for malaria elimination surveillance systems: a roadmap *(35)*

The development of a digital health enterprise is a dynamic process (*Fig. 1.1.4*). Depending on your country's context, needs and constraints, you may reorder the steps taken during each phase or even the overall process. Or you may need to revisit earlier phases as your national digital health ecosystem and health needs change over time, requiring new strategic plans and different digital health interventions. Within a broader ecosystem of valuable documents, tools and processes important to planning and implementing digital health, this document focuses on several important phases, providing specific steps and outputs, which are harmonized with the concepts, frameworks and terms of these other prominent digital health resources.

Fig. 1.1.4. Essential processes of national digital health implementations.



1.2 How to use this Guide

This Guide covers the different phases outlined in *Fig. 1.1.1* by leveraging supporting resources, focusing the most detail on phases 2–5. This document is designed to be used in two ways:

+ to support a **facilitated planning process**, resulting in a costed implementation plan suitable for a funder, whether a government finance ministry or an agency (such as the World Bank, Gavi, The Global Fund or Bill & Melinda Gates Foundation).
+ to provide **stand-alone topical information and outputs**, organized by chapter, for establishing and costing a digital health implementation.

This Guide has been developed to accommodate different approaches for planning digital health implementations. It facilitates the stepwise or piecemeal approach to planning, as well as comprehensive approaches to how countries develop digital investments that can be leveraged across more than one health programme. **CHAPTERS 2–3** are useful for reviewing the performance of the health system and determining the challenges and needs within your programme area, regardless of whether or not you seek digital health interventions as part of the mechanism to address the identified needs. **CHAPTER 4** helps identify appropriate digital health interventions in line with health system challenges and the maturity of the digital ecosystem. **CHAPTERS 5–7** can help ensure that your plans to implement digital health are viable and that digital applications are integrated and sustained within financial and other constraints.

Completing the Guide in its entirety will yield several outputs that can be combined into a costed implementation plan or considered individually:

- » team roles and responsibilities and charter stating shared vision and goals
- » documented health programme processes and end-user and data workflows
- » defined problem statement detailing specific bottlenecks, challenges and needs in the health system
- » identification of appropriate, prioritized digital health interventions to address current challenges and needs
- » detailed assessment of the enabling environment and current constraints
- » implementation plan that considers existing resources, potentially reusable components, environmental limitations and needs for standards and interoperability
- » summarized high-level financial plan and costing
- » proposal for governance mechanisms and risk mitigation
- » logic-model plan for M&E and adaptive management.
- » Each chapter includes the following information:
- » suggested inputs and expected outputs
- » a step-by-step process to guide work
- » illustrative examples from real programmes
- » templates or worksheets to complete
- » additional resources for more information
- » links to relevant Principles for Digital Development.

The structure and key outputs of this Guide are outlined in *Fig. 1.2.1*.

BID INITIATIVE CASE STUDY

BID Initiative case study: Step-by-step guide

Throughout this Guide, you will find illustrations from the BID Initiative (*bidinitiative.org*) of how government stakeholders and technical partners navigated these steps in designing, costing and implementing a digital health intervention. Launched in 2013, the BID Initiative was led by PATH and the governments of Tanzania and Zambia. The BID Initiative was grounded in the belief that better data plus better decisions would lead to better health outcomes. Although BID initially focused on addressing critical routine delivery of immunization services, the approach was designed to be applicable to other health areas, such as nutrition or maternal and newborn health.

Fig. 1.2.1. Overview of the chapters in this Digital Implementation Investment Guide.

By the end of this Guide, you will be able to complete essential activities (see *Fig. 1.2.1*) that produce outputs that comprise a costed implementation plan (see *Fig. 1.2.2*).

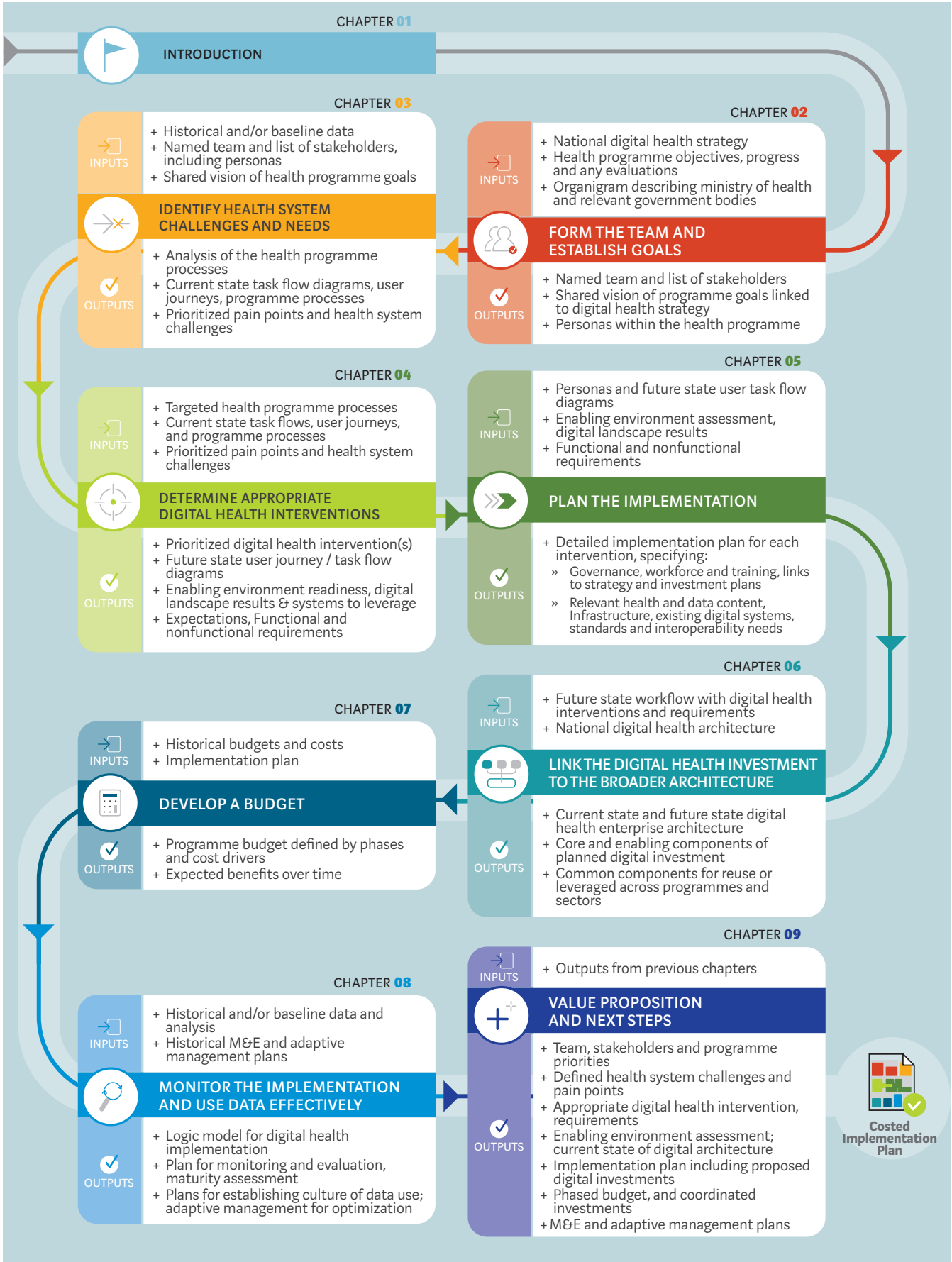
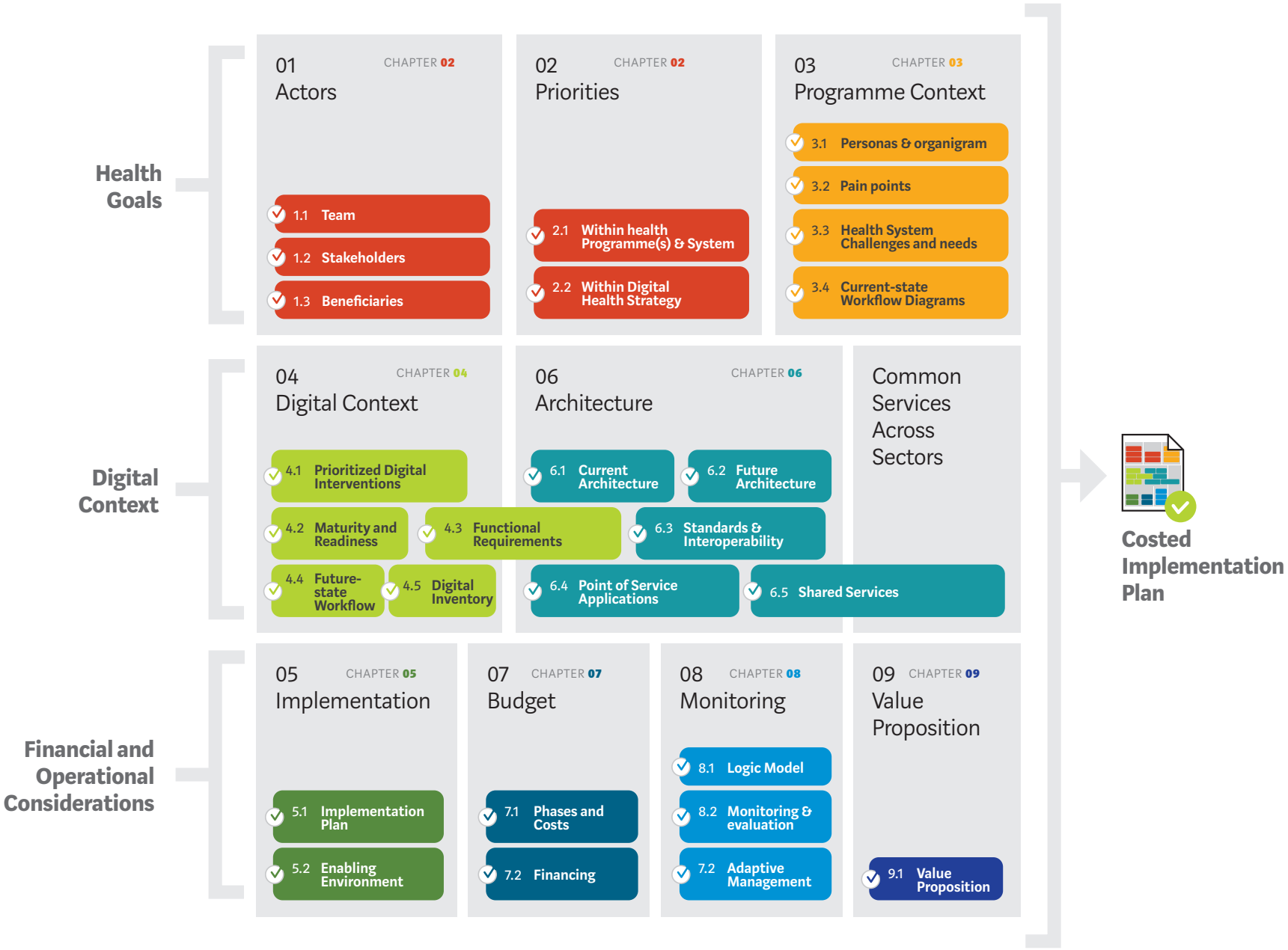


Fig. 1.2.2. Summary of outputs within a costed implementation plan.



1.3 Key terms for using this Guide

A full glossary is included as *Annex 1.1*, but several key terms are useful to understand at the outset.

This Guide assists readers to develop a costed implementation plan to support a digital health enterprise comprising appropriate digital health interventions targeting health system challenges and deployed within digital applications to strengthen the performance of one or more health programmes and realize digital health outcomes within national digital health strategies.

BOTTLENECKS: Specific gaps or problems in the workflow of delivering health services specific to a health programme area, persona or process (for example, "health workers have difficulty keeping track of when pregnant women are due for an antenatal care visit"), in contrast to a health system challenge, which is a general representation of the problem across any health programme area (for example, "loss to follow-up").

COSTED IMPLEMENTATION PLAN: A document that describes, in sequence, an identified set of challenges, accompanied by a contextually appropriate, financially justified plan for deployment and monitoring of resources. The responsible party will use this plan to obtain financial support to implement the proposed activities for the digital health implementation within a specific timeline. The purpose of this Guide is to develop a costed implementation plan for digital application(s) within an exchanged digital health system architecture to address needs of health programme(s).

DIGITAL HEALTH: Digital health is the systematic application of information and communications technologies, computer science, and data to support informed decision-making by individuals, the health workforce, and health systems, to strengthen resilience to disease and improve health and wellness. *(36)*.

DIGITAL HEALTH APPLICATION: The software, information and communications technology (ICT) systems or communication channels that deliver or execute the digital health intervention and health content *(1, 14)*.

DIGITAL HEALTH ECOSYSTEM: The combined set of digital health components representing the enabling environment, foundational architecture and ICT capabilities available in a given context or country *(14)*.

DIGITAL HEALTH PLATFORM: A shared digital health information infrastructure (infostructure) on which digital health applications are built to support consistent and efficient healthcare delivery. The infostructure comprises an integrated set of common and reusable components that support a diverse set of digital health applications. The components consist of software and shared information resources to support integration, data definitions and exchange standards for interoperability and to enable the use of point-of-service applications across health programme areas and use cases *(14)*.

DIGITAL HEALTH ENTERPRISE: The organizational unit, organization or collection of organizations that shares a set of health goals and collaborates to provide specific health products and/or services to clients, along with the business processes, data, systems and technologies used to support the operations of the health system, including the point-of-service software applications, devices and hardware, governance and underlying information infrastructure (such as the digital health platform) functioning in a purposeful and unified manner.

This Guide distinguishes between four different types of digital health enterprise system architectures (see *Fig. 1.3.1*) along a continuum of maturity *(37)*.

- **SILOED:** A digital health enterprise system architecture composed of stand-alone application(s). A digital health project is a time-bound implementation of a siloed digital health enterprise, usually to demonstrate proof of concept.
- **MUD** (Monolithic Unarchitected Software Distributions): Haphazardly structured, sprawling MUD systems are characterized by an evolving agglomeration of functions, originating without a predetermined scope or design pattern, which accumulate technical debt.
- **INTEGRATED:** A digital health enterprise system architecture in which two or more applications are directly connected to one another (that is, without an intermediary data exchange), intended to address one or more health system challenges and fulfil health programme goals.
- **EXCHANGED:** A digital health enterprise system architecture consisting of multiple applications

using standards to connect through a health information exchange to address collective needs across the health system, operating in a coordinated manner within a digital health architecture.

DIGITAL HEALTH IMPLEMENTATION: The development and deployment of digital health application(s) and/or platform(s) to support and strengthen a health enterprise within a given context, accompanied by a governance framework, operational plan, human resources and related activities for its successful execution.

DIGITAL HEALTH INTERVENTION: A discrete technology functionality – or capability – designed to achieve a specific objective addressing a health system challenge. Examples of digital health interventions include decision support, targeted client communications, and stock notifications; see *WHO Classification of digital health interventions* for a full list *(4)*.

DIGITAL HEALTH INVESTMENT: Financial and other resources, including human resources, that are directed towards digital health implementations.

DIGITAL HEALTH OUTCOME: The desired change in the health system or services by using digital health interventions. May also be known as an eHealth outcome *(3)*.

DIGITAL HEALTH STRATEGY: An overarching plan that describes high-level actions required to achieve national health system goals. These actions may describe how new digital health components will be delivered or how existing components will be repurposed or extended. May also be known as an eHealth strategy.

ENABLING ENVIRONMENT: Attitudes, actions, policies and practices that stimulate and support effective, efficient functioning of organizations, individuals and programmes. The enabling environment includes legal, regulatory and policy frameworks and political, sociocultural, institutional and economic factors *(16)*. These factors can include infrastructure, workforce, governance mechanisms and legislation and policies in the country.

HEALTH PROGRAMME: Operational unit within a government ministry supporting formal activities institutionalized at a national or subnational level to address clear priority health objectives. Health programmes are government led and persist across budget cycles as long as the underlying need persists. Family planning and malaria control programmes are some examples of health programmes.

HEALTH SYSTEM CHALLENGE: A generic (not health domain specific) need or gap that reduces the optimal implementation of health services. Health system challenges represent a standardized way of describing bottlenecks. For example, "loss to follow-up" is a health system challenge used to generally describe specific bottlenecks that may be articulated as "the person did not come back for their appointment" or "the person has not received a follow-up vaccination".

INTEROPERABILITY: Interoperability is the ability of different applications to access, exchange, integrate and use data in a coordinated manner through the use of shared application interfaces and standards, within and across organizational, regional and national boundaries, to provide timely and seamless portability of information and optimize health outcomes. *(1, 14)*.

STAKEHOLDERS: All persons affected by or interested in the consequences of a digital health implementation.

- The **PLANNING TEAM** includes stakeholders who are responsible for guiding the development of the digital health implementation. This team includes representatives from government and implementing partners, where appropriate.
- **END-USERS** are individuals, typically health workers, who interact directly with the digital health intervention once implemented. End-users may include health system managers who interact with the data generated by the digital health intervention. Clients, or patients, could also be end-users if they engage directly with the digital health intervention.
- **BENEFICIARIES** are individuals or members of the community who may benefit from the digital health intervention when used by another end-user, such as a pregnant woman receiving care from a health worker using a digital health intervention like decision support to coordinate referrals.
- **FUNDERS** are organizations that provide resources to design, develop and implement digital health implementations. They may be associated with government agencies, nongovernmental organizations (NGOs), bilateral or multilateral agencies, private foundations or private-sector organizations.

Fig. 1.3.1. Digital health enterprise system architectures.

SILOED

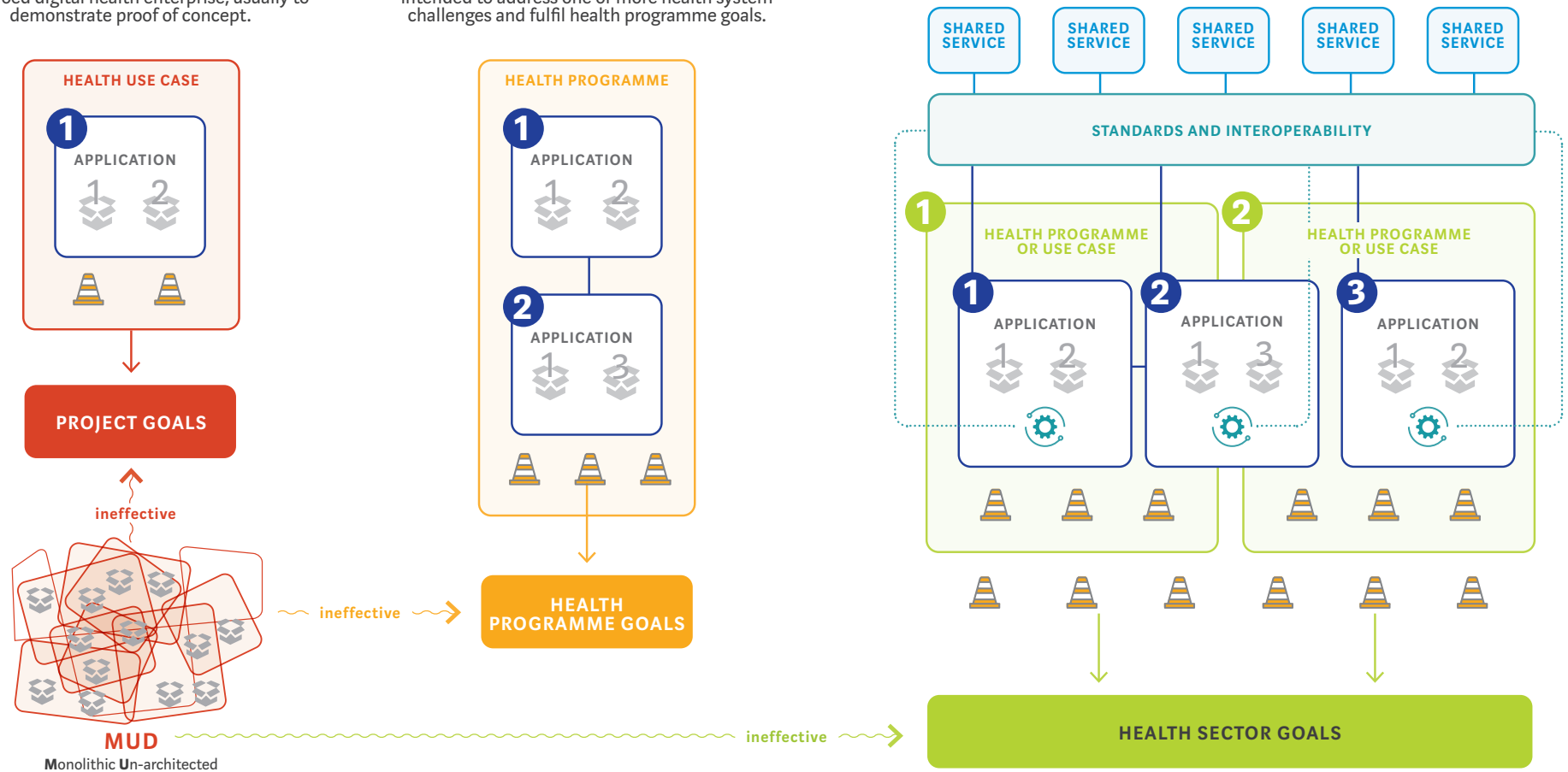
A digital health enterprise system architecture composed of standalone application(s). A digital health project is a time-bound implementation of a siloed digital health enterprise, usually to demonstrate proof of concept.

INTEGRATED

A digital health enterprise system architecture in which two or more digital applications are directly connected to each other (i.e. without an intermediary data exchange) intended to address one or more health system challenges and fulfil health programme goals.

EXCHANGED

A digital health enterprise system architecture consisting of multiple applications using standards to connect through a health information exchange to address collective needs across the health sector, operating in a coordinated manner within a digital health architecture.



1.4 When to use this Guide

There are several situations where you might find this guide useful.

When identifying how best to **apply the *WHO guideline: Recommendations on digital interventions for health system strengthening*** *(1)*. For example, the guideline recommends the use of digital decision-support tools for health workers within a health programme area; you would like to implement this recommendation but need to better understand whether it is the appropriate digital health intervention to address your health system challenges, as well as understand how it fits within the context of the health programme, health system and digital health landscape.

When presented with a **health system challenge and you want to determine if and how to incorporate digital health intervention(s)** to address the identified challenge within a health programme area. For example, there is low use of health services, and you are thinking about leveraging digital health to address this issue and achieve an outcome of increased demand for services.

When selecting specific **digital health interventions to meet the objectives of a national digital health strategy**. For example, the digital health strategy may have listed "strengthening the workforce through digital technology" as a digital health outcome. This Guide can help you select appropriate interventions to meet this outcome and understand how to design these interventions to work well within your local context.

The following resources provide examples of national digital health strategies:

- *Every African country's national eHealth strategy or digital health policy (38)*
- WHO Global Observatory for eHealth directory of eHealth policies *(39)*.

When **transitioning from a siloed digital health system architecture to an exchanged digital health system architecture** (see *Fig. 1.3.1*). This includes ensuring that the implementation of exchanged digital health enterprise systems is costed and has thoroughly considered foundational aspects, such as governance, standards and interoperability.

When validating the **need for a digital health investment in response to a funding request**. This is a common scenario; it is recommended that you follow the processes in this Guide to adequately assess the health system challenges and design a contextualized and impactful digital health implementation that can support evolving and collective needs within a common digital health architecture.

CHAPTER 02

FORM THE TEAM AND ESTABLISH GOALS

Once you are ready to start using this Guide, the first step is to form the team and establish goals for your investments in the digital health enterprise. In this chapter, you will determine team roles and responsibilities, develop a common understanding of the health programme's goals, and begin to understand how the health programme functions across all levels of the health system.

TOOLS	+ Common key roles and responsibilities (*Table 2.1.1*) + Planning and implementation charter (*Annex 2.1*) + Persona worksheet (*Annex 2.2*)
OBJECTIVES	+ Identify team and stakeholder roles. + Establish programme needs, goals and objectives. + Document structure of organizational units.
INPUTS	+ National digital health/eHealth strategy (if one exists) + Documents including health programme objectives, progress and any evaluations + Organograms describing directorates/departments in the Ministry of Health (MOH) and relevant government bodies, such as Ministry of ICT, civil registrars and so on
OUTPUTS	+ Identification of team (Output 1.1) + List of stakeholders to engage (Outputs 1.1, 1.2) + Shared vision of priorities within the health programme and digital health strategy (Outputs 2.1, 2.2) + Organogram and personas within the health programme (Output 3.1)

PRINCIPLES FOR
DIGITAL DEVELOPMENT

BE COLLABORATIVE[3]

+ **Understand how your work fits into the global development landscape.** Identify others working on the same problem in other geographies and determine if there is a community of practice that relates to your work. Find the technical leaders through virtual networks or communities of practice, such as the Global Digital Health Network, the Asia eHealth Information Network (AeHIN), Global Digital Health Partnership, Digital Health and Interoperability Working Group, Health Data Collaborative, African Alliance for Digital Health and/or Implementing Best Practices Initiative, who can help you disseminate your work to other teams, regions and countries.
+ **Engage diverse experts across disciplines, countries and industries throughout the project life cycle.** Create an engagement plan to apply this expertise at all phases and incorporate insights through feedback loops. Look for tools and approaches from other sectors and publish your findings so that they are available to other groups and countries.
+ **Plan to collaborate from the beginning.** Build collaborative activities into proposals, work plans, budgets and job descriptions. Identify indicators for measuring collaboration in your M&E plan.

3 Text adapted from Principles for Digital Development: Be collaborative: Core tenets (7).

2.1 Determine roles and responsibilities

Before embarking on the full planning process, you should form your team. Consider what skills, functions and knowledge may help when crafting a comprehensive costed implementation plan for a funder. Seek out individuals with adequate dedicated time who are qualified, motivated and knowledgeable over three areas: governance, management and operations.

GOVERNANCE: Consult a national digital health governance committee or other government technical oversight mechanism (see *Fig. 1.1.4*), if one exists, to ensure that the planned investment aligns with other government investments and national priorities in the current or upcoming health-sector plan, or consider forming such a mechanism if one does not exist. This committee can be responsible for providing overarching direction and guidance.

If forming a governance committee, discuss the governance principles and how responsibilities would be shared, even if no formal governance policies exist yet. Identify a senior ministry sponsor to chair the committee who can mobilize resources, align interests and resolve potential conflicts, as well as a digital health lead who is tasked with oversight of deployment of the digital health enterprise. This process should lead to the development of a corresponding Terms of Reference.

Consider including these people on the governance committee:

- senior ministry sponsor
- ministry lead for digital health, which may be Health Information Systems (HIS), M&E or combined with the Ministry of ICT
- representatives of relevant additional ministries (such as ICT, civil registrars, network regulators and local government)
- technical team leaders
- representatives of funding and technical agencies.

MANAGEMENT: The management team will be responsible for completing the process to develop a costed implementation plan as outlined in this Guide. This team should expect to devote a substantial level of their daily work time to these tasks. Look for team members who possess a significant amount of technical capacity; prior experience in managing large implementations is an important asset.

Consider including these people on the management team:

- project/process manager, who takes responsibility for the delivery of this process
- procurement manager
- M&E analyst
- digital health specialist/enterprise architect
- health programme manager
- human-centred design advisers
- change management advisers
- policy advisers
- implementing-partner representatives.

OPERATIONS: The operations team works under the guidance of the management team, providing necessary technical expertise. Consider the skills needed to successfully implement the proposed work when selecting operations staff, as they will provide important perspectives on how to build out a viable plan. Team members may have multiple competencies, or you may need more than one person for any one of these areas.

Consider including these people as operations support:

- business analysts (to develop requirements for the digital enterprise, consisting of applications and platform)
- software developers
- system maintenance, optimization and end-user support or help desk staff
- training or technical staff
- database managers
- end-user representatives.

Mapping stakeholders with the roles and responsibilities of individuals can help achieve this goal (see *Annex 2.1*). You will draw on various people at different points, and identifying expertise at the outset will speed the

planning process. *Table 2.1.1* describes each of these roles in detail to guide recruitment of the required skill sets. Although your digital health implementation may not require every role, these are perspectives that should be considered either internally or through external mechanisms, such as proposals for technical assistance.

Table 2.1.1. Key roles and their descriptions.

Functional area	Role	Description
GOVERNANCE	Digital health governance mechanisms	May include a sponsor from a senior ministry and representatives from other relevant ministries and funders, as well as technical team leaders. In some contexts, digital health governance committees are called *Technical Working Groups*. These governing stakeholders oversee the digital health investment's progress, engage the right stakeholders, ensure financing and provide sufficient oversight to the Management and Operations teams. They set the overall direction, make key decisions and select important team members.
	Digital health lead	Accountable for successfully deploying the digital health intervention within the context of the broader health system and may be tasked with developing or refining the national digital health strategy. The digital health lead may also be responsible for identifying needed policies and gaps, such as in data security, standards and the national digital health enterprise architecture.
MANAGEMENT	Project/process manager	Takes on the responsibility for day-to-day direction of the implementation, communicates with the Governance team and ensures that the system is deployed on time and on budget. Ideally, an influential and skilled person within the MOH will fill this role, but technical partners can support it. The project manager should possess excellent managerial, technical and negotiation skills. This person also facilitates and promotes adoption of the change-management process.
	Procurement manager	Ensures that implementation partners follow organizational guidelines for contracting and licensing.
	M&E analyst	Reviews the planned digital health intervention to determine the key indicators to use for monitoring progress and ensuring that national needs for reporting indicators are met. In some contexts, this role may be called the data manager or health management information system (HMIS) lead.
	Digital health specialist/ Enterprise architect	Ensures that the planned digital health implementation can operate within the current ICT infrastructure, recommends new infrastructure investments and reviews ICT human-resource capacity to ensure that the entire digital health enterprise can be deployed sustainably. This person should have expertise in informatics or HIS architecture.
	Health programme managers	Provide technical feedback on the programmatic needs and clinical workflows for the specific health domain affected by the digital health implementation.
	Human-centred design expert	Engages the end users directly for co-design and co-creation of the planned digital health intervention. Trained in human-centered design, this person would provide technical support in determining the most appropriate methodologies and mechanisms for engaging the end-users from the beginning.
	Change management expert	Explores the intended and unintended impact of the digital health interventions on current workflows, identifies potential risks (including human, technical and system risks) and works with the team to develop mitigation plans for possible failure points in the proposed implementation. This person also reflects on the needs for change management and ensures that interventions take into account end-users' motivations to support adoption of the digital health interventions.
	Implementing partner representatives	Represent organizations responsible for implementing the digital health interventions within applications and the enterprise. Provide technical support, strategic direction and guidance and share practices from other contexts.

Functional area	Role	Description
OPERATIONS	Business analyst	Analyses and documents workflow of the clinical care and health programme processes and recommends digital health interventions relative to the prioritized business requirements.
	Software developers	Transform requirements into specifications for information systems and executable code.
	Quality assurance testers	Validate that the requirements have been met by the software developers and oversee testing of the applications for bugs and functionality issues before deployment.
	Security and data-hosting adviser	Manages and advises on security risks, including cloud hosting.
	Systems maintenance, optimization and end-user support or help desk staff	Ensure that the digital health enterprise technologies are well maintained and operating at peak performance. Also provide different methods of support via email, voice and in person to end-users and administrators of the digital health enterprise.
	Training or technical staff	Train and provide capacity-building support to end-users and administrators of the digital health enterprise.
	Database managers	Maintain database performance and ensure that end-users can access and use high-quality data.
	End-user representatives	This important stakeholder group can give feedback on design choices, increasing ownership and agreement during implementation.

Box 2.1.2. Resources for establishing governance mechanisms.

For detailed case studies on establishing governance mechanisms, see the Broadband Commission Report *Digital health: a call for government leadership and cooperation between ICT and health* (42), which describes processes conducted at country level, bolstered by specific examples from Canada, Estonia, Malaysia, Mali, Nigeria, Norway, the Philippines and Rwanda.

The *Digital health convergence meeting toolkit* (43) provides useful considerations for establishing governance mechanisms through convergence meetings that bring together different stakeholders, including departments in MOHs, development partners, international NGOs, experts in related fields and end-users. The convergence-meeting approach offers a framework for bringing together government officials from different ministries, digital health professionals in countries and technical experts committed to successfully implementing and strengthening the HIS and digital health.

CASE STUDY

Convening stakeholders and determining governance structure in Sierra Leone

In 2016 following the Ebola viral disease outbreak, WHO facilitated a planning process with the Ministry of Health and Sanitation (MOHS) for informing prioritization of digital systems addressing national health priorities, in line with directives from the President's Recovery Plan *(40)*. This process sought to align the use of digital tools with defined health system challenges in response to the immediate national priorities of restoring health services, particularly related to malaria, acute malnutrition and maternal and newborn deaths due to home deliveries *(40)*. Furthermore, the fragmented approach to digital health investments during the Ebola outbreak underscored the importance of governance structures and strategic planning.

During this process, WHO and the MOHS convened a diverse set of stakeholders representing programme directorates leading work across various health domains, information systems and M&E of aggregate health indicators, the Ministry of ICT, donors, NGOs and implementation partners *(41)*. Over the course of a three-day workshop, the convening organizations facilitated discussions on the specific health needs that would be the focus of digital health investments, as well as the governance structure for developing a national digital health enterprise architecture and administering digital health investments.

This process resulted in defining the roles of different directorates within the MOHS and assigning responsibilities for maintaining and harmonizing different digital systems. The outcome of this meeting resulted in a joint declaration across all programme directorates within the MOHS known as the Bintumani Declaration (based on the name of the venue in which the meeting and declaration was held). The following is an excerpt from the Bintumani Declaration:

> We, the stakeholders here gathered, under the firm leadership of the MOHS through the Directorate of Planning, Policy and Information (DPPI), hereby declare:
>
> - Sierra Leone will develop a unified national architecture for our health information systems;
> - That will improve the availability, appropriate access and use of quality health information across all levels of the health system;
> - We will increase access to and use of health information technology to improve service delivery and demand for services to improve health outcomes;
> - This process will be led, championed and sustained by the DPPI for the benefit of all;
> - We will strengthen our existing governance structure to improve its effectiveness and participation by our partners;
> - We pledge to seek the commitment of government and partners to provide technical and/or financial resources to realize this vision.
>
> These declarations – dubbed the Bintumani Declarations – made on this 3rd day of August the year 2016 have been endorsed by the Ministry of Health and Sanitation and its partners. *(41)*

BID INITIATIVE CASE STUDY

BID Initiative: User advisory groups and goals

The BID Initiative was designed to be country led and country owned, with partnership and collaboration elevated as core values. In Tanzania, the Immunization and Vaccine Development program (a department of the Ministry of Health, Community Development, Gender, Elderly and Children) oversaw the overall governance of the BID Initiative, and a user advisory group (UAG) was established to play a critical role in the prioritization, design and development of proposed approaches and interventions *(44)*. PATH and other technical partners provided management and operations support. The UAG met in person monthly, and each member served as a champion for BID, sharing information and gathering feedback in their local communities, as well as supporting dissemination and implementation of the completed interventions.

The UAG provided an opportunity for end-users to get deeply involved in BID's strategic planning and decision-making from the outset. It included 15 representatives from all levels of the health system in the BID Initiative's Arusha testing region, including the Regional Immunization and Vaccine Officer. Members provided input on topics like supply chain, data collection, service delivery and community involvement. End-user involvement is critical in understanding what end-users do, what they need and how to create a sense of ownership that is crucial to the success of any initiative. A similar UAG was also set up in the Livingstone District of Zambia *(45)*.

These stakeholders helped validate and refine a list of the most critical routine problems with immunization service delivery that they would work to address through the initiative:

- incomplete or untimely data
- lack of unique identifiers for infants
- inaccurate or uncertain target population for calculating immunization rates
- difficulty identifying infants who do not start immunization or who drop out (defaulter tracing)
- poor data visibility into supplies at the facility and district levels
- complex data-collection forms and tools
- insufficient management of supply chains and logistics
- inadequate capacity for data management and use at all levels of the health system.

These problems were identified through desk reviews, consultation meetings, scoping visits, an in-depth analysis of demographic and immunization data and a landscape of the countries' digital health infrastructure at the outset of the BID Initiative.

The following tools are available from the BID Initiative to help with forming UAGs.

- The *Stakeholder analysis tool* *(46)* helps identify and map individuals and organizations to include on your team.
- The *UAG terms of reference* *(47)* can be adapted to reflect the goals and responsibilities of your unique UAG.

2.2 Develop a common understanding of the health programme's needs and goals

Once you have formed the planning team, convene them and any necessary additional stakeholders to articulate a common understanding of the main goals of the health programme and how they align with your country's national digital health strategy (if there is one). The team should also review core programme documents, data and assessment reports that describe the programme's goals and objectives, including how it has performed to date.

In this review of health programme documents, aim to clearly identify the following:

1. Short- and long-term goals and objectives of the health programme

   a. Assess how the program aligns with priorities under the national strategic health plan or other government strategies for investing in health. Ensure that all stakeholders have a shared understanding of the health programme's goals.

   b. Assess how the health programme aligns with the national digital health strategy (if one exists). For example, the national digital health strategy might include overarching goals like "improved access to health services". This may be followed by "digital health outcomes" (possibly stated as "eHealth outcomes" or "health ICT outcomes", as in the example of Nigeria in *Fig. 2.2.1*), such as "effective use of telemedicine and ICT for health worker training and support" *(48)*.

   c. Assess how well these goals align with the needs of the population that the health programme targets. Should the health programme focus on particular populations or groups to improve equity and coverage?

Fig. 2.2.1. Example of Nigeria's national health ICT vision extracted from the national eHealth strategy.

NIGERIA NATIONAL HEALTH ICT VISION	**By 2020, Health ICT will help deliver and enable universal health coverage —** whereby Nigerians will have access to the services they need without incurring financial risk.					
UHC OUTCOMES	Improved access to health services	Increased coverage of health services	Increased uptake of health services	Improved quality of care	Increased financial coverage for health care	Increased equity in, access to, and quality of health services, information, and financing.
HEALTH ICT OUTCOMES	Effective use of telemedicine and use of ICT for health worker training and support	Effective use of CRVS, HRIS, NHMIS & LMIS for tracking demand and supply of health services and commodities	Effective use of mobile messaging & cash transfers for demand creation	Effective use of ICT for decision support & within the continuum of care	Effective use of ICT for health insurance & other health-related financial transactions	Effective use of ICTs for delivering appropriate health services for those who need them most based on epidemiology and ability to pay
LONG-TERM ICT OUTPUTS	Nationally scaled integrated Health ICT services and applications supported by Nigerian Health Information Exchange implemented with appropriate funding, infrastructure & equipment, training & policies.					

Source: Government of Nigeria National health ICT strategic framework, 2016 (48).

2. Health programme indicators, or measures of success, and evaluations to help assess whether health programme goals are being met, which will help establish deficiencies within the health programme and begin to identify where to target potential digital health investments

   a. Team members focused on M&E should identify and summarize appropriate health programme performance reports prior to the stakeholder meeting.

   b. Assess whether data to understand programme performance are adequate and routinely collected or whether additional data are required to improve programme assessment; articulate these as "gaps".

   c. Use this discussion to identify any other objectives that are valuable to the programme stakeholders but have not been clearly articulated in the documented goals and objectives reviewed in (1) above.

2.3 Understand programme operations across levels of the health system

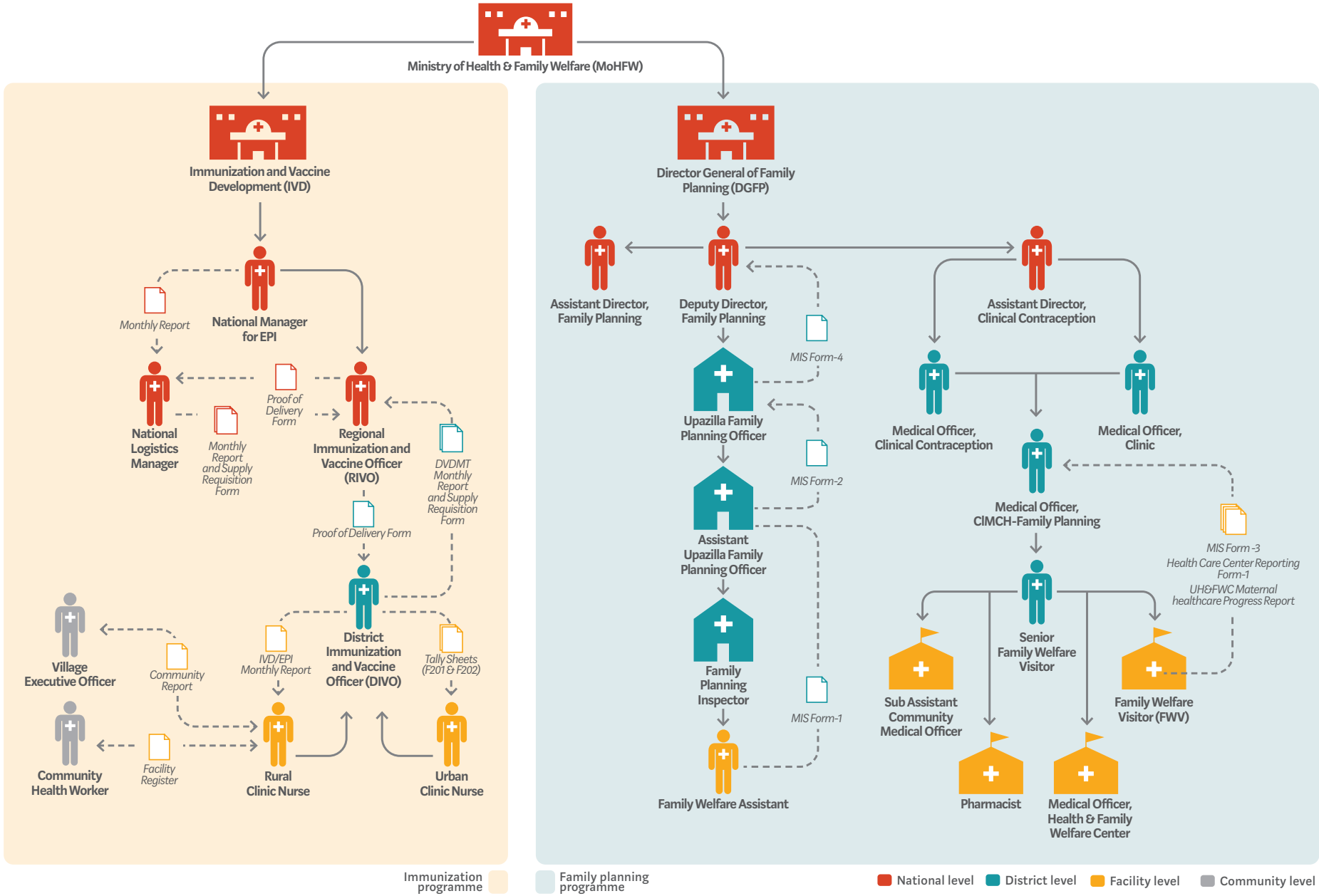
All stakeholders need to understand how the current health programme operates in practice, including the workflows and information flows across all levels of the health system (a focus of *Chapter 3*). You may find it helpful to document the structure of the health system and the types of workers and their roles at each level of the system. Resources like organizational diagrams (organograms) and health workforce operational guidance may exist that describe the health programme's management, human-resource structure and expected roles and responsibilities.

During this step, try to describe the following:

- » the different tiers of the health system, including the community, district and provincial levels
- » the types of health provider and management workforce cadres associated with the programme area and their relationships with the levels of the health system
- » linkages across different health programme areas, such as immunizations and antenatal care
- » the names of the health facility types and the health workforce cadres associated with providing care within the health programme area.

You may find it helpful to create a diagram using lines and arrows to illustrate the levels of the health system, facility types and cadres, their relationships to one another and their collective responsibilities (see *Fig. 2.3.1*).

Fig. 2.3.1. Illustrative example of a health system organogram and relationships.



Once you have mapped the general health system, identify the range of end-users and beneficiaries of the specific health programme. These individuals may be the same ones identified in the organogram – health workers, community-level supervisors, clinical staff and district-level managers – and they may include individuals from NGOs and other sectors of government.

To help understand specific end-users and beneficiaries of the health programme, you should create personas, which are generic aggregate descriptions of the different types of people involved in or benefiting from the health programme. Personas help stakeholders view the objectives and programmatic challenges from the vantage point of the people who deliver or receive health services. Personas also help align stakeholders around shared definitions and perceptions. Finally, they provide a common point of reference on who delivers health services, monitors or supervises services and, ultimately, receives services.

For the purposes of this Guide, consider creating personas for managers, health workers and clients in the health programme. For managers and health workers, list personal and professional aspirations and challenges for each persona, as well as familiarity with and use of technology. Include the following characteristics:

- responsibilities within the health programme area
- any dependencies (actions or individuals) required to trigger essential activities
- challenges routinely faced that negatively affect the persona's responsibilities and health outcomes, or what affects job satisfaction
- vision of success from the persona's perspective, or what would make it easier to perform the job well.

For clients, include the same characteristics as in provider personas, plus the following:

- barriers to accessing appropriate services and completing recommended treatments (including financial, information, geographic and cultural obstacles that may prevent use)
- vision of successful care from the client's perspective, or what would improve satisfaction with health services that the client has received.

As an example, *Table 2.3.2* describes key personas that commonly engage with or benefit from childhood immunization programmes (for more information, see *Chapter 4*). When you design the digital health implementation, you will directly involve the identified personas and incorporate their feedback into the design, particularly if they are intended end-users of digital health interventions. Once you have identified and described each persona, detail their user stories and routine interactions within each health programme and between personas. *Chapter 4* describes the process of developing user stories in greater detail.

See *Annex 2.2* for a worksheet to use when developing personas.

Table 2.3.2. **Examples of personas developed when planning an immunization programme.**

MANAGER PERSONA: Dr Regina Flowers, Regional Immunization Officer	
RESPONSIBILITIES	Reports and communicates district-level lessons to policy-makers at the national level. Oversees funding for and supply of vaccines.
DEMOGRAPHICS	**Age**: 50+ **Education**: MD Fluent in English. Uses computers and smartphones regularly.
CHALLENGES	Vaccine use and supply data are frequently missing or erroneous. Data reports are delayed and difficult to synthesize. Field staff are not well trained.
WHAT WOULD SUCCESS LOOK LIKE	Adequate funding. High-quality and regular data. Engaged and responsive policy-makers.
MANAGER PERSONA: Mr Paul Dacosta, District Immunization Officer	
RESPONSIBILITIES	Provides vaccines and supervision to clinics. Supervises 30 clinics. Records vital statistics
DEMOGRAPHICS	**Age**: 50+ **Education**: MPH Fluent in English. Owns a smartphone. Can use computers.
CHALLENGES	Unable to supervise all the clinics due to time constraints. Data not reported regularly by the clinics.
WHAT WOULD SUCCESS LOOK LIKE	Regular contact with the clinics with time to troubleshoot. High-quality and regular reports from the clinics.
PROVIDER PERSONA: Ms Cissy Dialo, Clinic Nurse	
RESPONSIBILITIES	Administers vaccines in the clinic or during home visits.
DEMOGRAPHICS	**Age**: 25+ Educated Owns a basic personal phone.
CHALLENGES	Clients often miss or delay immunization. Vaccines frequently out of stock.
WHAT WOULD SUCCESS LOOK LIKE	A system to manage all the clients to ensure that they receive vaccines on time.
CLIENT PERSONA: Mrs Marisa Mukumba and Jenny, Client Mother and Child	
RESPONSIBILITIES	Mother takes the child for immunizations.
DEMOGRAPHICS	Child's father has a mobile phone. Mother is literate.
CHALLENGES	Forgets when the next immunization is due. Local clinic does not regularly have supplies.
WHAT WOULD SUCCESS LOOK LIKE	Good access, on time, to quality care for the child. Going to the facility when health workers are there and needed vaccines are in stock.

Source: Adapted from Product vision for the BID Initiative, 2014 (49).

You should now have an understanding of the following:

- ❒ Members of your team (Output 1.1)
- ❒ Stakeholders to engage throughout the planning and implementation process (Output 1.2)
- ❒ Key outcomes from the national digital health strategy (if one exists) that you intend to build on
- ❒ Priority goals (Outputs 2.1, 2.2), organogram (Output 3.1) and personas (Outputs 3.1, 1.3) within the health programme(s) you are addressing.

This information can be collected in the worksheet in *Annex 2.1*.

CHAPTER

03 IDENTIFY HEALTH SYSTEM CHALLENGES AND NEEDS

In the previous chapter, you aligned a team around the primary goals of the health programme and identified key national strategies (health programme and digital health) to guide the planning process. In this chapter, you will pinpoint specific health programme processes and articulate the bottlenecks that you seek to improve, which will set the stage for selecting appropriate digital health interventions.

TOOLS	+ Process matrix (*Annex 3.1*) + Root causes of common bottlenecks (*Fig. 3.2.1*) + Bottleneck-mapping worksheet (*Annex 3.2*)
OBJECTIVES	+ Examine current processes and workflows for the health programme area. + Identify and prioritize bottlenecks, also known as pain points, within the health programme area. + Link bottlenecks to standardized health system challenges to determine actionable areas for improvement.
INPUTS	+ Named team and list of stakeholders engaged throughout the planning and implementation process + Shared vision of health programme goals + Personas within the health programme
OUTPUTS	+ Current-state ("status quo") workflow diagrams illustrating the user journey of selected health programme processes (Output 3.4) + Prioritized bottlenecks (Output 3.2) mapped to list of health system challenges to be addressed (Output 3.3)

PRINCIPLES FOR DIGITAL DEVELOPMENT

UNDERSTAND THE EXISTING ECOSYSTEM[4]

+ **Engage with your target end-users and consult existing research to develop an understanding** of the people, networks, cultures, politics, data needs, infrastructure and markets that make up your ecosystem before designing your initiative or tool.
+ **Coordinate with other implementing organizations, civil society and the government** early on to learn from successful and unsuccessful initiatives in the ecosystem, to avoid duplicating efforts and to integrate with existing technical systems more easily.

DESIGN WITH THE USER[5]

+ **Incorporate multiple user types and stakeholders** in each phase of the project life cycle to direct feature needs and revise the design. Here, users are people who will interact directly with the tool or system, and stakeholders are people who will be affected by or have an interest in the tool or system, such as people whose data are being collected, government officials or researchers who may study the data collected.
+ Design tools that **improve users' current processes**, saving time, using fewer resources and improving quality.
+ **Develop a context-appropriate digital implementation** informed by end-users' priorities and needs, considering the ecosystem and accepting that some digital approaches will not be appropriate.
+ Develop the digital enterprise in an **incremental and iterative manner**, with clear objectives and purpose in mind.
+ **Ensure that the design is sensitive to and considers the needs of the historically underserved.**
+ **Embrace an iterative process** that allows for incorporating feedback and adapting your implementation after initial testing and launch.
+ **Be open about setting expectations** and let people opt out of participating in the design process.

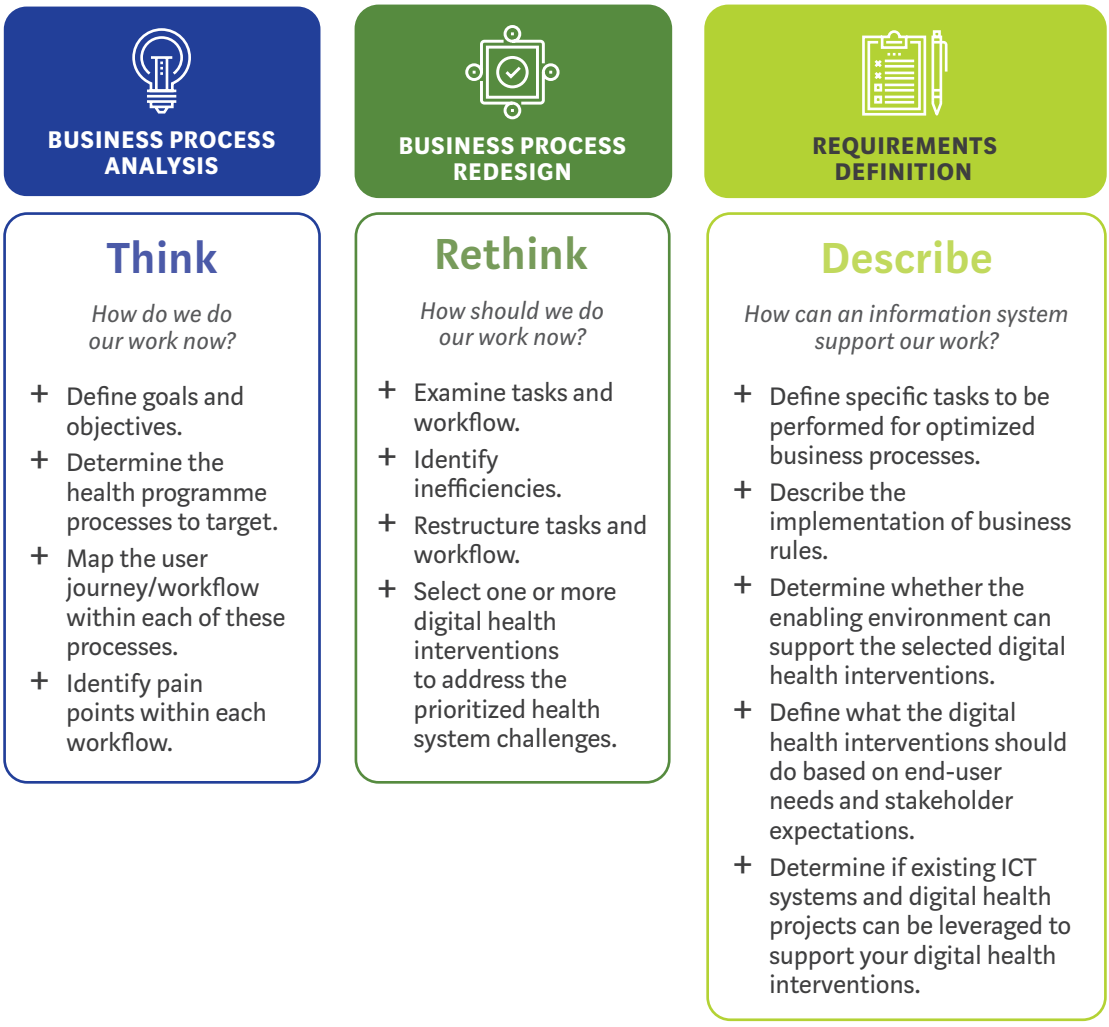
4 *Text adapted from Principles of Digital Development: Understand the existing ecosystem: Core tenets (7).*

5 *Text adapted from Principles of Digital Development: Design with the user: Core tenets (7).*

In this chapter, you will pinpoint specific health programme processes and articulate the bottlenecks that you seek to improve, which will set the stage for selecting appropriate digital health interventions (see *Fig. 3.1*). This process builds on the Public Health Informatics Institute's Collaborative Requirements Development Methodology (CRDM), a commonly used approach for defining the problem, identifying how it could be improved, and describing how the improved process would need to function *(50)*.

Fig. 3.1. Adaptation of CRDM approach for defining health system challenges.

The CRDM approach is broken down into three areas of concentration:



3.1 Map the current state of programme activities

First, you will need to understand how the health programme currently functions, or the workflow of the programme. This requires thinking through the tasks that are performed to meet the goals and priorities of the health programme articulated in *Chapter 2*. In other words, you will analyse the various processes within the health programme and identify the bottlenecks that prevent optimal delivery of those services, resulting in a diagram of the current state.

The process for mapping the current state has three steps.

1. Determine the health programme processes to target.
2. Map the user journey (illustrated through a workflow) within each of these processes.
3. Identify bottlenecks within each workflow.

3.1.1 DETERMINE THE HEALTH PROGRAMME PROCESSES TO TARGET

Health programme processes, also called *business processes*, consist of a set of activities or tasks performed together to achieve the objectives of the health programme area or health system *(51)*. Processes involve different personas and may cross multiple levels of the health system. For example, within the area of antenatal care, health programme processes can include activities associated with identifying pregnant women, generating demand for services, monitoring supplies and commodities, managing and following up with clients, and reporting (see *Fig. 3.1.1.1*).

Start by identifying all of the priority processes for your health programme. For each of the identified processes, list the objectives, the inputs needed, the expected outputs, the specific sets of tasks that make up the process and the expected outcomes. Describe tasks in as much detail as possible, and include every step of the process.

The process matrix in *Fig. 3.1.1.1* illustrates health programme processes for an immunization information system. In this example, the Expanded Programme on Immunization (EPI) constitutes the health programme, with the goal of providing universal immunization for all children *(52)*. Within the EPI health programme, there may be a variety of processes, such as stock management and patient management for tracking vaccination history. These processes have a set of tasks that one of the personas needs to carry out, such as registering clients, ordering stock and recording stock levels. See *Annex 3.1* for a process matrix worksheet.

Fig. 3.1.1.1. Process matrix illustrating three example processes within a typical vaccination programme.

#	PROCESS	OBJECTIVE	TASK SET	OUTCOMES
A	**Patient management**	Maintain a database of all newborns, with their vaccination history.	» Register patient » Search for existing record » Maintain patient database	More complete registration of newborns
B	**Vaccination management**	Ensure that all infants are vaccinated with all vaccine doses in the national schedule.	» Define national schedule » Plan vaccinations » Send reminders » Register vaccinations » Monitor vaccination coverage	More timely vaccination, higher vaccination coverage
C	**Stock management**	Ensure that vaccines and other stock are always available when needed, while minimizing wastage and excess stock.	» Order stock » Receive » Store » Count stock » Monitor balances, expiry dates, wastage and usage	Higher availability and lower wastage of vaccine and other stock
D	**Service delivery**	Ensure that the provider is providing quality services (providing vaccinations) to clients by having the necessary vaccination history and list of which vaccinations are needed.	» Provide counselling » Diagnose » Dispense (provide vaccination) » Refer » Update record with which vaccinations have been given » Schedule and inform client of next visit	Provider is following correct protocol and vaccination schedule, more timely vaccinations, increased coverage, improved quality of care, greater documentation of vaccinations provided

Source: Adapted from WHO/PATH Planning an information systems project, 2013 (2).

3.1.2 MAP THE WORKFLOWS FOR TARGETED PROCESSES

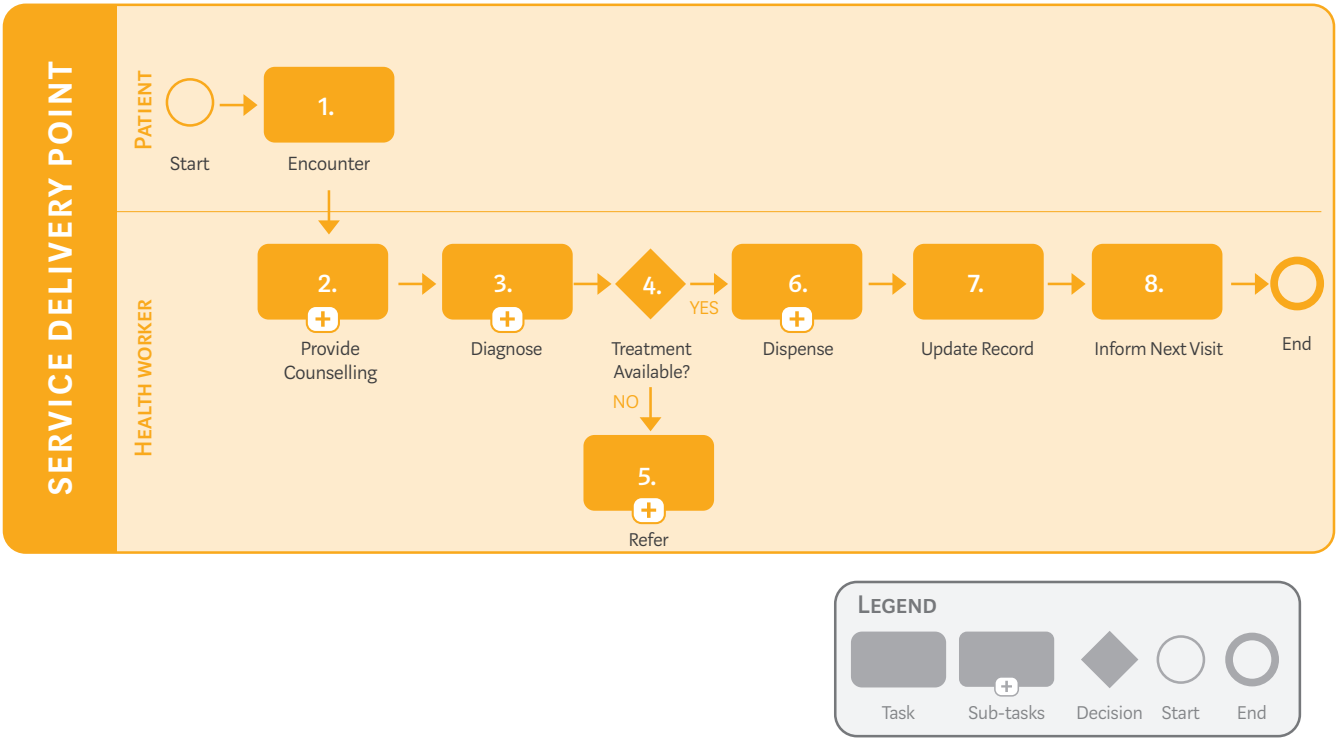
Now that you have identified and described important processes in the health programme, you can further examine the user journey to understand where to make improvements. Describing these processes as they occur, with as much input from programme implementers with on-the-ground experience as possible, is vital to capture events as they typically happen, rather than how they are officially supposed to happen or imagined to happen in theory. Detailing **tasks**, or the specific activities within a health programme process, will uncover opportunities to improve the overall process.

Workflows, or *task flow diagrams*, are one way of illustrating the user journey. Workflow diagrams are visual representations of the progression of activities (tasks, events and interactions) performed within a health programme process. These diagrams help visualize specific activities within the process and illustrate the interactions between the personas who perform those activities (see *Fig. 3.1.2.1*). The result of one task generally triggers another task, until the final process objective is reached. All tasks associated with the process being mapped should appear at least once on the workflow diagram. These diagrams also map how information moves through the system and can be used to identify and illustrate where bottlenecks occur. (See *Box 3.1.2.2* for a description of symbols generally used in workflow diagrams.)

Develop workflows for the different processes through discussions with the people who provide services within the health programme. Try to get multiple perspectives of how work is actually performed, rather than how health system managers may think (or hope) the work is done. This should also be complemented by mapping the range of processes and interventions delivered during a given interaction. By doing so, you can ensure that you avoid designing around a single health need but missing other interactions that the health provider may have at the same time with the same patient.

Ultimately, any separate workflows that are part of a process should tie together when the analysis is complete. As stakeholders review activities within the different processes, they can reflect on the challenges that prevent achieving the outlined activities. When designing an intervention, you could use the workflow diagrams to explain how the health programme works, the interrelations between people and places and the issues to address in order to improve performance. You may also want to review common workflow diagrams documented in WHO digital accelerator kits *(22)* relevant to the programme area(s), which can offer a starting point for discussion and comparison with your own workflow systems.

Fig. 3.1.2.1. Example workflow diagram for a service-delivery process.



Source: Adapted from WHO/PATH Planning an information systems project, 2013 (2)

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Box 3.1.2.2. Conventions that are generally used when mapping workflows.

- » Tasks are represented as boxes.
- » Diamonds represent decision points.
- » Boxes with double lines represent bundles of numerous subtasks.
- » Circles represent start and end points of the workflow.

For more information on standard notation for workflow diagrams, see the *CRDM website (50)* and WHO's Optimizing person-centric record systems: a handbook for digitalizing primary health care *(53)*.

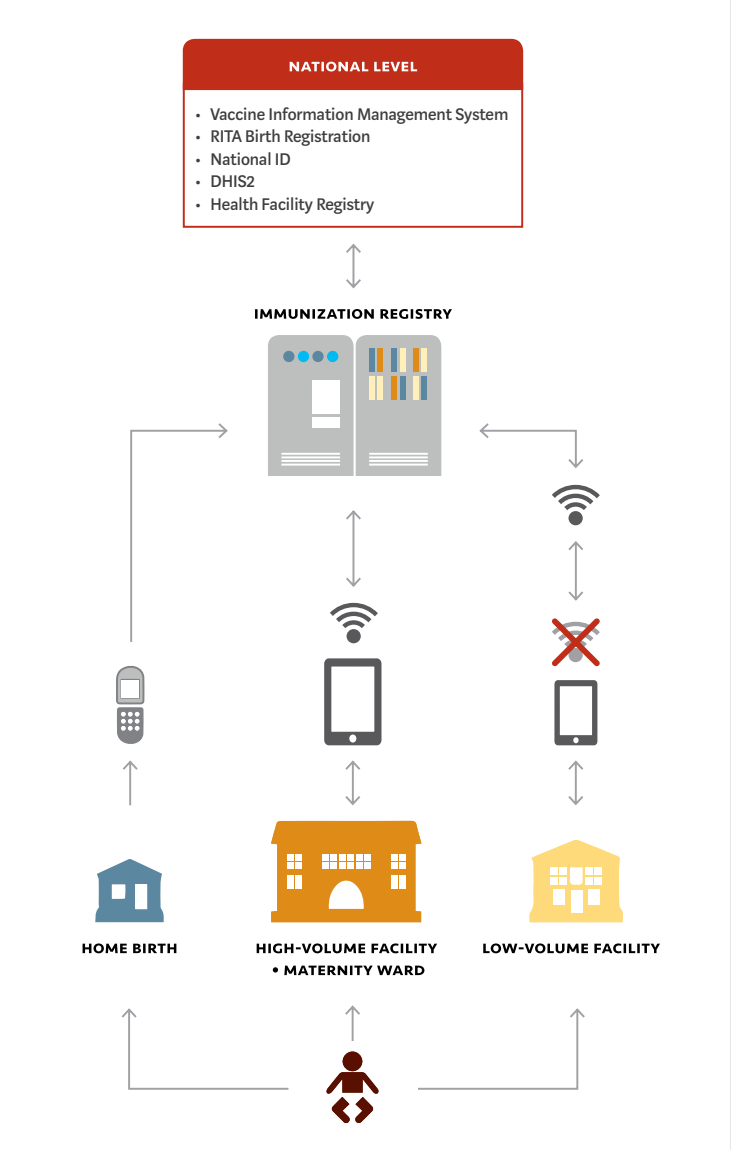
BID INITIATIVE CASE STUDY

BID Initiative: Business processes

It was hard for Oliver Mlemeta, the sister in charge at the Usa River Health Facility in Tanzania, to know how many children to expect on immunization day. To figure out which children were due, she would spend hours sifting through dense immunization registries and tallying numbers. Then she had to make sure she had adequate supplies on hand. If her vaccine stock was low, she would spend more time calling other clinics and retrieving what she needed by motorbike. Sometimes, she would have to turn mothers and children away because there were not enough supplies.

When her facility's immunization day arrived, Oliver and her team would vaccinate hundreds of children. Afterwards, more days of reporting awaited the team; they often worked nights and weekends to record metrics into paper ledgers by hand. Once the data were sent to the district, it was just as difficult for district staff to provide feedback that could help Oliver improve services. She rarely knew how she and her facility were performing because the flow of data was often unidirectional.

The BID Initiative was designed to make Oliver's work easier, to help her do her job better and to reach more children with lifesaving vaccines. Its vision was to empower countries to enhance immunization and overall health service delivery by improving data collection, quality and use. In doing so, the BID Initiative worked closely with the governments of Tanzania and Zambia to identify the most critical challenges to immunization service delivery, defining 16 business processes and associated tasks related to operating a national immunization information system in Africa, including client registration, vaccine administration and report generation. These processes were developed through ongoing consultation with key country stakeholders and can be found in the *Product vision for the BID Initiative* (49).



3.1.3 IDENTIFY AND CONFIRM BOTTLENECKS

As you create the workflows, challenges – or bottlenecks – should emerge. These are areas where failures in service delivery occur, where health workers experience frustrations or even where patients may be lost to follow-up. Bottlenecks are the specific gaps that prevent personas from reaching their goals of success and achieving positive health outcomes. Bottlenecks contribute to the suboptimal implementation of health programmes and are often causes of the failure to meet the programme's goals.

For example, in the workflow shown in *Fig. 3.1.2.1*, you may find that clients routinely do not show up for their expected first encounters (Task 1). Further discussion may reveal that clients experience difficulties (such as when articulating their needs) that prevent them from benefiting from a health worker's consultation and diagnosis (Task 2). Issues like inaccurate diagnoses or adherence to clinical protocols during consultations may emerge as additional bottlenecks associated with the health worker, also occurring at Task 2.

You could validate that the workflow diagrams are accurate through observations and interviews with stakeholders who are involved in performing the work, as well as with clients attempting to access the health system. This validation should take place with the health workers and clients who know what happens on a daily basis and who can share rich insights into how these activities work in practice, rather than with directors and supervisors. You could organize discussions with those at the frontlines who can additionally articulate their challenges in delivering health services, highlighting the bottlenecks. Reviewing the workflow diagram with them and explaining your goals and what you will do with the information will improve accuracy in representing the workflows. This process of engaging with personas will help document gaps between the current state and the desired future state of the health programme by identifying the following:

- inefficiencies or gaps
- efficiencies that can be gained with repeatable tasks
- redundancy in tasks, such as information collected more than once
- blocks to the optimal flow from one task to the next.

3.2 Conduct a root cause analysis of bottlenecks

A root cause analysis helps identify the factors underlying the bottlenecks occurring in health programme processes. This analysis narrows the list of actionable bottlenecks and determines which issues can be addressed with available resources.

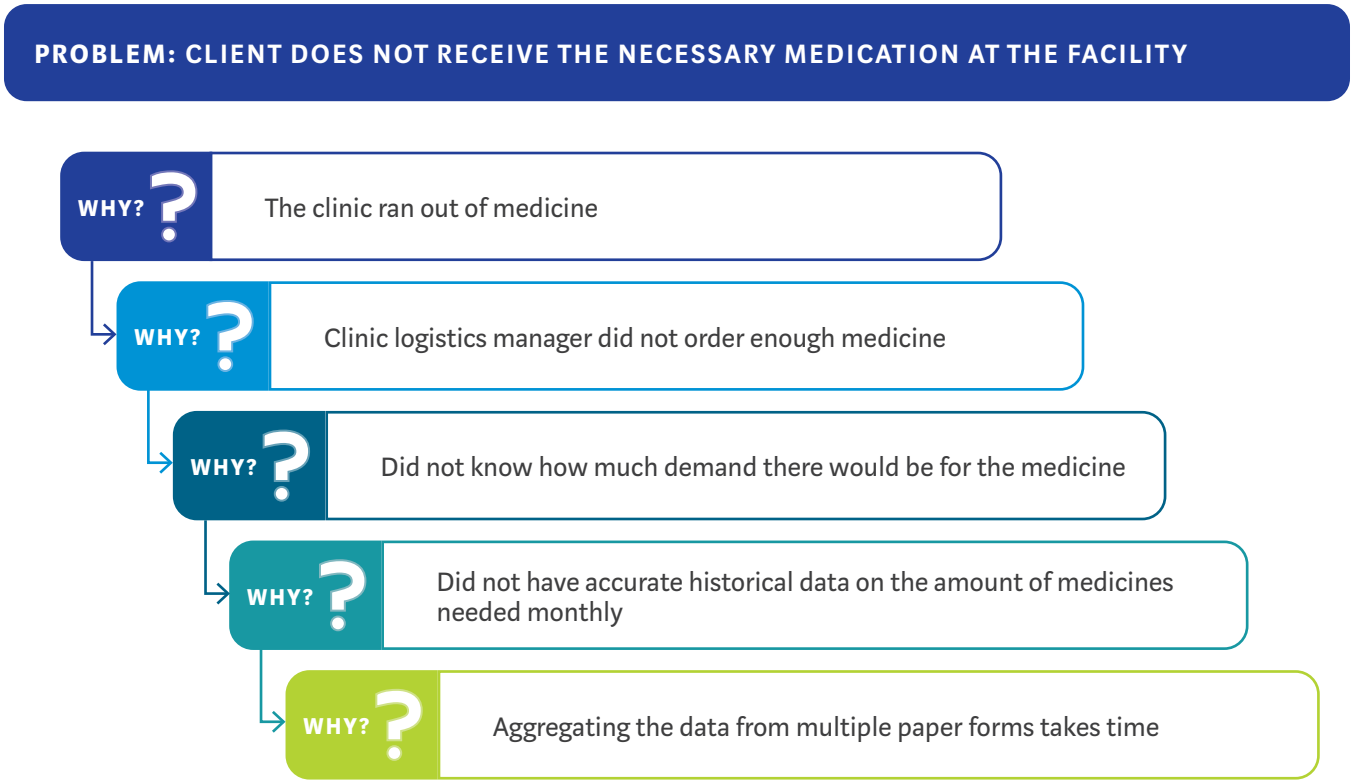
Three types of root causes may emerge through this process.

1. **PHYSICAL**: tangible, material items failed in some way.
2. **HUMAN**: people did something wrong or did not do something required.
3. **ORGANIZATIONAL**: a system, process or policy that people use to make decisions is faulty.

The root cause analysis may also reveal situations where a digital health intervention may not be warranted or ideal. For example, the reason vaccines are not given to every child who comes to an immunization camp may not be because the vaccines are out of stock, but because a supervisor has discouraged the vaccinator from opening a multidose vial for a single child, resulting in wastage. In this case, other types of nondigital interventions to mitigate the recurring problem would be more appropriate.

The 5 Whys method is an intuitive way to identify the root cause of a bottleneck (see *Fig. 3.2.1*). This method involves asking "Why does this problem exist?" five times, or until you get to the foundational roots of the problem. It is important to include those who are experiencing the problem directly to be involved in determining the "Whys".

Fig. 3.2.1. Using the 5 Whys model to identify the root cause of bottlenecks.



Source: iSixSigma: Determine the root cause: 5 whys (54).

Find more examples and worksheets to support the 5 Whys process in the *iSixSigma online library* (54).

3.3 Prioritize bottlenecks

Now that you have a better understanding of their root causes, you can rank the bottlenecks, identifying those that contribute the most to preventing success of the health programme. Although you may ideally like to address every bottleneck, limits on resources often require focusing on the most important challenges or the ones that you feel you have the ability to influence. Stakeholders should discuss and review the bottlenecks and their root causes, comparing them until they agree on a ranking from most to least critical.

Factors that influence bottleneck rankings include whether the issue can actually be resolved, the capacity of stakeholders to drive this change and the potential impact of resolving the issue. Also take the perspectives of different personas into account when prioritizing bottlenecks. For example, in Task 2 of *Fig. 3.1.2.1* ("Provide Counselling") and Task 3 of *Fig. 3.1.2.1* ("Diagnose"), the most important bottleneck for the client may be not having appropriate information on the type of services she should be receiving, whereas the health worker may feel most frustrated by not having the clinical tools necessary to screen patients.

Table 3.3.1 offers some considerations for ranking bottlenecks, which you may find useful in guiding discussion and reaching consensus among stakeholders. The table describes three hypothetical examples of bottlenecks, which receive scores of Low (1), Medium (2) or High (3) based on responses to three questions. Adding the scores together gives the prioritized ranking. Alternatively, you may choose to list and prioritize the bottlenecks by debate.

Table 3.3.1. Formula for scoring and ranking bottlenecks, with examples.

Bottleneck	1. How much impact does this bottleneck have on the process? (1–3)	2. What is the likelihood of overcoming this bottleneck? (1–3)	3. Is this important to a wide range of stakeholders? (1–3)	Score	Prioritized Ranking
Example Aggregating data from paper forms is burdensome and rarely done correctly.	Low (1)	High potential (3)	Yes (3)	1+3+3=7	**HIGHEST**
Example Mother's belief that newborns should not be immunized if they seem "small" in size.	Medium (2)	Medium potential (2)	Some (2)	2+2+2=6	**MEDIUM**
Example Budget is not available to provide blood pressure cuffs to all clinics for hypertension screening.	High (3)	Low potential (1)	No (1)	3+1+1=5	**LOWEST**

3.4 Map programme-specific bottlenecks to generic health system challenges

At this point, focus on describing the highest priority bottlenecks using a common vocabulary, so you can link them to possible interventions. WHO developed a classification for health system challenges that standardizes the categories of common bottlenecks experienced at various levels of the health system (see *Fig. 3.4.1*). This classification provides a consistent method for grouping the diverse ways that various participants, from patients to health workers to decision-makers, have for expressing very granular, programme-specific bottlenecks and their root causes. It also ensures that all stakeholders have a common understanding of the challenges and a consistent language for articulating the need, as well as for mobilizing support and funding.

Note that digital health may not be the most suitable approach for addressing the specific challenge. Health system challenges can and should be addressed in different ways. Nondigital approaches, such as training, supervision or paper tools, are often more appropriate solutions, and the optimal solution for your context may require a combination of approaches. Your team will ultimately design an approach that makes the most sense within your environment and that meets the needs of your stakeholders and end-users. *Chapter 4* guides you through the steps of identifying digital health interventions for the specific health system challenges that you have prioritized.

Fig. 3.4.1. **WHO classification of health system challenges.**

Health System Challenges

1 Information

1.1	Lack of population denominator
1.2	Delayed reporting of events
1.3	Lack of quality/ reliable data
1.4	Communication roadblocks
1.5	Lack of access to information or data
1.6	Insufficient utilization of data and information
1.7	Lack of unique identifier

2 Availability

2.1	Insufficient supply of commodities
2.2	Insufficient supply of services
2.3	Insufficient supply of equipment
2.4	Insufficient supply of qualified health workers

3 Quality

3.1	Poor patient experience
3.2	Insufficient health worker competence
3.3	Low quality health commodities
3.4	Low health worker motivation
3.5	Insufficient continuity of care
3.6	Inadequate supportive supervision
3.7	Poor adherence to guidelines

4 Acceptability

4.1	Lack of alignment with local norms
4.2	Programs which do not address individual beliefs and practices

5 Utilization

5.1	Low demand for services
5.2	Geographic inaccessibility
5.3	Low adherence to treatments
5.4	Loss to follow up

6 Efficiency

6.1	Inadequate workflow management
6.2	Lack of or inappropriate referrals
6.3	Poor planning and coordination
6.4	Delayed provision of care
6.5	Inadequate access to transportation

7 Cost

7.1	High cost of manual processes
7.2	Lack of effective resource allocation
7.3	Client-side expenses
7.4	Lack of coordinated payer mechanism

8 Accountability

8.1	Insufficient patient engagement
8.2	Unaware of service entitlement
8.3	Absence of community feedback mechanisms
8.4	Lack of transparency in commodity transactions
8.5	Poor accountability between the levels of the health sector
8.6	Inadequate understanding of beneficiary populations

Box 3.4.2. Linking health system challenges to universal health coverage.

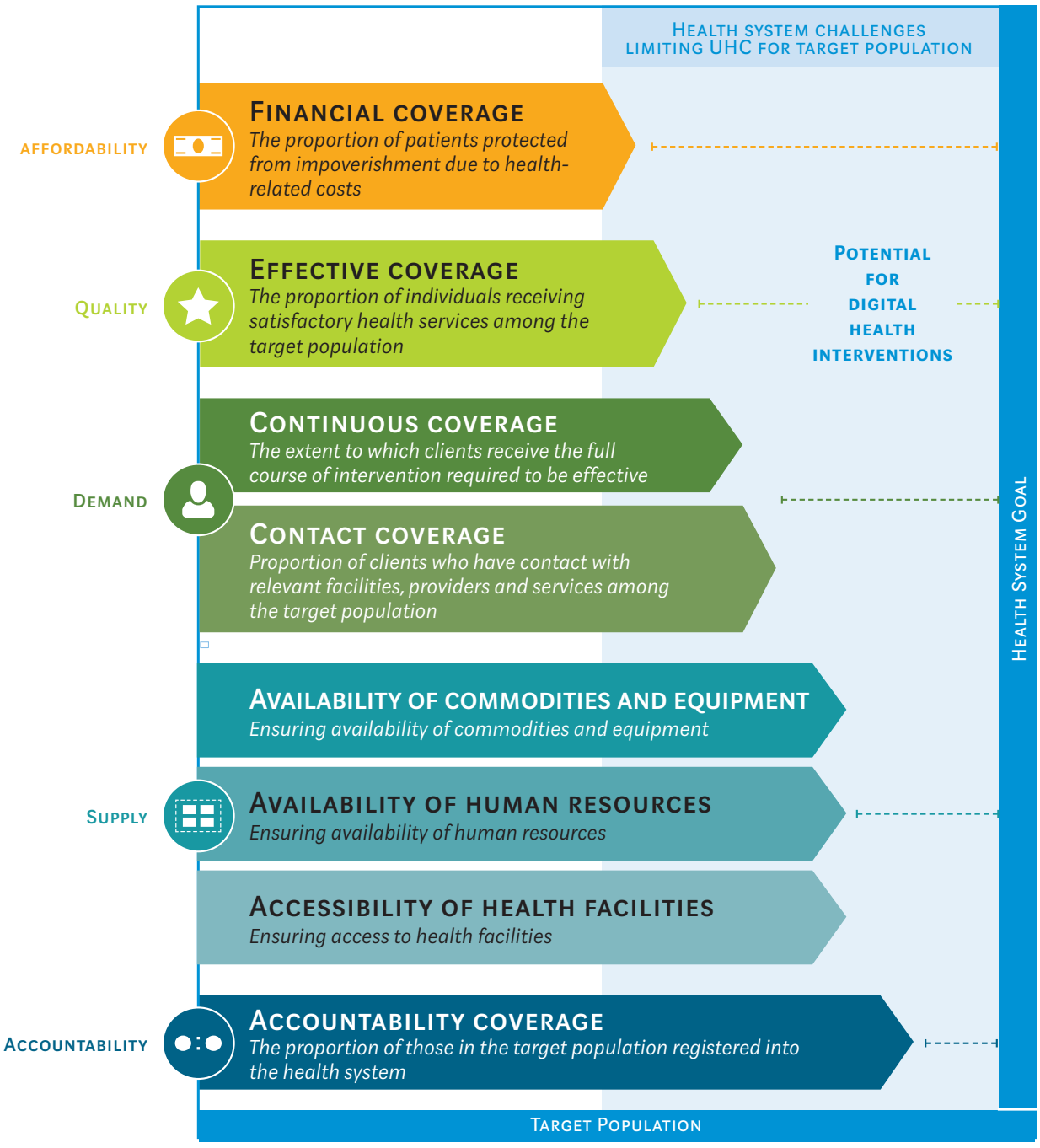
Although you have gone through an extensive process to identify the key bottlenecks and health system challenges, you may have overlooked some areas. You may want to take the further step of mapping your bottlenecks to the different contributors to achieving universal health coverage (UHC). The goals of UHC aim to ensure access to all individuals who need services and that these services are delivered with the intended quality and do not cause financial hardship *(55)*.

The Tanahashi framework is a common approach to articulating the set of health system challenges that need to be overcome in efforts to achieve UHC for specific health interventions within target populations (see *Fig. 3.4.3*). Reviewing the different sections of the framework, such as supply and demand, can also highlight the range of different health system challenges that should be addressed. For example, it may be difficult to overcome the challenge of loss to follow-up of clients (continuous coverage) if there is low demand for services (contact coverage) and clients are not coming to facilities in the first place. The updated framework used here includes the following layers *(56)*:

- **ACCOUNTABILITY COVERAGE**: the proportion of those in the target population known and registered in the health system
- **ACCESSIBILITY AND AVAILABILITY OF SERVICES**: includes ensuring availability of commodities, equipment and human resources and accessibility to health facilities
- **CONTACT COVERAGE**: proportion of clients who have contact with relevant facilities, health workers and services among the target population
- **CONTINUOUS COVERAGE**: the extent to which clients receive the full course of intervention required to be effective
- **EFFECTIVE COVERAGE**: the proportion of individuals receiving satisfactory health services among the target population
- **FINANCIAL COVERAGE**: the proportion of patients protected from impoverishment due to health-related costs.

Annex 3.2 provides a template for mapping bottlenecks to health system challenges and examples of bottlenecks linked to health-system-challenge classifications by UHC layer.

Fig. 3.4.3. **Health system needs for universal health coverage.**



Source: Mehl & Labrique, 2014 (56).

At this point in the process, you have accomplished the following tasks:

- ❒ Analysed the health programme processes to be improved (*Annex 3.1*)
- ❒ Mapped the current state ("status quo") of the user journey and workflows within the health program processes (Output 3.4)
- ❒ Prioritized bottlenecks (Output 3.2) and health system challenges (Output 3.3) to be addressed, detailed in template (*Annex 3.2*).

CHAPTER 04

DETERMINE APPROPRIATE DIGITAL HEALTH INTERVENTIONS

In the previous chapter, you examined different health programme processes and identified key health system challenges. In this chapter, you will rethink the way these tasks are performed and reflect on interventions to address the identified bottlenecks.

TOOLS	+ Bottleneck-mapping worksheet (*Annex 3.2*) + WHO *Classification of digital health interventions (4)* + Digital health intervention selection matrix (*Fig. 4.1.3*) + Digital Health Atlas *(8)* or digital landscape review + Global Digital Health Index *(9)* or other digital maturity assessment
OBJECTIVES	+ Identify digital health interventions aligned to the health system challenges prioritized in *Chapter 3*. + Define the requirements for each proposed digital health intervention. + Determine whether the capability for each proposed digital health intervention exists and whether it can be used within the existing digital health enterprise or if new investment is required to achieve this capability. + Understand the state of maturity for digital health in the country and the readiness of the enabling environment.
INPUTS	+ Analysis of the targeted health programme processes + Current-state ("status quo") workflow diagrams of the user journey with the health programme processes + Prioritized bottlenecks and health system challenges to be addressed
OUTPUTS	+ List of prioritized digital health interventions (Output 4.1) + Future-state user journey/workflow diagrams (Output 4.4) + Enabling-environment assessment (Output 4.2) + Functional and nonfunctional requirements (Output 4.3) + Landscape analysis to determine whether or how the existing digital health enterprise can be leveraged (Output 4.5)

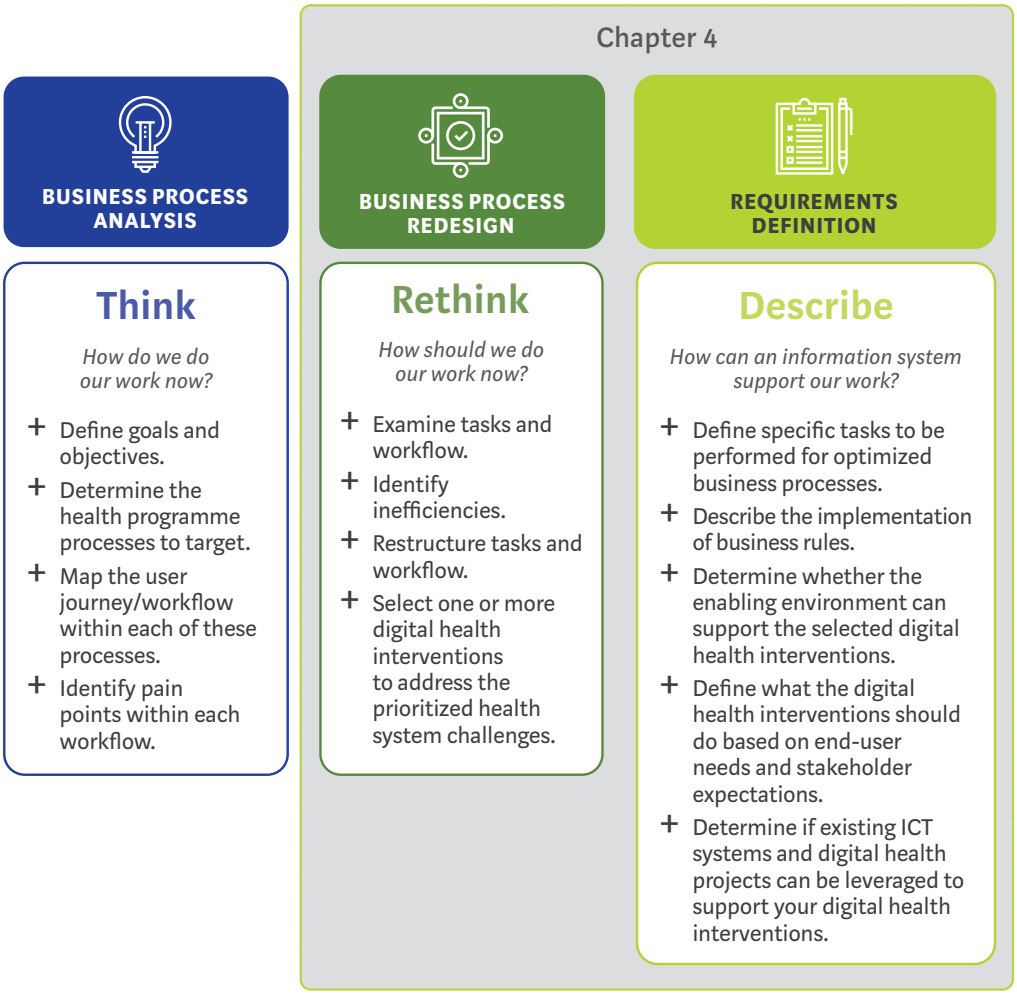
PRINCIPLES FOR DIGITAL DEVELOPMENT	
USE OPEN STANDARDS, OPEN DATA, OPEN SOURCE, AND OPEN INNOVATION[6]	+ **Define and communicate what being open** means for your initiative. + **Adopt and expand on existing open standards, such as Health Level 7 Fast Healthcare Interoperability Resource (HL7 FHIR)**: specifications developed by, agreed to, adopted by and maintained by a community that enable sharing of data across digital applications and the digital health platform. + **Share nonsensitive data after ensuring that data privacy needs are addressed**; to encourage open innovation by any group or sector, do not place restrictions on data use. + **Use existing open source and open standards–based software** where appropriate to help automate data sharing, connect your tool or system with others and add flexibility to adapt to future needs. + **Develop any new software code to be open sourc**e, which anyone can view, copy, modify and share, and distribute the code in public repositories. + **Enable innovation** by sharing freely without restrictions, collaborating widely and co-creating tools when it makes sense in your context.
REUSE AND IMPROVE[7]	+ **Identify the existing technology tools (local and global), data and frameworks being used by your target population, in your geography or in your sector**. Evaluate how these could be reused, modified or extended for use in your program. + **Develop modular, interoperable approaches** instead of those that stand alone or are attempting to be all-encompassing in their features. Interoperability will ensure that you can adopt and build on components from others and that others can adopt and build on your tool in the future; and swap out systems when improved – standards-based –solutions become available. + **Collaborate** with other digital development practitioners through technical working groups, communities of practice and other knowledge-sharing events to become aware of existing tools and to build relationships that could lead to the future reuse and improvement of your tool.

7 *Text adapted from Principles for Digital Development: Use open standards, open data, open source, and open innovation: Core tenets (7).*

In the previous chapter, you examined different health programme processes and identified key health system challenges. In this chapter, you will rethink the way these tasks are performed and reflect on interventions to address the identified bottlenecks (see *Fig. 4.1*). This is called business process redesign. It is at this stage where you will critically assess whether and how digital health applications may be used to alleviate the identified bottlenecks. Then, based on your decision, you can begin to describe what digital health applications must do to effectively support the optimized health programme processes.

Fig. 4.1. Redesigning health programme processes.

The CRDM approach is broken down into three areas of concentration:



A digital health intervention encompasses the functionality needed to alleviate the bottleneck and improve functioning of the health system. The digital health intervention may be implemented using a set of software applications and hardware, which when combined are referred to as the digital health application. The interventions within a digital health application can be as simple as a weekly mobile phone call to bridge the long distances separating patients from health workers, or as complex as helping health workers manage clinical records that are connected to laboratory, logistics, reporting and human resource management systems.

When identifying potential digital health interventions, consider the ability of the health system to absorb and sustain the planned interventions. Additionally, assess whether existing applications that offer the functionality needed for the digital health interventions may already exist in your country that could be reused or adapted for your implementation. Digital health applications are "the software and ICT systems that deliver or execute the digital health intervention and health content" *(14)*. Digital health enterprises include one or more digital health applications, but also comprise the hardware, standards, people, processes, policies, governance and underlying information infrastructure that support the operations of a health programme or health system *(14)*.

Identifying and selecting digital health interventions includes the following steps.

1. Select one or more digital health interventions to address the prioritized health system challenges (if digital is appropriate). If digital is appropriate, select interventions that have demonstrated effectiveness, and determine how these interventions can address your health system challenges.
2. Determine whether the enabling environment can support the selected digital health interventions. This includes understanding the ecosystem and absorptive capacity of the environment in which the interventions will be implemented to ensure their feasibility.
3. Define what the digital health interventions should do based on end-user needs and stakeholder expectations. This includes determining what the future state of the workflow or user journey will be after incorporating the interventions.
4. Determine if existing digital health applications within the enterprise can be leveraged to support your digital health interventions. This will help you understand how your proposed implementation can integrate with or use the functionality of existing digital health applications and shared services within the enterprise.

Table 4.1.4 provides a worksheet to help you think through how to address the identified bottlenecks from the perspectives of different personas (developed in *Chapter 2*) as you work through these steps. For each combination of persona and bottleneck, describe the specific information or functionality needed and possible measures of success, once the intervention is used to overcome the bottleneck. Then you can identify appropriate digital health interventions, together with the enabling infrastructure and capacity needed to implement them.

4.1 Determine and select digital health interventions for the prioritized health system challenges

Over the past two decades, a variety of digital health approaches have been tested as ways of alleviating health system challenges that have not otherwise been adequately addressed. From health-promotion messages sent to clients to applications that track stock levels, digital health interventions have been used individually (siloed) or combined with shared services using data exchange standards to form robust and extensible digital health enterprises.

You could reflect on the root causes of each health system challenge to understand how a particular intervention may overcome or mitigate it (see *Chapter 3*). Involve potential end-users (clients, health workers, supervisors and so on) at this stage as they may be instrumental in understanding whether and how digital health interventions can help address the identified issues. You may also find it appropriate to address a health system challenge by combining digital and nondigital approaches.

To begin selecting digital health interventions, first review the WHO *Classification of digital health interventions* shown in *Fig. 4.1.1* (*4*). This classification system presents the diverse ways that technology has been documented to support health system needs and address challenges (see *Fig. 4.1.2*). Each digital health intervention included in the *Classification* represents a discrete unit of technology functionality to address a health programme need or overcome a health system challenge. Furthermore, the *Classification* provides a standardized vocabulary that public health practitioners and software vendors can understand when expressing how the digital health intervention should function. Your review of this document should facilitate your understanding of the opportunities that may exist when building a digital health enterprise and how the digital health interventions will address identified health system challenges.

Fig. 4.1.1. Classifications of digital health interventions.

1.0 CLIENTS

1.1 TARGETED CLIENT COMMUNICATION
- 1.1.1 Transmit health event alerts to specific population group(s)
- 1.1.2 Transmit targeted health information to client(s) based on health status or demographics
- 1.1.3 Transmit targeted alerts and reminders to client(s)
- 1.1.4 Transmit diagnostics result, or availability of result, to client(s)

1.2 UNTARGETED CLIENT COMMUNICATION
- 1.2.1 Transmit untargeted health information to an undefined population
- 1.2.2 Transmit untargeted health event alerts to undefined group

1.3 CLIENT TO CLIENT COMMUNICATION
- 1.3.1 Peer group for clients

1.4 PERSONAL HEALTH TRACKING
- 1.4.1 Access by client to own medical records
- 1.4.2 Self monitoring of health or diagnostic data by client
- 1.4.3 Active data capture/ documentation by client

1.5 CITIZEN BASED REPORTING
- 1.5.1 Reporting of health system feedback by clients
- 1.5.2 Reporting of public health events by clients

1.6 ON-DEMAND INFORMATION SERVICES TO CLIENTS
- 1.6.1 Client look-up of health information

1.7 CLIENT FINANCIAL TRANSACTIONS
- 1.7.1 Transmit or manage out of pocket payments by client(s)
- 1.7.2 Transmit or manage vouchers to client(s) for health services
- 1.7.3 Transmit or manage incentives to client(s) for health services

2.0 HEALTHCARE PROVIDERS

2.1 CLIENT IDENTIFICATION AND REGISTRATION
- 2.1.1 Verify client unique identity
- 2.1.2 Enrol client for health services/clinical care plan

2.2 CLIENT HEALTH RECORDS
- 2.2.1 Longitudinal tracking of clients' health status and services
- 2.2.2 Manage client's structured clinical records
- 2.2.3 Manage client's unstructured clinical records
- 2.2.4 Routine health indicator data collection and management

2.3 HEALTHCARE PROVIDER DECISION SUPPORT
- 2.3.1 Provide prompts and alerts based according to protocol
- 2.3.2 Provide checklist according to protocol
- 2.3.3 Screen clients by risk or other health status

2.4 TELEMEDICINE
- 2.4.1 Consultations between remote client and healthcare provider
- 2.4.2 Remote monitoring of client health or diagnostic data by provider
- 2.4.3 Transmission of medical data to healthcare provider
- 2.4.4 Consultations for case management between healthcare provider(s)

2.5 HEALTHCARE PROVIDER COMMUNICATION
- 2.5.1 Communication from healthcare provider(s) to supervisor
- 2.5.2 Communication and performance feedback to healthcare provider(s)
- 2.5.3 Transmit routine news and workflow notifications to healthcare provider(s)
- 2.5.4 Transmit non-routine health event alerts to healthcare provider(s)
- 2.5.5 Peer group for healthcare providers

2.6 REFERRAL COORDINATION
- 2.6.1 Coordinate emergency response and transport
- 2.6.2 Manage referrals between points of service within health sector
- 2.6.3 Manage referrals between health and other sectors

2.7 HEALTH WORKER ACTIVITY PLANNING AND SCHEDULING
- 2.7.1 Identify client(s) in need of services
- 2.7.2 Schedule healthcare provider's activities

2.8 HEALTHCARE PROVIDER TRAINING
- 2.8.1 Provide training content to healthcare provider(s)
- 2.8.2 Assess capacity of healthcare provider(s)

2.9 PRESCRIPTION AND MEDICATION MANAGEMENT
- 2.9.1 Transmit or track prescription orders
- 2.9.2 Track client's medication consumption
- 2.9.3 Report adverse drug events

2.10 LABORATORY AND DIAGNOSTICS IMAGING MANANGEMENT
- 2.10.1 Transmit diagnostic result to healthcare provider
- 2.10.2 Transmit and track diagnostic orders
- 2.10.3 Capture diagnostic results from digital devices
- 2.10.4 Track biological specimens

3.0 HEALTH SYSTEM MANAGERS

3.1 HUMAN RESOURCE MANAGEMENT
- 3.1.1 List health workforce cadres and related identification information
- 3.1.2 Monitor performance of healthcare provider(s)
- 3.1.3 Manage certification/ registration of healthcare provider(s)
- 3.1.4 Record training credentials of healthcare provider(s)

3.2 SUPPLY CHAIN MANAGEMENT
- 3.2.1 Manage inventory and distribution of health commodities
- 3.2.2 Notify stock levels of health commodities
- 3.2.3 Monitor cold-chain sensitive commodities
- 3.2.4 Register licensed drugs and health commodities
- 3.2.5 Manage procurement of commodities
- 3.2.6 Report counterfeit or substandard drugs by clients

3.3 PUBLIC HEALTH EVENT NOTIFICATION
- 3.3.1 Notification of public health events from point of diagnosis

3.4 CIVIL REGISTRATION AND VITAL STATISTIC
- 3.4.1 Notify birth event
- 3.4.2 Register birth event
- 3.4.3 Certify birth event
- 3.4.4 Notify death event
- 3.4.5 Register death event
- 3.4.6 Certify death event

3.5 HEALTH FINANCING
- 3.5.1 Register and verify client insurance membership
- 3.5.2 Track insurance billing and claims submission
- 3.5.3 Track and manage insurance reimbursement
- 3.5.4 Transmit routine payroll payment to healthcare provider(s)
- 3.5.5 Transmit or manage incentives to healthcare provider(s)
- 3.5.6 Manage budget and expenditures

3.6 EQUIPMENT AND ASSET MANAGEMENT
- 3.6.1 Monitor status of health equipment
- 3.6.2 Track regulation and licensing of medical equipment

3.7 FACILITY MANAGEMENT
- 3.7.1 List health facilities and related information
- 3.7.2 Assess health facilities

4.0 DATA SERVICES

4.1 DATA COLLECTION, MANAGEMENT, AND USE
- 4.1.1 Non-routine data collection and management
- 4.1.2 Data storage and aggregation
- 4.1.3 Data synthesis and visualization
- 4.1.4 Automated analysis of data to generate new information or predictions on future events

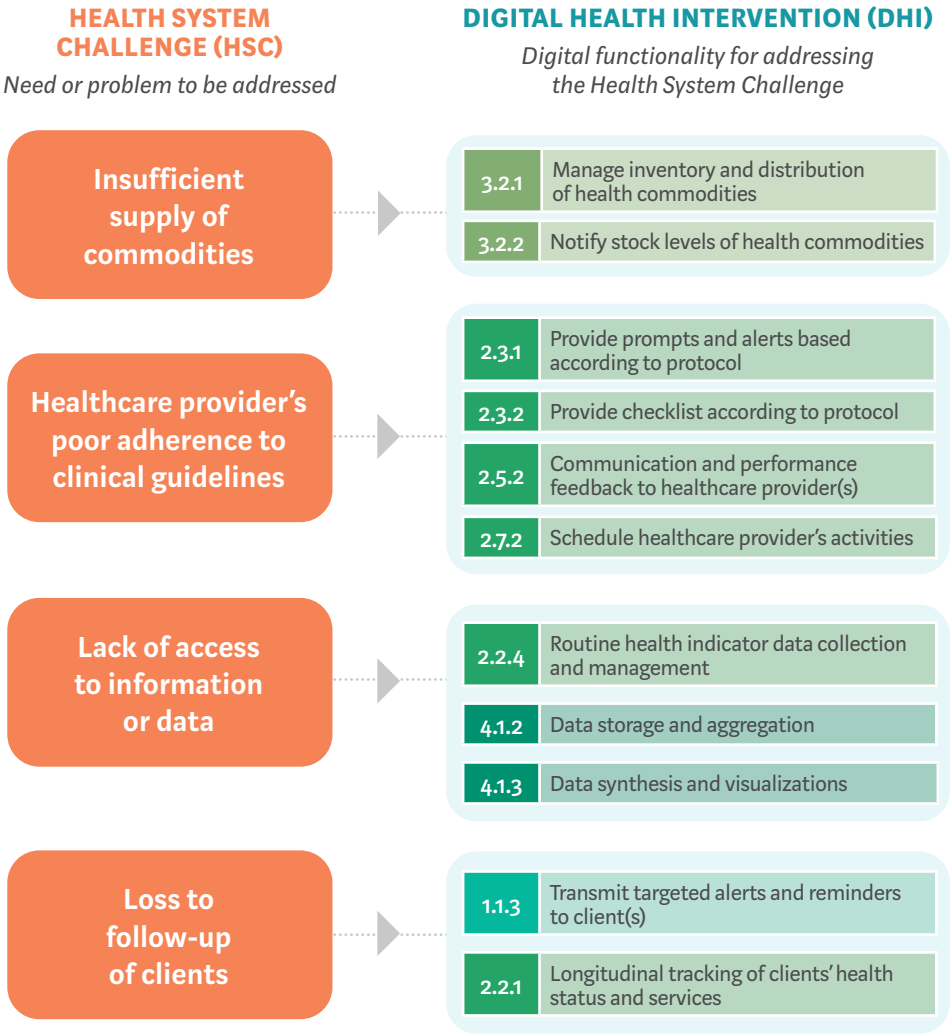
4.2 DATA CODING
- 4.2.1 Parse unstructured data into structured data
- 4.2.2 Merge, de-duplicate, and curate coded datasets or terminologies
- 4.2.3 Classify disease codes or cause of mortality

4.3 LOCATION MAPPING
- 4.3.1 Map location of health facilities/structures
- 4.3.2 Map location of health events
- 4.3.3 Map location of clients and households
- 4.3.4 Map location of healthcare providers

4.4 DATA EXCHANGE AND INTEROPERABILITY
- 4.4.1 Data exchange across systems

Source: WHO Classification of digital health interventions, 2018 (4).

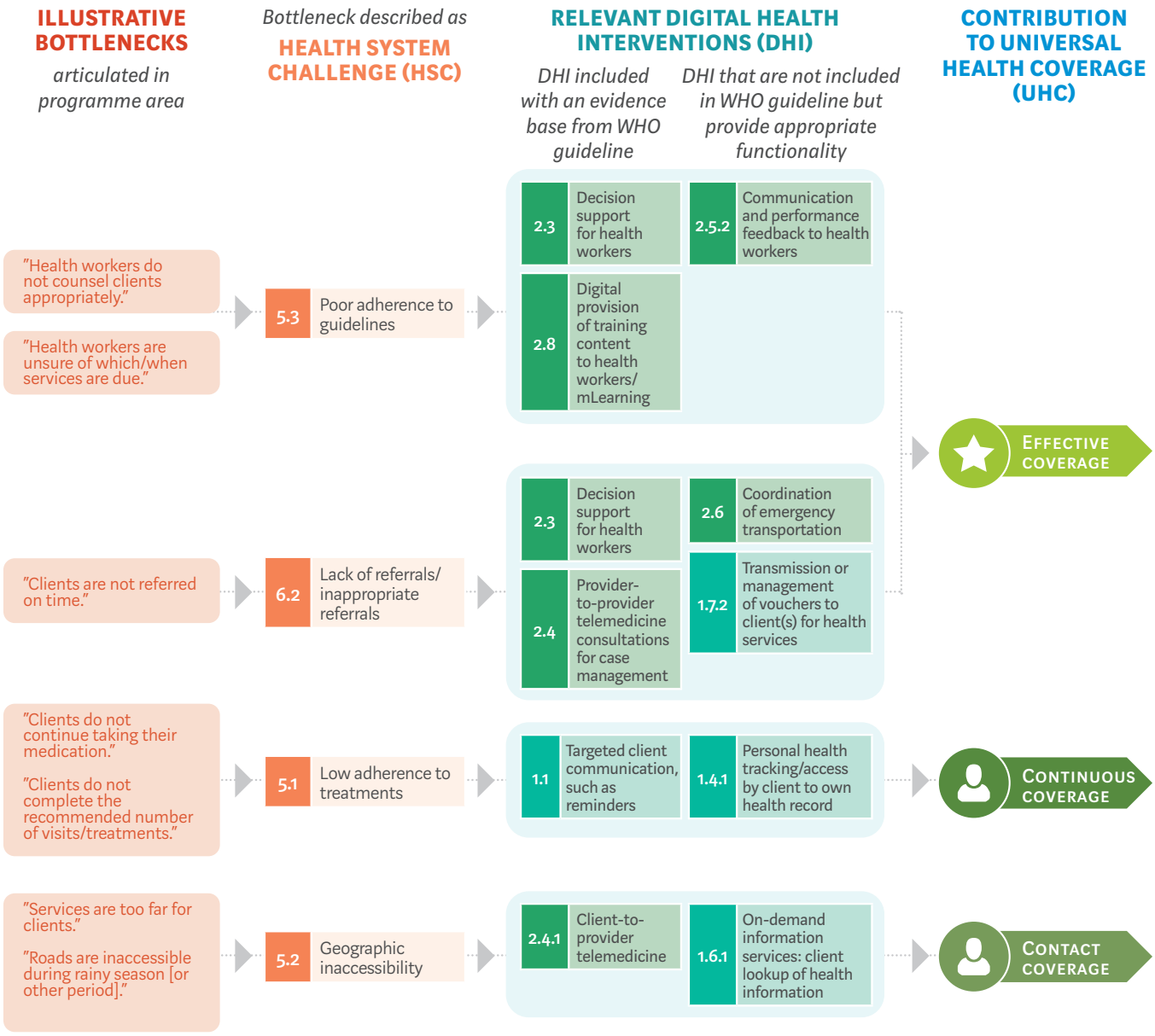
Fig. 4.1.2. Linkage between health system challenges and digital health interventions.



When determining which digital health interventions are appropriate, consider reviewing the *WHO Guideline: Recommendations on Digital Interventions for Health System Strengthening (1)*, which lists evidence-based digital health interventions and considerations for implementation. Should WHO recommendations on digital health interventions not yet exist for the health system challenges you have identified, you could draw from research evidence and regional experiences to determine whether to use alternative or existing digital health interventions in your context or whether to consider a nondigital approach more carefully (see *Box 1.1.3*). Keep in mind that WHO does not recommend investments in digital health interventions that do not have a robust evidence base.

Fig. 4.1.3 illustrates the links between programmatic bottlenecks and health system challenges and suggests appropriate digital health interventions to address the challenges, based on recommendations from the WHO guideline. Recommended digital health interventions are based on extensive reviews of scientific evidence demonstrating the interventions' value in addressing specific health system challenges. *Annex 5.3* provides a list of common health system challenges associated with digital health interventions featured in the WHO guideline.

Fig. 4.1.3. Digital health intervention selection matrix.



Source: Adapted from the WHO Classification of digital health interventions, 2018 (4).

Consider the range of digital health interventions that may be appropriate for your identified health system challenges. Cross-checking these against the WHO evidence-based recommendations and any country experiences will help you identify a set of digital health interventions suitable for the expressed needs.

CASE STUDY

Determining appropriateness of digital health interventions for health system challenges

As part of the joint process with the Ministry of Health and Sanitation in Sierra Leone for identifying health system challenges and assessing the appropriateness of digital health interventions, WHO convened stakeholders to review challenges faced within the health system and across different programmatic areas. This was a consultative process to identify areas of improvement and assess whether digital health interventions may play a role in addressing some of the issues that were raised. *Table 4.1.4* gives some examples of bottlenecks raised during this multistakeholder assembly, as well as discussions about the role of digital health interventions in addressing the root causes of these health system challenges.

Table 4.1.4. Bottlenecks discussed in a multistakeholder meeting.

BOTTLENECK ARTICULATED THROUGH DISCUSSIONS	ROOT CAUSES LINKED TO BOTTLENECK	BOTTLENECK EXPRESSED AS A STANDARDIZED HEALTH SYSTEM CHALLENGE	DISCUSSIONS ON THE ROLE OF DIGITAL HEALTH INTERVENTIONS IN ADDRESSING ROOT CAUSES OF HEALTH SYSTEM CHALLENGES
Inequitable distribution of trained midwives	High attrition rate of trained midwives from hard-to-reach areas Overall lack of trained midwives nationally	**HSC 2.4.** Insufficient supply of qualified health workers	Digital health interventions such as listing health workforce cadres could be used to track the distribution of deployed health workers (DHI 3.1.1). Provider-to-provider telemedicine could assist with enabling less-skilled health workers to consult with midwives and other relevant health professionals (DHI 2.4.4). However, a digital health intervention may not be well suited for addressing the root cause of overall lack of trained midwives nationally.
Poor functioning or lack of medical infrastructure, including power, blood services and water	Inadequate maintenance of equipment Infrastructural constraints	**HSC 5.2.** Geographic inaccessibility	Digital health interventions are not well suited to address the root cause of this bottleneck.
Frequent stockouts of drugs and supplies	Limited prediction of stockouts for ordering required drugs in a timely manner, both from the central to the district level and from the district to the primary healthcare unit Poor monitoring of drug availability Inadequate logistics (such as vehicles or fuel) for delivering commodities	**HSC 2.1.** Insufficient supply of commodities	Although digital health interventions may not alleviate the constraints associated with inadequate vehicles or availability of commodities at the central level, a digital health intervention such as notification of stock levels could be used to communicate when there are stockouts and request replenishments in a timely manner (DHI 3.2.2).

4.2 Determine whether the enabling environment can support the identified digital health interventions

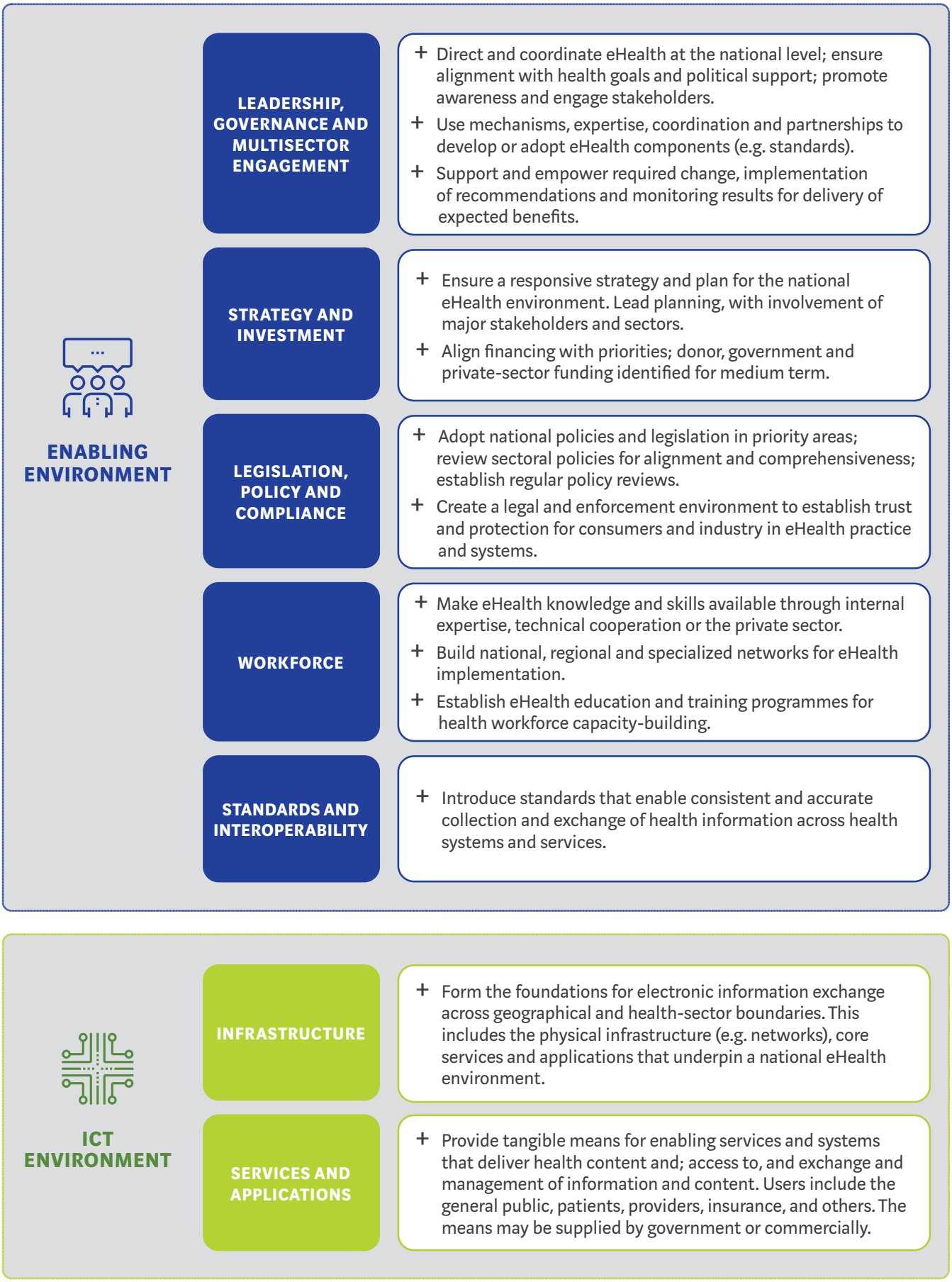
Digital health interventions are delivered through digital health applications, which ideally are linked to a supportive digital health platform comprising shared services and enabling components (in cases where there are multiple applications); together with the people, processes and policies that support and use them to deliver health services to clients, these applications and platform make up the digital health enterprise. Successful deployment of digital health applications requires a thorough knowledge of the ecosystem where the interventions will be deployed and whether they can be supported in that environment. Understanding this context can inform the feasibility of implementing the digital health enterprise, as well as demonstrate where system integrations will be required.

For example, in settings with limited infrastructure and governance structures, it may be prudent to opt for less complex digital health implementations until these building-block enabling factors evolve to a more mature state. Regardless, each subsequent investment in digital health should contribute cumulative value to the functioning of the digital health enterprise, addressing health needs within the health programme and across the health system. Investments in ball-of-mud health software characterized by an evolving agglomeration of functions, originating without a predetermined scope or design pattern, which are monolithic contribute to an accumulation of technical debt and are not advised (see *Fig. 1.3.1*).

The national digital health strategy, investment roadmap, country assessment of digital maturity, national inventory of digital assets and enterprise architecture documentation, if available, should serve as a starting point for understanding the priorities and state of the national digital health ecosystem, and hence the feasibility of selected digital health interventions and the context for integrating the prioritized interventions into the national system (see *Fig. 1.1.4*). The digital health strategy outlines a country's vision as it relates to the enabling environment (see *Fig. 4.2.1*), such as legal, regulatory and policy frameworks and ICT workforce needs, as well as the ICT environment, including infrastructure and foundational architecture.

A comprehensive digital health strategy establishes the vision for how digital health approaches will support a national health system and provides the operational details necessary to achieve this vision. The digital health investment roadmap provides an overview of the national vision and financial implications for stepwise investment in foundational and health programme–specific digital health applications and shared services. The results of one or more digital-maturity-assessment outputs provide a practical assessment of the progress of establishing different critical enabling components of governance and environment represented in the digital health strategy, the HIS, interoperability of the digital health enterprise or the digital health application implementation scale (see *Box 4.2.2* for resources). A national inventory of digital health assets, such as the Digital Health Atlas *(8)*, provides an overview of the knowledge, experience, targeted health focus, digital characteristics and maturity of specific digital applications and shared services within the country (see *Box 4.4.1* for more information). The national vision for an enterprise architecture provides documentation of logical organizational and business processes of the national health system and its supporting data, applications, shared services and digital infrastructure, with clearly defined goals and objectives for achieving future health goals.

Fig. 4.2.1. **Roles and contributions of component "building blocks" to the enabling environment for digital health enterprises.**



Source: WHO/ITU National eHealth strategy toolkit, 2012 (3).

Depending on your timeline, you may want to develop short-term plans that take into account the current enabling environment, while contemplating medium- and long-term plans that benefit from your deliberate new investments to catalyse some components of the environment to mature further. A comprehensive analysis of the enabling environment will also help you document the **nonfunctional requirements**, which describe general attributes and features to ensure usability and overcome technical and physical constraints. Examples of nonfunctional requirement include ability to work offline, multiple language settings, and password protection *(57)*. However, many of these factors usually fall outside the health sector, making it difficult to address gaps within the proposed intervention's life span or budget. Other components of the enabling environment may require lengthy processes, such as developing a skilled workforce or adopting national information standards, and therefore also fall outside the time frame of the proposed intervention *(3)*. (See *Box 4.2.2* for a list of resources to help assess the enabling environment.)

Box 4.2.2. Useful resources for assessing the readiness of the enabling environment.

- *National eHealth strategy toolkit* *(3)* is an expert, practical guide that provides governments, their ministries and stakeholders with a solid foundation and method for developing and implementing a national eHealth vision, action plan and monitoring framework.
- Global Digital Health Index *(9)* is a resource for quantitatively assessing the maturity of the enabling environment; using indicators based on the National eHealth strategy toolkit *(3)*, countries can track their progress towards fulfilling the building blocks of an enabling environment.
- *HIS stages of continuous improvement toolkit* *(11)* supports assessment, planning and prioritizing interventions and investments to strengthen an HIS, measuring current and desired HIS status across five core domains and mapping a path towards improvement.
- *HIS interoperability maturity toolkit* *(58)* supports identification of the key domains for interoperability and the required levels of maturity to achieve HIS interoperability goals.
- Assessing the enabling environment for establishing a contextualized national digital health strategy *(59)* provides a systematic, structured approach to assessing the enabling environment for digital health based on the development of Nigeria's National Health ICT Strategic Framework.
- Information and communication technologies for women's and children's health: a planning workbook *(60)* outlines a systematic approach to determining countries' absorptive capacity for digital health interventions and offers considerations for a variety of factors related to the enabling environment, spanning from policy and infrastructure to sociocultural issues, and ways of understanding and mitigating potential risks.

Additionally, seek the experiences of global communities of practice to learn about how other MOHs and implementers are developing infrastructure, policies and strategies and using digital health interventions to address different health system challenges.

4.3 Determine what the interventions will need to do

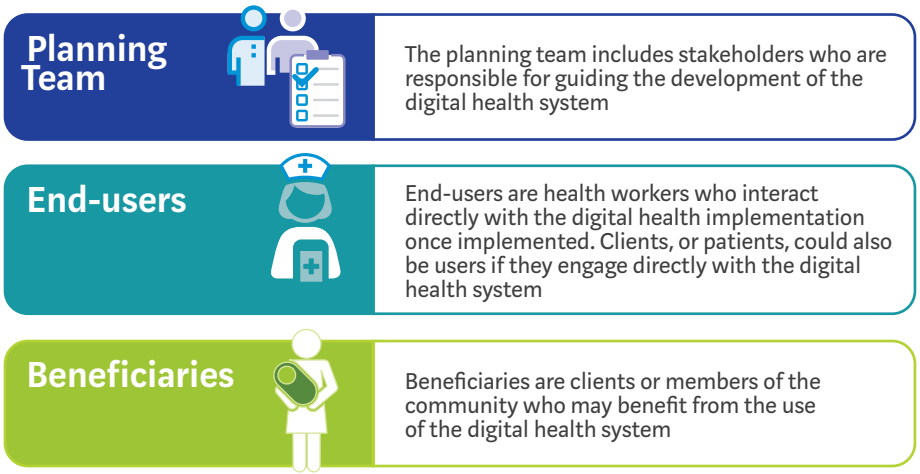
Once you have selected which types of digital health interventions will appropriately address your health system challenges and their suitability for your context, you can start defining the requirements of each intervention and the digital health application that will be used to execute the intervention.

The requirements should not be just digitizing the processes identified in the current-state workflows developed in *Chapter 3*; also think through ways that introducing efficiencies can optimize the performance of the health system and programme area.

Answer these three questions to determine the requirements (see *Fig. 4.3.1*).

1. What do members of the **planning team** (stakeholders) expect the digital health interventions to do for them?
2. What do **end-users** expect the digital health interventions to do for them?
3. What do **beneficiaries** expect the digital health interventions to do for them?

Fig. 4.3.1. Stakeholder relationships with a digital health intervention.



4.3.1 IDENTIFY FUNCTIONAL REQUIREMENTS AND USER STORIES

Functional requirements describe what the digital health application needs to do to address the health system challenges identified in *Chapter 3*. These requirements answer the question, "What does the intervention need to do to help overcome a health system challenge?" Software developers use the functional requirements as a reference to ensure that the intervention meets the needs of the targeted end-users.

The functional requirements consist of simple statements that summarize what the end-user needs the digital health intervention to do (see *Table 4.3.1.1* for an example). Start with a brainstorming session to generate all possible scenarios that your team can imagine in a logical sequence along the process workflow developed in *Chapter 3*. Consider all end-users who will access the intervention directly or who will need to access information provided by the intervention to make decisions.

Table 4.3.1.1. An example scenario for a pregnancy-support digital health intervention.

END-USER	REQUIRED FUNCTIONALITY	REASON
As a community nurse	I need a list of my clients whose antenatal visits are due today	So that I can plan my day accordingly, including adequate supplies to conduct antenatal care checkups.
As a community nurse	I need to look up a client's past health record	So I can evaluate whether the client is in a high-risk category and needs additional advice.
As a community nurse	I need to be able to send my client an SMS reminder	So that she can remember to come to the clinic for a follow-up ultrasound in the third trimester.

You may find it helpful at this time to prioritize the most important functions ("must have") and identify others that may be optional to develop, if time and budget permit ("nice to have"). This distinction of must have versus nice to have may also depend on the connectivity requirements, such as how urgently the information is needed (for example, the information needs to be available in real time).

4.3.2 UNDERSTAND AND MANAGE EXPECTATIONS FROM END-USERS AND STAKEHOLDERS

It is also essential to understand how the digital health implementation will work for everyone involved and how to improve the usability and value of the applications for end-users. Some functions may not be part of a end-user's workflow or direct experience but are relevant to the stakeholders. A senior policy-maker may need to see aggregate performance data characterized by geographic region, for example, but a health worker working in close contact with communities may not have immediate use for this macrolevel information. Refer to the current-state workflow diagrams, which you created in *Chapter 3*, to determine who performs what tasks within a health system and their roles as beneficiaries, end-users or stakeholders.

Consider three distinct groups when describing what the intervention needs to do (the functional requirements):

- end-users, the people who will actually use the intervention
- beneficiaries, individuals or groups whose health the intervention is intended to improve
- other stakeholders, those with a keen interest in the success of the digital health implementation and the health programme, such as members of the planning team.

Understanding the perceptions, roles and responsibilities, as well as the motivations, of the people who will interact with or be affected by the digital health intervention ensures that the intervention responds to these human needs. Make the lists of these actors as broad or as close to the health programme as your team feels is necessary. Briefly describe each kind of stakeholder or end-user, and assess their potential responses to identified digital health interventions (see *Fig. 4.3.2.1* for an example). Once this is done, the design team may choose to modify the requirements to mitigate potential risks and ensure that the digital health implementation meets broader needs.

Fig. 4.3.2.1. Examples of different personas interacting with digital health interventions.

GROUP	DESCRIPTION	POTENTIAL RESPONSE TO DIGITAL HEALTH INTERVENTIONS (POSITIVE AND NEGATIVE)
Stakeholder	***Community leader***	May be excited to have an innovative project in the community. Will want to understand the information given to end-users. Will want to be involved in or leading all planning meetings.
Stakeholder	***District programme manager***	May need information from the digital health intervention at an aggregate geographic level to manage programme resources.
End-user	***Clinic nurse***	May be apprehensive about switching to a new way of working, especially if older in age and accustomed to the traditional ways that service is provided. Will need more information on how the digital health intervention will impact their work, including job security and relationship with supervisor.
End-user	***Pregnant woman***	May be excited to be involved in this new initiative but may also worry about what her husband will think. She knows she will also have to ask her older children or neighbour's kids to help her figure out what she is expected to do with the phone.

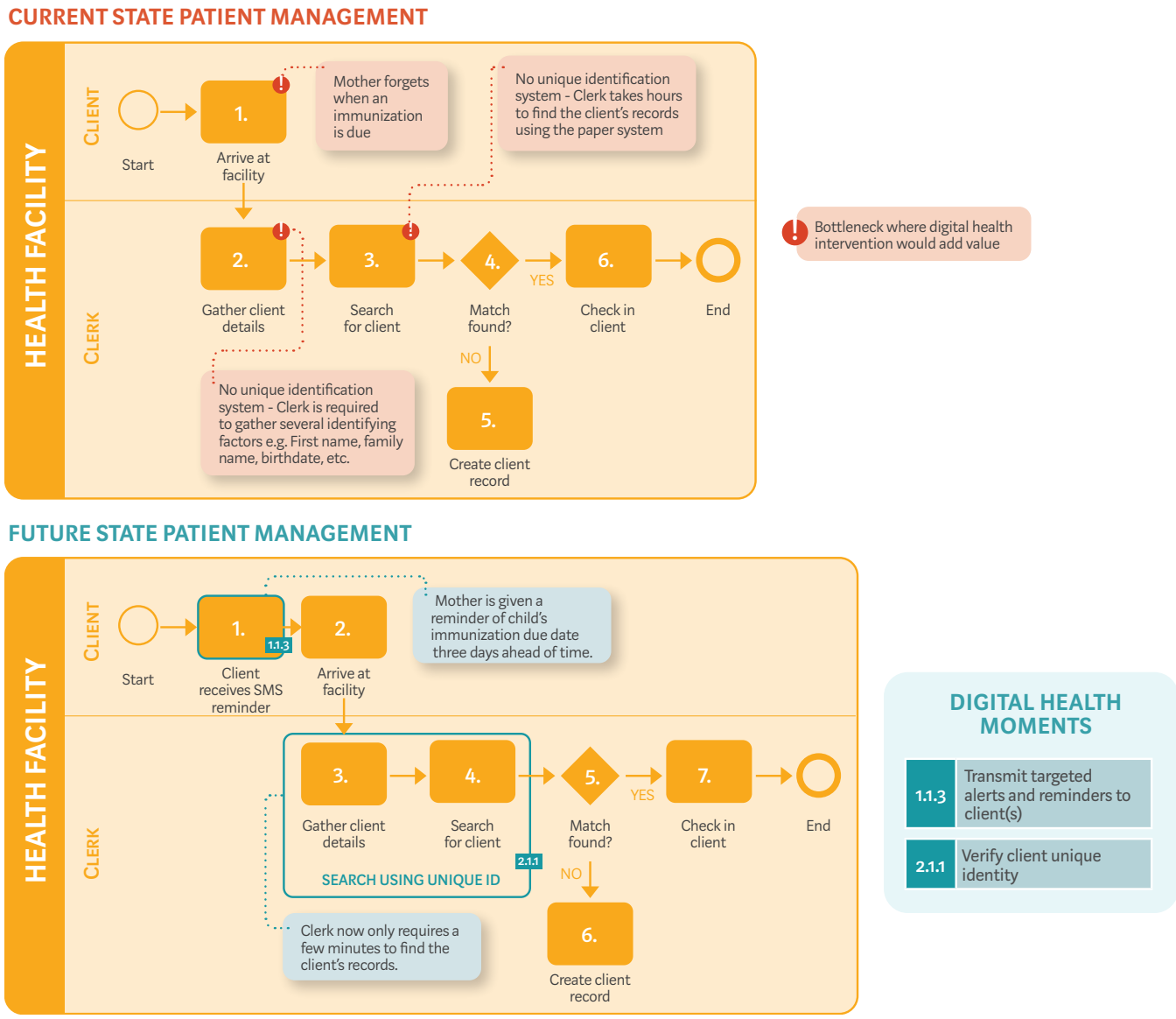
4.3.3 MAP FUTURE-STATE WORKFLOW

Once you have gathered the different requirements and assessed their implications on end-users and stakeholders, you can begin to conceptualize the future-state workflow. In *Chapter 3*, you diagrammed the current state of the health programme. Now you could develop new versions of these diagrams, workflow diagrams of the future state, to illustrate the processes in the desired system where the digital health intervention overcomes the bottlenecks (see *Fig. 4.3.3.1*). To do this, reimagine the health programme optimized with a digital health implementation in place. Indicate the digital health moments, those points in the process where digital health interventions address bottlenecks to improve the current state. The number of future-state diagrams may differ from the number of current-state diagrams because you may need to plan for additional locations where data will be managed or used for decision-making.

To create the future-state workflow diagrams, follow these steps.

1. Review the current-state workflow diagrams and the end-user profiles. Considering these factors will ensure that the intervention is realistic.
2. Redraw the workflow diagrams from *Chapter 3* to include proposed digital and nondigital changes that together optimize to address health system challenges.

Fig. 4.3.3.1. Bottleneck and future-state workflow diagrams.



4.4 Determine if existing digital health applications, platforms and enterprises can achieve the requirements

A digital health intervention operates through a digital health application, which when connected to other shared technologies (such as data-exchange enabling components and registries in the platform), together with the supported business processes, policies that govern them and people that use them, make up a digital health enterprise. The best scenario is that your digital health investment leverages or extends the digital health enterprise that is already in place in your context. Building on existing investments, such as by expanding the functionality of existing applications or the connected platforms (like shared services) or incorporating new health content into the tools that health workers already use, can limit the fragmentation of the digital health enterprise and support the sustainability of your intervention.

BID INITIATIVE CASE STUDY

BID Initiative: Data quality and use interventions

Together with end-users from all levels of the health system, the BID Initiative collaboratively developed a comprehensive set of tools and approaches to improve immunization data collection, quality and use spanning data-management policies and practices, information system products and training on the tools, as well as methods for better using data to make critical decisions about immunization services. These improvements included the following:

- an electronic immunization application (EIR) linked to a client registry (Tanzania only) and supply chain information
- automated, simplified report generation
- data-use campaigns
- microtraining videos
- peer-support networks
- barcodes or QR codes on child health cards and vaccine supplies
- targeted supportive supervision for health workers
- data visualizations and dashboards to monitor facility and neighbouring facility performance.

The BID team applied a "top-down" approach with a "bottom-up" view when drafting these interventions. They started by considering Tanzania's and Zambia's national strategies, incorporating the current context of the end-users (such as the functional architecture) before considering the facility applications (such as the technical architecture) that were in use. With key stakeholders, they also assessed existing information systems and how they matched the defined requirements, along with the projects and pilots that had come before, so as not to duplicate efforts or invest in technologies and strategies that do not yield a high impact.

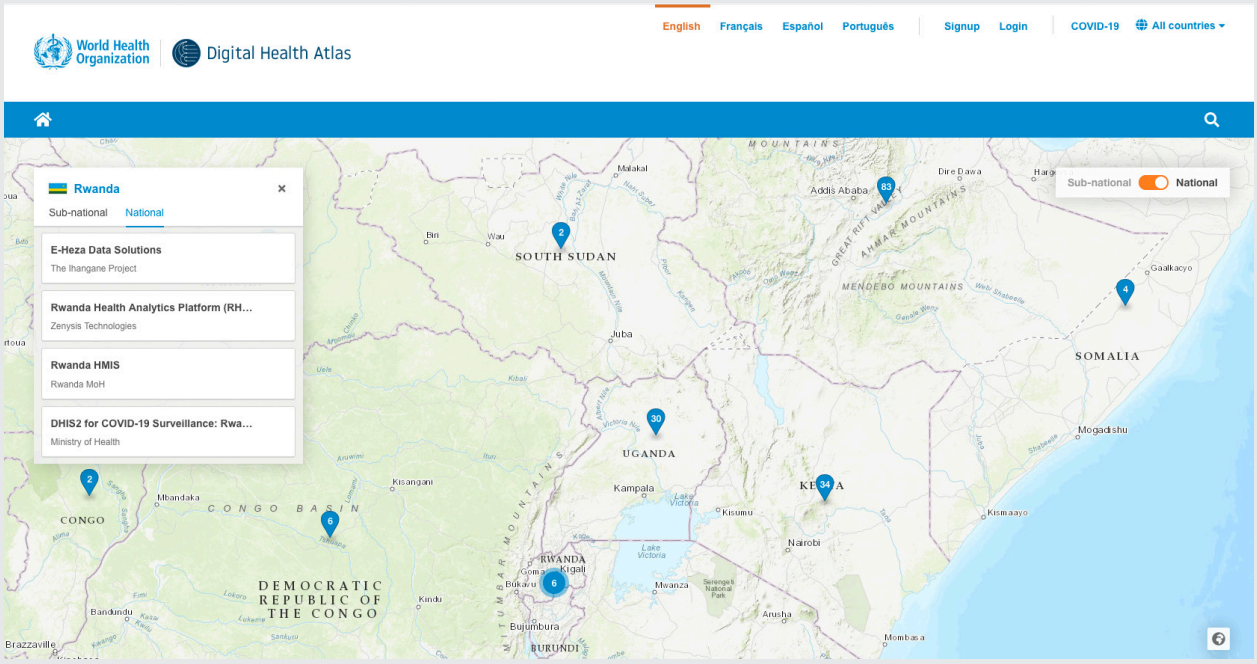
Adapted from The BID Initiative Story: Implementing solutions (61).

To increase your awareness of this ecosystem and identify opportunities for improving interoperability and contributing to a shared and sustainable digital health enterprise, conduct a landscape analysis and inventory of existing digital health applications, enabling components, shared services and enterprises used in your country. The team conducting the landscape analysis should gather the following information for each digital health implementation:

- number of end-users, categorized by cadre
- group or individual responsible for maintenance
- levels of the health system or departments in a health facility affected by the intervention
- software programs in use, including version numbers, licences, recurrent costs and operating systems
- digital health interventions included in the digital health implementation, system infrastructure and other environmental requirements
- key data supplied by each individual digital health implementation
- availability of end-user and technical documentation
- extent that the application(s) can exchange data within the broader digital health enterprise
- standards being used to define the data structure, exchange and storage.

You may wish to leverage the Digital Health Atlas *(8)* to review existing digital health inventories or conduct one in your region or country (see *Box 4.4.1*).

Box 4.4.1. The Digital Health Atlas and other repositories of digital health implementations.



Identifying existing digital health interventions to use for your planned work can be challenging. WHO's *Digital Health Atlas* (DHA) can help you conduct a digital health inventory *(8)*. The DHA is a web-based tool for cataloguing and tracking digital health implementations. Searching the DHA for implementations filtered by health domain, health system challenge area, software applications or context may reveal opportunities for reuse and collaboration.

You may also consider tapping into existing communities of practices, such as the *Global Digital Health Network (62)* or a regional network like the *AeHIN* (63). In some cases, a recent landscape report highlighting other digital health interventions and ICT systems in the country may be available. These repositories may include current as well as historical deployments that have ended for reasons other than funding cessation; insights from such deployments may help you smartly plan for and avoid pitfalls that others have faced. Examples of such landscape analysis reports include the following:

- Accessing the enabling environment for ICTs for health in Nigeria: a landscape and inventory *(64)*
- Bangladesh eHealth inventory report *(65)*
- mHealth in Malawi: landscape analysis *(66)*.

In addition to assessing the landscape of digital health applications in your context, you may also consider leveraging software applications identified in *The Global Goods Guidebook (15)*. This guidebook compiles mature digital health applications that use open standards, are supported by a robust developer community, have demonstrated effectiveness and can be adapted to different countries and use cases *(15)*. A mature digital health software global good is "software that is (frequently) Free and Open Source Software (FOSS), is supported by a strong community, has a clear governance structure, is funded by multiple sources, has been deployed at significant scale, is used across multiple countries, has demonstrated effectiveness, is designed to be interoperable and is an emergent standard application" *(67)*. For more information on the criteria used to determine and assess the maturity of software global goods, visit the *Digital Square wiki (67)*.

Your investment in digital health implementations may offer opportunities to contribute new functionality to software global goods that may offer benefits beyond your programme area, and similarly, your implementation may benefit greatly from linking to or using existing functionalities, which can reduce costs and accelerate deployment timelines. Additionally, for interventions focused on health workers, you could determine which existing ICT tools (hardware and applications) various cadres have experience with to maximize appropriateness of hardware specifications prior to implementation of the digital health intervention(s).

4.5 Progress check

You have now determined the digital health interventions and identified digital health applications to support your planned implementation.

At this point in the process, you have an understanding of the following:

- ❒ Digital health interventions that are appropriate to address the bottlenecks and health system challenges identified in Chapter 3 (Output 4.1)
- ❒ Digital health interventions that can be supported in your local context (Output 4.2)
- ❒ Expectations of what the digital health intervention should do, or the functional requirements (Output 4.3)
- ❒ Future-state workflow based on the selected interventions and functional requirements (Output 4.4)
- ❒ Assessment of available digital health applications and enterprises that your chosen digital health interventions can integrate with or leverage (Output 4.5).

Fig. 4.5.1 highlights the major considerations discussed so far when selecting digital health interventions and the digital health applications and platform in which they will be implemented. As you review these factors, check that the digital health interventions you have selected are still the most appropriate. Also consider how the interventions you have selected will work with currently deployed applications and fit within the larger digital health ecosystem. *Chapter 5* will go into greater detail on other considerations when implementing a digital health enterprise that delivers the selected digital health interventions and related functional requirements.

Fig. 4.5.1. Considerations for designing a digital health enterprise to deploy selected digital health interventions.

Identified pain points and health system challenges

- ❒ What are the health system challenges identified by the stakeholder group?
- ❒ Will digital health interventions be appropriate or are there non-digital approaches that should also be considered?

Evidence-base and experience with the implementing the digital health intervention(s)

- ❒ Has the digital health intervention been shown to address your health system challenges?
- ❒ Will more than one be needed to address the health system challenges?
- ❒ Have the digital health interventions been tested or implemented at the scale necessary?

Enabling Environment

- ❒ Will the enabling and ICT environment be able to support the selected digital health intervention?
- ❒ What precautions will you need to take in planning the digital health implementations (also elaborated on in Chapter 5)?

Requirements

- ❒ How well does the enterprise meet the user needs and stakeholder expectations?
- ❒ Does the enterprise fit well within the existing culture, language and workflow processes?

Linkages to other ICT Enterprises

- ❒ Are there other digital health interventions and ICT enterprises being implemented in the targeted context?
- ❒ Will you be able to leverage the additional enterprises?

CHAPTER

05 PLAN THE IMPLEMENTATION

The previous chapters helped you identify which digital health interventions to implement and why. This chapter examines more closely how to plan for implementing your prioritized interventions within a digital health enterprise, recognizing the iterative nature of the implementation process.

TOOLS	+ Questions to ask technology vendors (*Annex 5.1*) + Key considerations for implementing a digital health intervention (*Annex 5.3*)
OBJECTIVES	+ Review critical factors to consider when planning to implement a digital health intervention. + Develop a realistic implementation plan that is responsive to the enabling environment.
INPUTS	+ Future-state user journey/workflow diagram (*Chapter 4*) + Enabling-environment assessment (*Chapter 4*) + Functional and nonfunctional requirements (*Chapter 4*) + Landscape analysis results (*Chapter 4*) + Personas (*Chapter 2*)
OUTPUTS	+ Detailed implementation plan for selected digital health interventions (Output 5.1) + Documentation in the Implementation Summary Template (*Annex 5.2*)

PRINCIPLES FOR
DIGITAL DEVELOPMENT

BUILD FOR
SUSTAINABILITY[8]

+ **Plan for sustainability** from the start.
+ **Develop a definition of *sustainability*** for your initiative.
+ Identify and implement a **sustainable business model**.
+ **Use and invest in** local ICT service providers.
+ **Engage local governments** and integrate national strategies into programming.
+ **Collaborate instead of competing**, and partner to identify the best approach with the greatest impact.
+ **Build a programme that can be adapted** as end-user needs and the context change.

8 Text adapted from Principles for Digital Development: Build for sustainability: Core tenets (7).

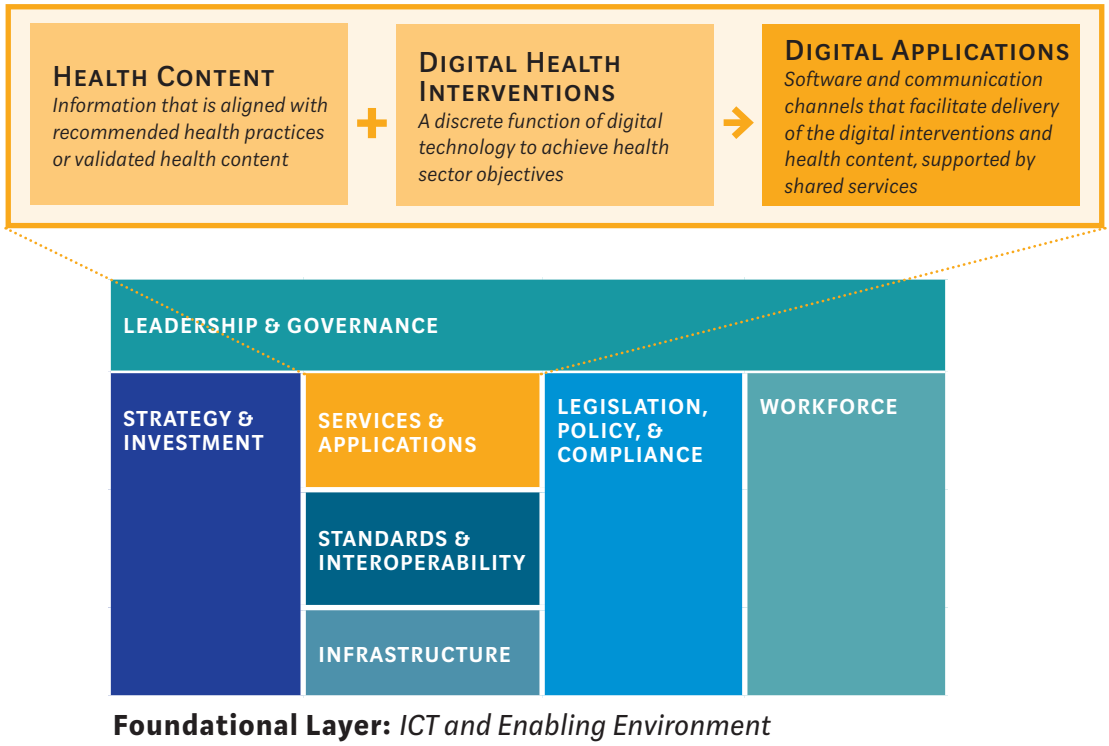
The previous chapters helped you identify which digital health interventions to implement and why. This chapter examines more closely how to plan for implementing your prioritized interventions within a digital health enterprise, recognizing the iterative nature of the implementation process.

Digital health implementations are broadly based on the following critical components (see *Fig. 5.1*):

1. appropriate and accurate health content and information, defined based on the health programme guidelines and related evidence-based practices, and data needs for the programme or use case
2. the digital health intervention itself, consisting of the discrete digital functionality being applied to achieve the health objectives (the digital health interventions selected in *Chapter 4*)
3. digital health applications, which represent the software and communication channels that facilitate the delivery of digital health interventions combined with health content, and which may be supported by shared services such as registries and an interoperability layer
4. foundational ICT and enabling environment (such as governance, infrastructure, legislation and policies, workforce, and enterprise architecture, including services, applications, standards and interoperability) in which the implementation is situated.

Depending on the complexity of the prioritized digital health interventions and the maturity of the digital health enterprise, the requirements for ensuring effective implementations can vary considerably. However, for any digital health application to scale and become institutionalized within a health programme, it must align with the infrastructure, legislation and policies, and country or implementation leadership and governance. These components, or foundational building blocks of a digital health strategy, contextualize the implementation of the digital health application and are critical for its viability and sustainability. While most digital health implementations tend to focus extensively on the technological aspects like the software and hardware, effective partnerships and a well-trained workforce underpin the success of any implementation. Additionally, maximizing opportunities for interoperability and linkages to broader systems based on data standards will reduce fragmented siloed digital health implementations and enhance the overall digital health ecosystem in the country. (Financial investments are also one of the building blocks and will be discussed in more detail in *Chapter 7*.)

Fig. 5.1. **Essential components of a digital health implementation.**



Foundational Layer: *ICT and Enabling Environment*

In this chapter, you will explore the different considerations and key questions that can help guide your digital health implementation (see *Table 5.2*). These considerations are based on the seven foundational building blocks, as well as additional factors that may influence the success of your implementation. After completing this chapter, you may want to reassess whether the digital health interventions you selected are still feasible for your context based on your evaluation of these considerations.

Table 5.2. **Illustrative implementation considerations for digital health.**

Factor	Illustrative considerations
STRATEGY AND INVESTMENT	» Is there a digital health strategy or investment roadmap in place? How do your identified digital health interventions align with the national strategy and current and proposed digital health investments in the country? » What new investments are required to make it possible to ensure that your digital health interventions are integrated into an existing or future digital health enterprise architecture?
INFRASTRUCTURE	» What are the electricity conditions at the deployment sites? » What kinds of connectivity and bandwidth are available at the deployment sites? » If the planned intervention will use mobile technology, what types of devices are end-users familiar with?
LEGISLATION, POLICY AND COMPLIANCE	» Are there mechanisms for ensuring the privacy and security of information during transmission? » Are there relevant policies for unique IDs and identity management for digital health implementations that involve clients/patients? » Are there procedures for redundant data storage in case of primary data loss? » Are there other policies, such as HIS policies, to which digital health implementations will have to adhere?

Factor	Illustrative considerations
LEADERSHIP AND GOVERNANCE	» Is there a national digital health governance framework or action plan, such as technical working groups? » Are partnership terms and formal collaborations documented in a memorandum of understanding? » Do separate departments or divisions oversee ICT and digital health? » Is there a group or committee that combines ICT staff and staff from public health vertical programmes (such as malaria, tuberculosis, HIV/AIDS or maternal and child health) that you should include?
WORKFORCE	» Are training procedures in place for health workers to build capacity with digital health applications? » If health workers will use a digital application concurrently with paper-based systems, how will the double work be managed? » How are change management and transitioning to digital approaches being supported? » Are there considerations and actionable policies to support health workers who may find their roles redundant following the introduction of a particular digital implementation? » Are plans for health workers' privacy and safety in place regarding the use or exchange of data with chosen digital health interventions?
SERVICES AND APPLICATIONS	» Are there existing digital health applications that can support the selected digital health interventions? » Are there mechanisms for procuring hardware locally or leveraging existing hardware? » Are there processes in place for maintaining the hardware and software? How will updates to the software be pushed out to the end-users? » What are the regulations and procedures for hosting and storing data? » Does your implementation reference or link to shared services in the digital health platform, such as identification registries, a national health workforce registry or the master facility list?
STANDARDS AND INTEROPERABILITY *(See also Chapter 6.)*	» Is a digital health enterprise architecture or blueprint in place? Does your digital health intervention use data standards that are compatible with other systems in the country? » Are there reusable components, such as terminology services and data dictionaries, that you could incorporate? » Is there an interoperability framework to help guide how systems support one another? » Are there maintained data exchange standards (such as HL7 FHIR) that will need to be considered? » Is there a national interoperability mediator (for data exchange) that applications will need to leverage?
HEALTH CONTENT	» What are the evidence-based clinical and/or public health guidelines from which your health content will be derived? » What are the processes that will be followed to ensure that algorithms, decision support, checklists, messages, schedules and other operational components of the health content are in line with evidence-based recommendations and best practices? » What are the data and indicators that are critical to the functioning of the digital health intervention and the derivative outputs, such as recommended indicators and performance metrics? » How can you leverage and contribute to an existing data dictionary or terminology shared service?

Sources: Adapted from WHO/ITU National eHealth strategy toolkit, 2012 (3); The MAPS toolkit, 2015 (29).

Box 5.3. Description of digital health interventions reviewed in the *WHO guideline*.

Annex 5.3 expands on additional implementation considerations for specific digital health interventions prioritized in the WHO guideline *(1)*. If you are considering one of these interventions, review *Annex 5.3* for a more nuanced list of factors that could affect your implementation.

Digital health intervention	Definition	Synonyms and other descriptors
Birth notification	Digital approaches to support the notification of births, to trigger the subsequent steps of birth registration and certification, and to compile vital statistics	▸ Birth event alerts ▸ Enabling health workers and community to transmit alerts/notifications when a birth has occurred
Death notification	Digital approaches to support the notification of deaths, to trigger the subsequent steps of death registration and certification, and to compile vital statistics, including cause-of-death information	▸ Death surveillance ▸ Death event alert ▸ Enabling health workers and communities to transmit alerts/notifications when a death has occurred
Stock notification and commodity management	Digital approaches for monitoring and reporting stock levels, and consumption and distribution of medical commodities. This can include the use of communication systems (e.g. SMS) and data dashboards to manage and report on supply levels of medical commodities	▸ Stock-out prevention and monitoring ▸ Alerts and notifications of stock levels ▸ Restocking coordination ▸ Logistics management and coordination
Client-to-provider telemedicine	Provision of health services at a distance; delivery of health services where clients/patients and health workers are separated by distance	▸ Consultations between remote client/patient and health worker ▸ Clients/patients transmit medical data (e.g. images, notes and videos) to health worker
Provider-to-provider telemedicine	Provision of health- services at a distance; delivery of health services where two or more health workers are separated by distance	▸ Consultations for case management between health workers ▸ Consulting with other health workers, particularly specialists, for patient case management and second opinion
Targeted client communication (targeted communication to individuals)	Transmission of customized health information for different audience segments (often based on health status or demographic categories). Targeted client communication may include: i. transmission of health-event alerts to a specified population group; ii. transmission of health information based on health status or demographics; iii. alerts and reminders to clients; iv. transmission of diagnostic results (or of the availability of results).	▸ Notifications and reminders for appointments, medication adherence, or follow-up services ▸ Health education, behaviour change communication, health promotion communication based on a known client's health status or clinical history ▸ Alerts for preventive services and wellness ▸ Notification of health events to specific populations based on demographic characteristics
Health worker decision support	Digitized job aids that combine an individual's health information with the health worker's knowledge and clinical protocols to assist health workers in making diagnosis and treatment decisions	▸ Clinical decision support systems (CDSS) ▸ Job aid and assessment tools to support service delivery, may or may not be linked to a digital health record ▸ Algorithms to support service delivery according to care plans and protocol
Digital tracking of patients'/ clients' health status and services within a health record (digital tracking)	Digitized record used by health workers to capture and store health information on clients/patients in order to follow-up on their health status and services received. This may include digital service records, digital forms of paper-based registers for longitudinal health programmes and case management logs within specific target populations, including migrant populations.	▸ Digital versions of paper-based registers for specific health domains ▸ Digitized registers for longitudinal health programmes, including tracking of migrant populations' benefits and health status ▸ Case management logs within specific target populations, including migrant population
Provision of educational and training content to health workers (mobile learning/ mLearning)	The management and provision of education and training content in electronic form for health professionals. In contrast to decision support, health worker training does not need to be used at the point of care.	▸ mLearning, eLearning, virtual learning ▸ Educational videos, multimedia learning and access to clinical and non-clinical guidance for training reinforcement

5.1 Infrastructure considerations

Many digital health applications and platforms have seen limited adoption and success because they were piloted in areas that had inadequate access to electricity and mobile networks or were otherwise inappropriately designed for the context. Understanding the available infrastructure is foundational to defining the scope and feasibility of the digital health application. Several practical approaches help alleviate constraints posed by infrastructural limitations. For example, erratic power supply and Internet connectivity may cause challenges when uploading data to a central computer in real time and may even result in data loss. However, if you know about connectivity issues during the planning stages, you could design the digital health application to facilitate offline data collection, supported by manual transfer of data to a central computer where the data are stored. Similarly, if irregular access to electricity keeps end-users from charging digital devices, you could consider alternatives during planning, such as battery packs or solar chargers.

In the early stages of planning, consider the following questions to ensure that the infrastructure can support the implementation or to determine whether you need to establish contingency plans.

ELECTRICITY: What are the electricity conditions at the deployment sites? Is there a ready and stable supply of electricity? Does this electricity supply vary by season or during inclement weather? What alternatives exist to grid power, such as solar, wind or water turbines? Also consider training end-users on power management of devices: turning devices off, shutting off Bluetooth and so on.

CONNECTIVITY: What kind of connectivity is available at the implementation sites? Do end-users have reliable voice and text-messaging coverage? Do they have stable low- or high-speed Internet coverage? If possible, speak directly with end-users or mobile network regulators about coverage and connectivity. Coverage reports from mobile network operators (MNOs) often overstate connectivity or present only a snapshot of the coverage. If you plan to scale to regions with unreliable connectivity, consider interventions and applications that can work offline, and adequately plan for the amount of data that may be needed to be stored offline to ensure that the application still performs well with large amounts of data waiting to be sent to server.

DEVICES: What types of devices can be sourced locally? If the planned intervention will use mobile technology, what types of devices do end-users currently have? How comfortable are they with using different functions on their phones? Do they make voice calls only, or do they also use text messaging or interactive applications?

DIGITAL LITERACY AND LANGUAGE: What is the level of digital literacy (proficiency in operating digital devices) of the target population? If you plan to deploy the intervention across regions, how will you account for variations in digital literacy in accessing information over digital devices, as well as the range of languages that the content would need to include?

Box 5.1.1. Resource on hardware management.

» *BID Initiative Equipment support strategy* (68)

5.2 Legislation, policy and compliance considerations

It is important to understand the national policies and regulations that may apply and explore relevant global best practices when national policies are lacking. These could include regulations for hosting data and using personally identifiable information, processes for informed consent, relevant standards and linkages with other systems. A successful digital health implementation plan will assess the current policy environment, adapt the design to that environment and ensure that policies are sufficiently implemented. Evaluate these considerations in conjunction with leadership and governance considerations (see *section 5.3*), as sound policy relies on leaders and governance structures to ensure its effectiveness and accountability *(69, 70, 71)*.

5.2.1 DATA MANAGEMENT, PRIVACY AND SECURITY

Clear guidance and documentation for access to and sharing of data strengthen the security of the systems that process and store data (such as data warehouses). This can also help clarify who has access to what data, when and for what purpose and head off potential risks associated with inappropriate data use.

Guidance facilitates necessary privacy protection for sensitive data and mitigates against breaches that place the health system and beneficiaries at risk. See *Box 5.2.1.1* for examples of policies for protecting data, as well as *Annex 5.4* for an illustrative checklist to mitigate data management risks.

Look for the following guidance or policies when planning for data access and security needs:

- privacy protection for patients, caregivers and health workers
- security of protected information during transmission
- devices that can access each server where information is held
- access and use of data that donors and implementing partners collect and store, as well as for research purposes
- guidance on data flows from one place to another
- use of cloud-based services
- data ownership
- procedures for redundant data storage in case of primary data loss
- other policies, such as HIS policies, to which interventions will have to adhere.

Box 5.2.1.1. Examples of policies for data protection and regulation.

When defining the guidelines, consider principles of assessment, such as the UN Global Pulse's *Risk, harms and benefits assessment tool (72)*. This resource serves as an internal tool to better understand data privacy, ethics and data-protection compliance mechanisms associated with use of big data in development and humanitarian contexts.

The General Data Protection Regulation developed by the European Union provides useful considerations for managing data protection, privacy and security. These include client rights to[1]:

- be informed on how their data will be used
- access their data
- correct or rectify the collected data
- have their data deleted, or "be forgotten", if the data were collected unlawfully or deemed no longer necessary
- restrict data processing or completely object to the processing of personal data for the purposes of advertising or direct marketing
- transfer the data to another party without interference *(73)*.

Guidance from CDC[2] and UNAIDs[3] on data security, privacy and confidentiality; and relevant standards curated by ISO TC 215 on health informatics[4] will provide additional operational and technical requirements.

The African Union Convention on Cyber Security and Personal Data Protection provides similar articles, including these examples:

- Article 18 The right to object: Any person has the right to object, on legitimate grounds, to the processing of the data relating to him/her. He/She shall have the right to be informed before personal data relating to him/her are disclosed for the first to third parties or used on their behalf for the purposes of marketing, and to be expressly offered the right to object, free of charge, to such disclosures or uses.
- Article 21 Security obligations: The data controller must take all appropriate precautions, according to the nature of the data, and in particular to prevent such data from being altered or destroyed, or accessed by unauthorized third parties. (74)

While establishing such policies in countries is critical, raising awareness of and enforcing these policies are equally important.

1 *https://ec.europa.eu/info/priorities/justice-and-fundamental-rights/data-protection/2018-reform-eu-data-protection-rules/eu-data-protection-rules_en*
2 *https://www.cdc.gov/nchhstp/programintegration/docs/pcsidatasecurityguidelines.pdf*
3 *https://www.unaids.org/en/resources/documents/2019/confidenTality_security_tool_user_manual*
4 *https://www.iso.org/committee/54960/x/catalogue/p/1/u/0/w/0/d/0*

5.2.2 REGULATION OF NEW DIGITAL HEALTH TECHNOLOGIES

Many countries are developing national regulatory systems for health-related technology. Regional groups, such as the Digital Regional East African Community Health Initiative and the African Union's New Partnership for Africa's Development, encourage regional-level regulation or qualification of new technologies for their member countries. Although still emerging, international regulatory bodies are also establishing measures for quality assurance and safety of "software as a medical device" *(75)*, such as software that monitors blood pressure or diagnoses infections. These efforts at different levels can result in multiple layers of

regulation that you will need to examine and determine how to balance. (For more information about regulations of medical technologies, see *Box 5.2.2.1.*)

As technology continues to evolve, the procedures and policy considerations for introducing new technologies will also likely need to accelerate. The implementation leadership teams may want to consider how new technologies are integrated into the health system and what the policy foundation is for regulating the technologies. Consider the following questions when planning to meet regulatory requirements.

- How are new digital technologies approved for use, procurement and marketing within the public and private sectors of the health system? (Public and private systems often differ in regulatory rigor.)
- How can you ensure that your implementations are aligned with guidelines governing the connectivity of digital medical innovations, such as connected diagnostics?
- Is the current regulatory system fully financially resourced and staffed?

Box 5.2.2.1. Resources on regulation of medical device technologies.

- *International Medical Device Regulators forum (76)*
- *WHO Medical devices: regulations (77)*

5.3 Leadership and governance considerations

Having a clear understanding of the governance and leadership structure will help you craft an inclusive planning process and foster a sense of ownership of the implementation. Governance may include a steering committee or a decision-making board composed of a range of stakeholders (see *Chapter 2*). Engaging the right stakeholders from the beginning increases the possibility that they will incorporate future investments in the implementation into their annual budgets and workplans *(29, 69, 78, 79)*.

5.3.1 GOVERNANCE

Answering the following questions will help you facilitate active engagement with existing governance mechanisms.

- Are meetings scheduled at regular intervals to coordinate across leadership and build consensus on project directions and proposed changes?
- Are partnership terms and formal collaborations documented in a memorandum of understanding?
- Do separate departments or divisions oversee ICT, M&E and digital health? Is there a group or committee that combines ICT staff and staff from public health vertical programmes (such as malaria, tuberculosis, HIV/AIDS and maternal and child health) that you should include?
- Does the Ministry of Education cover aspects of training health workers? How is the Ministry of ICT involved in supporting the programme? Should you include a different ministry or department that manages the governance of administrative units (such as districts, provinces or regions), like the Ministry of Local Administration?

5.3.2 EXTERNAL PARTNERSHIPS

Implementing digital health interventions often requires working with a range of partners in addition to governmental organizations that are traditionally considered the public health sector. These partners can include NGOs, academic institutions, civil society organizations, donor organizations, and technology and software companies. Also consider local MNOs, telecommunications groups, the consumer products industry and pharmaceutical companies. Identify the resources, competencies and capacity needed to complement implementation needs and improve the potential for success. You may also want to consider aligning implementation of the digital health intervention with other large-scale health initiatives, such as a national maternal health effort, in which technical inputs, training and supportive supervision can be combined. Be sure to include technical partners and selected contractors as collaborators when developing the implementation plan.

Consider the strategic advantages that each partner brings. For example, partnering with MNOs may provide opportunities to access a larger number of end-users and reduce the cost of the intervention by bundling it with other MNO services. In turn, the MNO may value the enhancement of brand awareness and status that such a partnership can provide.

Also determine how you may need to work with a technology vendor and, if so, who that vendor should be. The technology vendor as a partner may provide training and installation support during initial deployment of the digital health implementation but have different procedures, pricing and expectations in other phases. The first step in hiring a technology vendor is to develop a requirements document (based on the requirements identified in *Chapter 4*), which serves as the basis for a request for proposals (RFP) for soliciting competitive bids. You circulate the RFP to potential vendors, who then respond with associated costs and details of the products and services they can provide to meet the requirements *(2)*. The RFP should also state the criteria you will use to evaluate submitted proposals.

5.4 Workforce and training considerations

Chapter 2 listed the key governance, management and operations personnel needed for a digital health implementation. At this point, you will focus on the workforce directly involved in the digital health enterprise, such as community and facility health workers and healthcare managers. Although some health workers will show great enthusiasm for new technologies, introducing and institutionalizing the intervention with all of the workforce or client end-users can be challenging.

Establish training programmes for each cadre of health worker and for healthcare managers who are involved with the digital implementation. Intensive introductory training on how to use new applications, followed by regular refresher training, is vital. Explore models like training of trainers and engaging local NGOs when scaling up training in a systematic way. Be sure to appropriately contextualize the model you choose for regional variations. Several studies have also highlighted how important it is to train not just the health workers who will directly interface with the devices, but also the managers who will provide oversight and ensure accountability. Additionally, you may consider embedding metadata (system-generated data on how the digital health intervention is being used) to monitor performance of health workers and determine where you may need to intervene or provide additional end-user support.

Build in sufficient time to learn the new digital health intervention, recover from errors and increase comfort and speed in using the application within the enterprise. Also assess if the digital health intervention will introduce a significant change that may require more intense training of health workers (and therefore additional funding and training-of-trainers courses). Start identifying champions at different levels to help inspire and motivate others. Transitioning from paper-based to digital systems is typically a phased process. In the initial phases, health workers will likely have to enter data twice, once on paper and once digitally, which can annoy workers and disrupt their ability to provide services. Start simple and minimize the number of required fields, if possible. Maintain technical support for end-users by levels. In the subsequent phases, you may start working more intensively on change management and processes to accept a paperless future state.

Involve end-users. Incorporate end-users' cultural preferences, and plan to adapt the design for new contexts. Also plan for changing the intervention's content and interfaces over time. Design information structures, images and icons so they can be changed easily if you scale to a different context. Involve end-users to make sure that the data you collect will have a purpose, which helps ensure that collected data are actually used.

Consider demonstrating how the data health workers collect will be used in the health programmes they implement. Recognize that many health workers and their managers may not intuitively understand digital health and the accompanying technology vocabulary. Ensure that health workers understand how data are stored and used, including the value of the data to them within their responsibilities. Consider making a regular plan to share the data back with them, showing how the data was used for decision-making at higher levels and how the data can be used to improve their own work.

Communicate expectations and best practices for managing passwords and personal health information, including why these are considered optimal behaviours.

BID Initiative: Workforce implementation

The BID Initiative developed a workforce implementation strategy *(80)* informed by John Kotter's eight-step model for change management (see *Fig. 5.4.1*). "Touches", or visits, were used to introduce and provide training on new tools and approaches, allowing health workers time to internalize the practice of data analysis and use (see *Fig. 5.4.2*). Successful implementation requires buy-in from local health workers, so BID centred its approach on health workers, both as trainers and trainees. Instead of having BID Initiative staff lead touches, district immunization officers led activities within facilities and provided direct support to health workers.

Fig. 5.4.1. Kotter's eight-step change model.

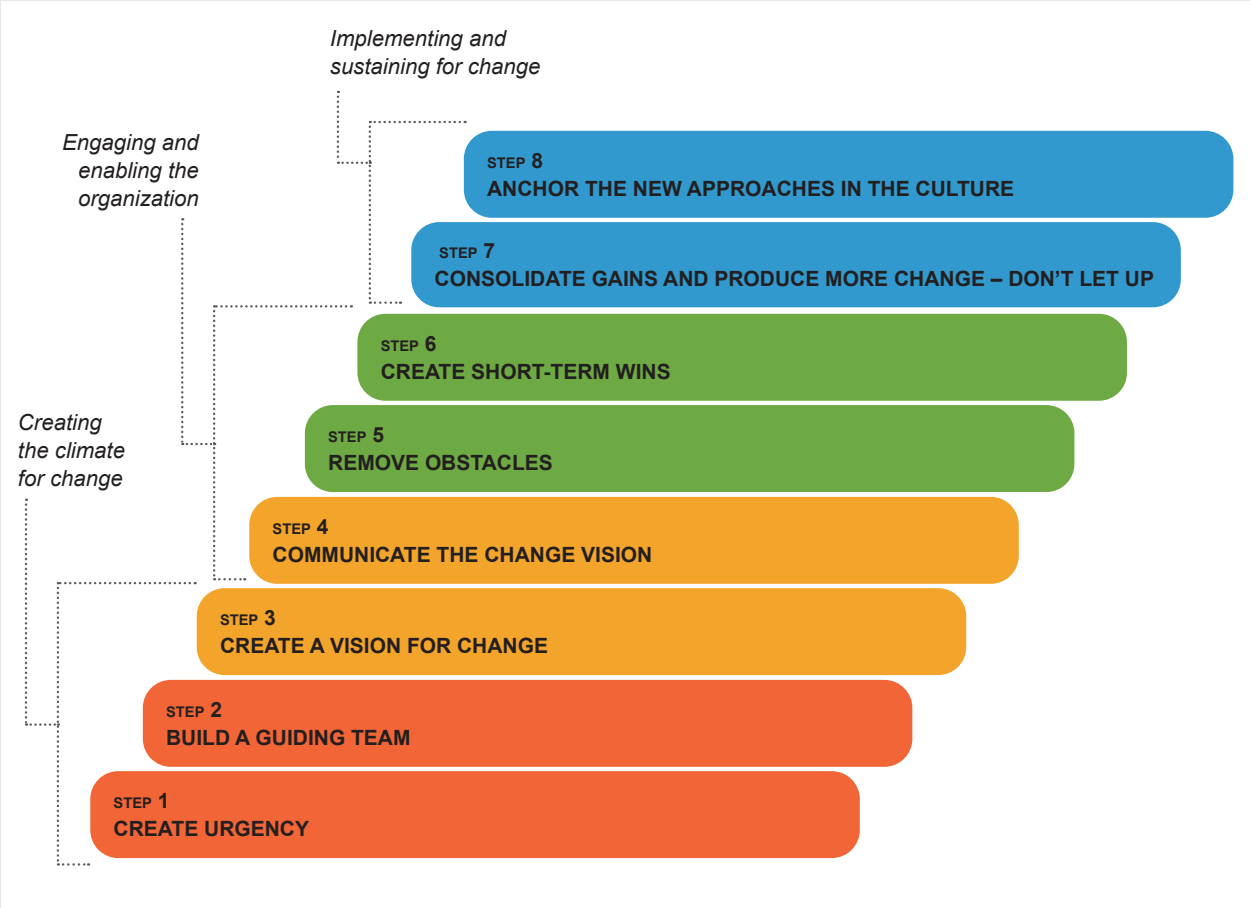


Fig. 5.4.2. Linking Kotter's change model to BID's touch strategy.

ROUTINE BID ACTIVITIES	KOTTER'S STEPS	OBJECTIVES	CHANGE MANAGEMENT ACTIVITIES
Touch 1	1 and 2	Introduce the intervention and prepare for Touch 2. Urgency is defined and advocated for.	Select a guiding team involving health facility in-charges with the district officials and regional/ provincial teams for support.
Touch 2	3 and 4	Introduce the electronic immunization registry to health providers and train them on how to use it to collect immunization data and use the data for decision-making.	Communicate the vision for data use and data quality interventions and how that vision contributes to addressing challenges faced by the facility, through posters, messaging, etc.
Touch 3	5 and 6	Provide immediate follow-up with the health providers. During this touch, health workers are also encouraged to use the system and to build their confidence.	Create short-term wins by sharing success stories early in the process, such as the ability to use the systems to easily collate information or prepare reports.
Touch 4	7 and 8	Emphasize the decision-making and data use culture. Ensure new ways behavior is recognized and rewarded to embed the change in the organizational culture. Institutionalize data use and data quality interventions and embed them into existing public processes using, for instance, supportive supervision.	Health providers are supervised and continue to use the new system. Health workers are also trained in several different data use scenarios using the built-in decision-making process. Future supervision is handed over to the district.

Source: BID Initiative briefs: recommendations and lessons learned: change management (80).

The following are additional BID Initiative tools and resources for workforce implementation:

- Rollout strategy *(81)*
- Facility and district visit strategy *(82)*
- Spotting and addressing resistance to change *(83)*
- Change readiness assessment tool *(84)*
- Coaching/supportive supervision job aid *(85)*.

5.5 Services and applications

Services and applications are the devices and tools, including software, used to collect, transmit, access and maintain health information, including the ICT systems that your digital health interventions will integrate with and leverage *(3)*. Services include digital registries for health workforce, master patient indexes and health facilities, and applications include a variety of software and ICT systems that may be operating in your country, such as HMIS, indicator-reporting dashboards, and terminology and identity management services, as well as any enabling components like the interoperability layer. Although specific requirements for services and applications will differ based on the digital health interventions that you have selected, consider the following to improve the uptake of your intervention.

Leverage existing hardware or reduce procurement of new hardware. Many digital implementations now rely on end-users' phones or other devices or on locally procured devices for deploying interventions. As much as possible, avoid investing in duplicative hardware that only a single unit or department will use. Also consider deployment of mobile-device management tools to ensure that purchased hardware is being used for its intended purpose and to reduce wastage *(86)*.

Determine an appropriate software and licensing plan to execute your digital health interventions. Based on the landscape analysis conducted in *Chapter 4*, you should be aware of which digital health interventions, applications and shared services are present in your country. Consider the advantages and disadvantages of different strategies before deciding on a specific software model. *Fig. 5.5.1* summarizes the predominant software models available for use, along with their benefits and risks. *Annex 5.1* provides more detailed questions that you may want to discuss with potential providers of software applications.

- To what extent is the application configurable by internal teams or requires customization by external teams? For example, if facility names or hierarchies change or new indicators are added, can they be reconfigured within the platform, or do you need the software vendor to make changes? What is the expected frequency of changes?
- How will changes or reconfigurations to the application be pushed to the end-users using outdated versions, or how will you bring in health workers for reinstallation?
- Are national vendors available to provide support? What are the risks of vendor lock-in, in which the customer becomes dependent on the vendor for products and services and cannot switch to another vendor without incurring substantial costs *(87)*? Are multiple vendors or a large community with experience providing support available for this specific digital health application or shared service?

Test the implementation for functionality and stability. Technology vendors typically work in iterations to develop applications and organize tests to assess the application's usability and stability. Note that this testing should be planned as part of a deployment strategy with continual end-user experience tests until the application is ready to scale. A formal sign-off with the developers is needed at each of the stages *(2)*.

- **End-user experience tests**, also called usability testing, are conducted to ensure that end-users can navigate through the system and perform the tasks as intended. This testing should be conducted continually throughout the development process in order to incorporate end-user feedback into the process as early as possible.
- An **end-user acceptance test** is conducted in a controlled setting with test data to assess whether the application performs as described in the requirements document prior to signing off on the functionality.
- A **functionality test** is conducted in a real-life setting with a limited number of end-users entering real data and using the application in the way that it was intended.
- Once the stability of the application has been tested in controlled and real-life settings with a limited number of end-users, a **load test (or stress/volume test)** is done to assess whether the application continues to function as intended with a larger number of simultaneous end-users.

» Throughout this process, put in place mechanisms to **collect and respond to end-user issues**, particularly in the early stages of piloting and deployment. This mechanism will need to describe how end-users are expected to report problems, who investigates and responds, and how quickly they should respond.

Ensure that the health content is in line with evidence-based recommendations and best practices. Based on the health programme area where your digital health intervention is focused, consult relevant resources and country experts to ensure that the following is true for your intervention. Leverage resources such as WHO Digital Accelerator Kits and Computable Guidelines Standards for up to date health and data content aligned with WHO Guideline and data recommendations.

» Health content embedded in the digital health application – such as counselling content or decision-support algorithms – reflects evidence-based practices derived from clinical or public health recommendations, as well as national guidelines.

» The digital health application will be able to capture relevant and appropriate data and make possible calculations of prioritized indicators for key decision-making and monitoring performance of the end-users, as well as inputs, outputs and impact.

» Content – where relevant – reflects appropriate theories of change and is culturally appropriate, locally validated and in line with national guidelines.

Fig. 5.5.1. Benefits and risks of different software models.

MODEL		BENEFITS	RISKS
CUSTOM-DEVELOPED SOFTWARE Build a software system from scratch.	*Examples:* Project Optimize demonstration projects in Albania, Guatemala, Senegal and Vietnam.	• You have control over technology, functionality and design. • The development experience creates ownership and improves sustainability. • It is possible to engage the local IT industry.	• Custom development tends to be difficult to manage within time and budget. • Control over design does not guarantee satisfaction with the end product, as that depends on the capabilities of the technical team. • Long-term support depends on the continued availability of individuals.
COMMERCIAL OFF-THE-SHELF SOFTWARE Buy a commercially available product.	*Examples:* Sage Enterprise Resource Planning, which is in use in many countries in Francophone Africa for essential medicines.	• The lead time from selection to implementation is normally shorter. • You can evaluate it before buying. • The product is maintained and upgraded (at a cost). • It has normally been tested and refined in other implementations.	• Often expensive and sold with unclear and complex fee structures, for example, a fee-per-server processor. • Commercial off-the-shelf software is not often designed for implementation in low-resource settings.
FREE PACKAGED SOFTWARE Software developed by a donor organization or technical agency. Alternatively, a system developed by a neighboring country.	*Examples:* USAID/John Snow, Inc.: • PipeLine • Supply Chain Manager World Health Organization: • Vaccination Supplies Stock Management tool • District Vaccine Data Management tool	• Shorter lead time. • Possibility to evaluate. • No upfront cost (but maintaining or customizing it may require investment).	• There is often no contract, so service and warranty for bug-fixing depends on goodwill of one or two individuals and there is no institutional support. • Many implementation and running costs are hidden.
OPEN SOURCE SOFTWARE The source code as well as the software product is freely available. Often, a community has been formed to support the open source software.	*Examples:* OpenLMIS OpenMRS DHIS2 OpenSRP	• You have the right to make changes to the software. • You can engage the local IT industry. • Benefit from communities and share development costs with other organizations.	• Can end up with a poorly supported product. • A loosely knit community might not be able to provide the business relationship you need. • Some of the implementation and running costs are hidden.
SOFTWARE AS A SERVICE (SaaS) Database and application hosted on remote servers, and software is sold (or offered freely) as a service that can be contracted per user and per month or year.	*Examples:* Logistimo Magpi CommCare Ona	• Highly feasible to implement and maintain. • Clarity about the cost to implement and run a SaaS application. • Investment in improved software can easily be shared among customers.	• Data hosted on remote servers: not always in agreement with national policy. • Ministries of health are not often well positioned to pay a regular service fee.

Source: WHO/PATH Planning an information systems project, 2013 (2).

5.6 Standards and interoperability

Standards and interoperability are also critical factors for ensuring the success of digital health implementations. For different systems to be interoperable, or to meaningfully exchange information with one another, procedures and data standards must be established that ensure a common language and facilitate data exchange. Interoperability is not only critical for driving cost efficiencies and reducing fragmentation across different digital systems, but is also necessary to support the continuity of care as patients engage at different points of service in the health system, and the digital health enterprise will need to ensure the golden thread of continuity is maintained across each provider and facility.

Chapter 6 will elaborate on the concepts of standards and interoperability and describe how the proposed digital health implementation can further link to a broader digital health enterprise architecture. Skipping this review step may result in a fragmented and siloed digital health implementation.

Box 5.6.1. General considerations for standards and interoperability.

Where appropriate, link to identification registries, such as a national health workforce registry, client registry or master facility list. For example, some countries have a facility registry with a master facility list that includes unique identifiers of health facilities and related information on the services they provide. The facility registry provides an identification number that can link different applications, such as electronic medical records and a telemedicine system. A similar example is a health worker registry, which provides unique identifiers for each health worker. These identifiers can facilitate exchanging data across the different applications in which digital health interventions are housed.

Use data standards for exchanging health information. Global bodies such as Health Level 7 (HL7), International Classification of Diseases (ICD) and International Health Exchange have established standards, rules that allow information to be shared and processed in a uniform, consistent manner *(88, 89)*. These data standards allow stakeholders to align on common data models, which then facilitates exchanging information across components of the digital health enterprise. For example, data terms used in an HMIS need to align with data terms used in an electronic medical record to allow comparison of indicators and analysis of health information. Developing a dictionary of health terms can be a gradual process that uses already established data standards while also curating local data.

5.7 National digital health strategy and investment plan

Determine whether you have a national digital health or eHealth strategy, and review the priorities, policies and operational aspects to establish areas of alignment and differences. The digital health strategy may detail the current policies and different enabling factors, which are critical to understanding the readiness of the national environment to support additional digital health applications. Also determine whether a national investment planning process has been conducted detailing the status, functionality, maturity and inventory of the national digital health enterprise and any plans for future digital health investments that may align with your needs.

CASE STUDY

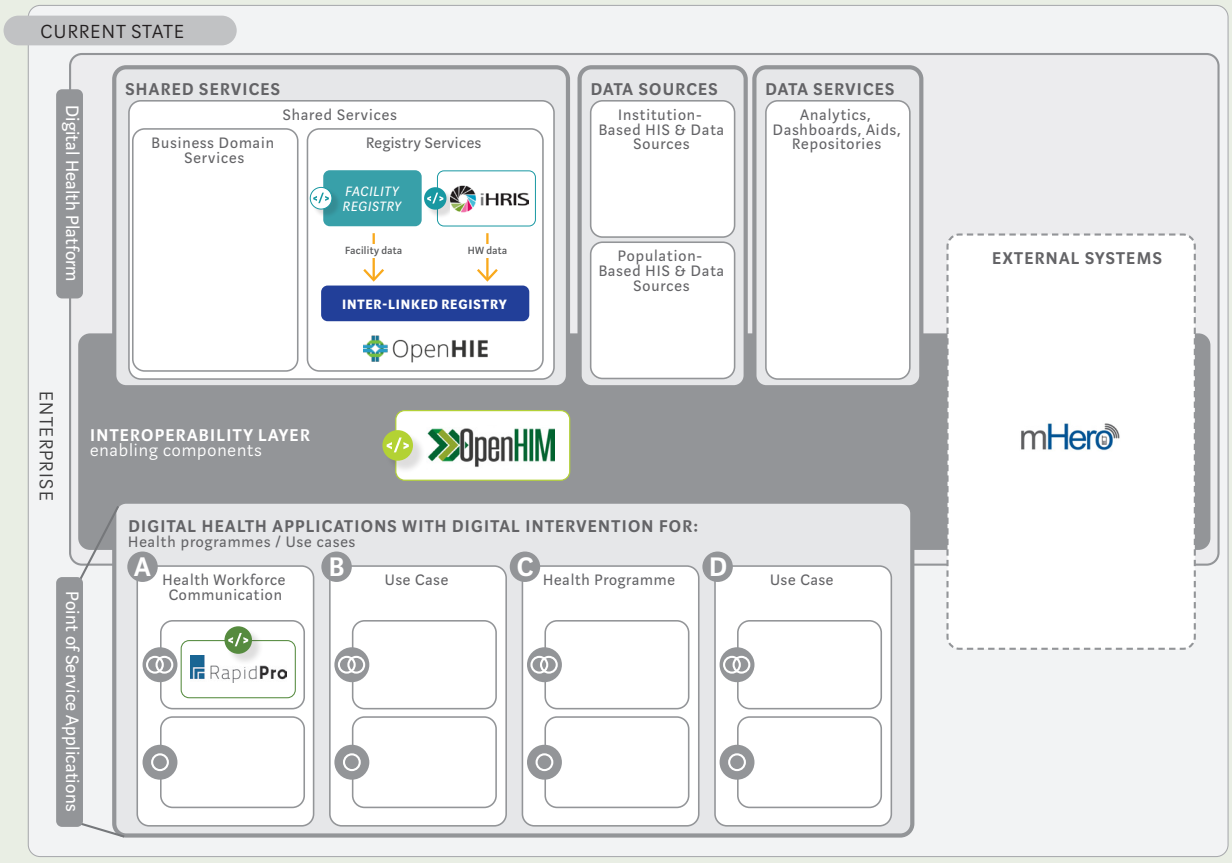
mHero – using data standards to effectively integrate different digital health interventions

mHero combines three technologies – IntraHealth's iHRIS software, UNICEF's RapidPro and Jembi's OpenHIM – into a powerful communication tool for ministry and health workers *(90)*.

iHRIS is open source health workforce information system software used to capture and maintain information for planning, managing, regulating and training the health workforce. RapidPro is an open source platform for building an interactive messaging system. OpenHIM is an interoperability layer for standards-compliant health information exchange, such as OpenHIE.

The combined tool, mHero, allows the MOH to instantly send information to health workers' mobile phones and enables health workers to send time-sensitive information back to ministry officials. This was done through rigorous adoption of open international standards, such as HL7 FHIR, for health data exchange, based on the OpenHIE framework. By using these standards, information about the health workers could be derived from the health workforce registry (iHRIS) and then used by the RapidPro messaging system to seamlessly communicate with health workers around the country (see *Fig. 5.6.2*). For example, information on the health facility associated with the health worker could be used as a way to target the messaging to health workers. Furthermore, the open source and open standards approach means that the mHero platform does not depend on any specific piece of software, which allows MOHs to readily integrate mHero into their HIS.

Fig. 5.6.2. How mHero integrates digital health interventions using standards.



Source: IntraHealth International, 2017 (90).

CHAPTER 06

LINK THE DIGITAL HEALTH IMPLEMENTATION TO THE ENTERPRISE ARCHITECTURE

Over the course of the previous chapters, you developed a plan for a digital health implementation focused on addressing identified health system challenges, with a clear understanding of the digital health interventions and other functionalities required. To advance this from being a siloed digital health implementation to an exchanged digital health system architecture, it is also important to consider the costs and implementation requirements that would enable you to cohesively benefit from and support the broader digital health enterprise, avoiding the missteps of investing in fragmented digital systems or ball-of-mud software applications trying to do everything.

TOOLS	+ OpenHIE diagram (*Fig. 6.3.2*) + TOGAF architecture building blocks (*Annex 6.1*) + Illustrative list of common components
OBJECTIVES	+ Link the digital health implementation to the broader digital health enterprise architecture. + Ensure that the costed implementation plan is reflected in the digital health enterprise architecture.
INPUTS	+ Defined future-state workflow and functional requirements (*Chapter 4*) + National digital health enterprise architecture (if available in country)
OUTPUTS	+ Core functional requirements for the planned digital health investment within the enterprise architecture (Outputs 4.3, 6.2) + Shared services and enabling components that can be reused or leveraged by other health programme areas or sectors (Outputs 6.3, 6.5) + Identification of which applications and shared services already exist and which will require further investment (Outputs 6.1, 6.4)

PRINCIPLES FOR DIGITAL DEVELOPMENT

REUSE AND IMPROVE[1]

- **Identify** the existing technology tools (local and global), data and frameworks being used by your target population, in your geography or in your sector. Evaluate how these could be reused, modified or extended for use in your program.
- **Develop** modular, interoperable approaches instead of those that stand alone or are attempting to be all-encompassing in their features. Interoperability will ensure that you can adopt and build on components from others and that others can adopt and build on your tool in the future; and swap out systems when improved – standards-based –solutions become available.
- **Collaborate** with other digital development practitioners through technical working groups, communities of practice and other knowledge-sharing events to become aware of existing tools and to build relationships that could lead to the future reuse and improvement of your tool.

1 *Text adapted from Principles for Digital Development: Reuse and improve: Core tenets (7).*

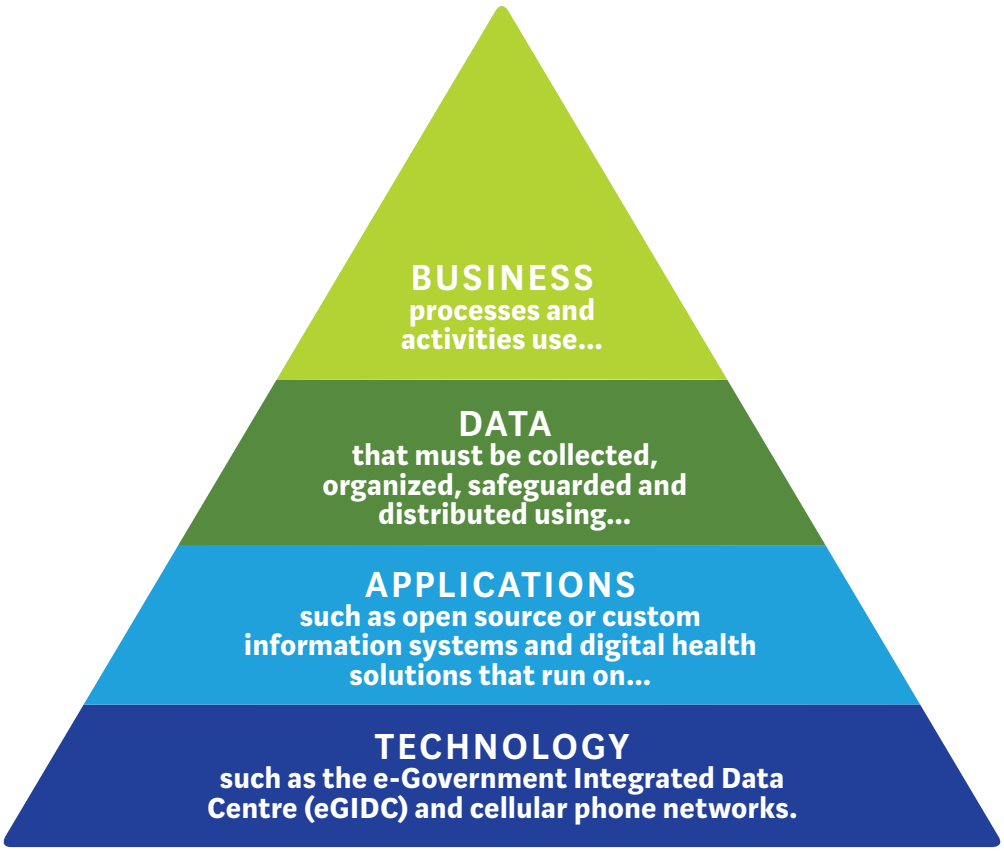
Over the course of the previous chapters, you developed a plan for a digital health implementation focused on addressing identified health system challenges, with a clear understanding of the digital health interventions and other functionalities required. To advance this from being a **siloed** digital health implementation to an **exchanged** digital health system architecture (see *Fig. 1.3.1*), it is also important to consider the costs and implementation requirements that would enable you to cohesively benefit from and support the broader digital health enterprise, avoiding the missteps of investing in fragmented digital systems or ball-of-mud software applications trying to do everything. When investments in digital health implementations are aligned with a nationally governed digital health enterprise architecture, in which systems contribute to and derive value from one another, the potential for your implementation to be sustained, scaled and institutionalized is greatly improved. In contexts where there may not be a defined digital health enterprise architecture, ITU's Digital health platform handbook *(14)* and the OpenHIE architecture specification *(91)* and community of practice *(18)* offer useful resources for planning a digital health enterprise architecture.

6.1 Assess the digital health enterprise architecture

A digital health enterprise architecture, if available in the country, outlines current and planned business processes, data, systems and technologies and provides an overview of the standards, information exchange and interoperability profiles that can be optimized across the enterprise. A clearly established enterprise architecture describing how different processes, data, systems and technologies function together is crucial for guiding interoperability to support data exchange between digital health applications, as well as collective functioning goals. An enterprise architecture blueprint lays the foundation for scaling up and sustaining digital health applications that are standardized and interoperable and that will facilitate access to higher quality, more complete information, in turn resulting in better decisions and more improved health outcomes across multiple areas. The architectural approach provides a view of all the necessary building blocks and a rational method of understanding, defining and manageably implementing digital health interventions.

Typically, there are four layers, or viewpoints, that describe various aspects of the health enterprise architecture (see *Fig. 6.1.1*). The health programme or business processes, such as the ones you developed in *Chapters 3* and *4*, depend on data augmented by appropriate health content for optimal functioning, including decision-making and effective action. These aspects are based on the health programme needs, as established in *Chapters 3* and *4*, and comprise the functional architecture. The technical architecture includes the required applications and technology that should be integrated and standardized to facilitate the delivery of identified digital health interventions and address the health sector goals. Adherence to appropriate health data and ICT standards becomes the critical link, or "glue", towards achieving greater interoperability.

Fig. 6.1.1. Digital health architectural approach.



Although this type of architectural vision may not exist or be fully developed for your context, you could consult the TOGAF and OpenHIE framework in *Fig. 6.3.2* to understand the different components typically found in developing a shared digital health enterprise architecture. Understanding the current architecture and its constituent functional and technical component parts will facilitate understanding the gap between what currently exists and can be leveraged and what may be missing, requiring further targeted investment through your costed implementation plan.

Lastly, depending on the complexity of the architecture, it may be helpful to consider a systems audit and seek the assistance of an expert in data exchange to make sure that the architecture is sustainable as the needs for digital evolve within and across health programmes. Given the rapid changes in technology, as well as the changes in health programme needs, the architecture should be built in a way to support additions of new applications, upgrades to legacy systems and adaptations to new demands. Within this planning process, the implementation team should consider costs for future upgrades, maintenance and remodelling of the architecture as additional needs emerge, such as including new shared services or data exchange standards.

BID INITIATIVE CASE STUDY

BID Initiative: Enterprise architecture approach

Multiple disconnected health data systems can stunt the efforts and potential of new technologies. Successful digital health enterprises take stock of the existing landscape and build upon it, with the goal of sustaining efforts well beyond a project life span. The BID Initiative worked closely with the governments of Tanzania and Zambia to integrate interventions into the broader health system and overarching health strategies.

The BID Initiative defined its enterprise architecture in terms of whole-system behaviours rather than specific technologies. It was not intended to be a definitive description of any single country's health enterprise architecture, but rather intended as a starting point that could adapt to a specific country's needs and reflect its unique context.

A number of core principles drove the architectural choices reflected in the BID design.

- **Data collection is integrated into the workflow.** This principle reflects the fact that for data quality and timeliness to improve, the use of data must be woven into the fabric of each workflow participant's business processes. All data will be captured electronically, as soon as possible and as close as possible to the step in the workflow where the data are generated.
- **Data will be shared to support multiple workflows.** As an example of this principle, child immunization transactions can be leveraged to track inventory transactions.
- **Users have access to the data necessary to perform their duties**. One of BID's objectives was to improve data quality and use; therefore, the workflow participants must have access to actionable, readily understandable data.
- **Interoperability and openness:** The preference was to adopt existing standards wherever possible and to adapt them where necessary. There was no expectation that new standards would need to be developed to support the BID Initiative.
- **Sustainability:** This principle means that simple, stable, readily adoptable solutions would be favoured over technologically "sophisticated" ones that would be difficult to deploy nationally. Communications infrastructure would be leveraged and centralized ICT solutions preferred over ones that are decentralized.

Adapted from Product vision for the BID Initiative, Chapter 2 ***(49)****.*

6.2 Identify common and enabling components and shared services (digital health platform)

When linking your digital health implementation to the broader digital health enterprise architecture, consider the core functionalities, or components, that are unique to your use case or health programme, as well as the components that can be generalized and reused in other health programme areas or even beyond the health sector. These common components (also called reusable components) represent opportunities for joint investment, allowing you to stitch together and harmonize different digital health interventions across programme areas and even sectors, while also facilitating the establishment of a common architecture from which all digital health implementations can benefit (see *Fig. 6.2.2*). Think of these common components as like roads and water pipes – "build once, use multiple times" – that you are likely to need for your digital health implementation and that others will also need and can collectively contribute towards and benefit from in subsequent adaptations and deployments. These reusable components may also be used outside the health sector, such as in education and social protection. The collective of common components is known as the digital health platform and can be subdivided into shared services and enabling components.

You could align your digital health implementation to link to and share these common components as they become available in the digital health enterprise architecture *(14)*. Standards and APIs (application programming interfaces), which are codes and software that allow two software programs to communicate with each other, can help link the digital health implementation to common components.

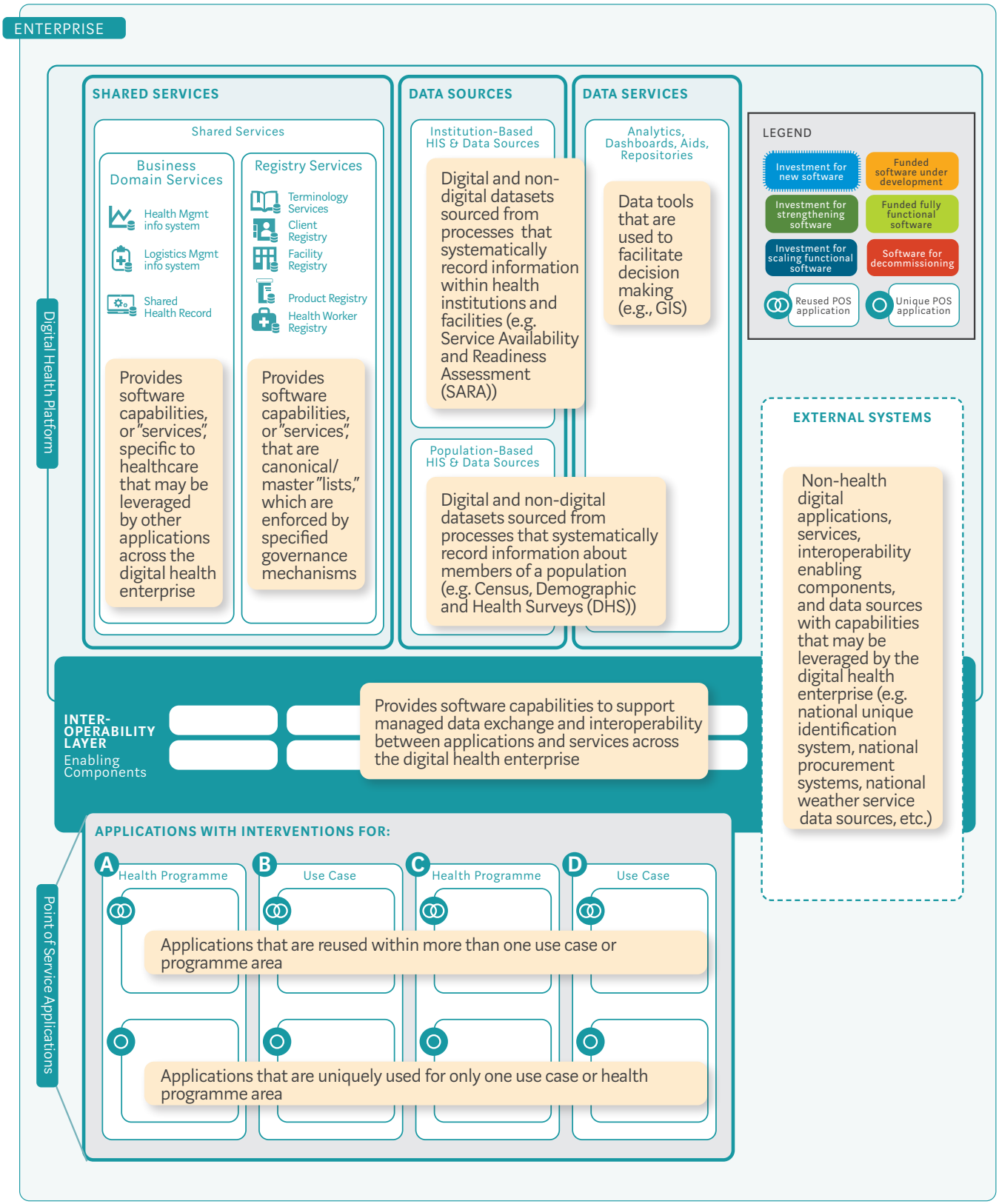
If these components do not yet exist in your setting, you could direct some of your digital health investment to support establishing a common component like a shared service that other health programme areas can later reuse. Not all of the necessary common components represented in an architectural diagram will be available at the same time; investments are often made sequentially as finances become available and needs arise. Accordingly, your digital health implementation will evolve over time by contributing investments or incorporating new components as the digital health ecosystem and architecture matures *(14)*.

Box 6.2.1. Illustrative list of common components.

The following are examples of common components that can be extended across other implementation areas:

- authentication services to determine access and control privileges
- identity management services, such as unique IDs for clients, health workers and facilities
- terminology services and reference data supporting metadata needs, including for data elements and indicators
- geolocation services
- payment services to facilitate financial transactions
- analytics engines supporting dashboards and similar tools
- scheduling and decision-logic engines
- data warehousing to support storage and archiving using common standard formats
- enterprise service bus to support a data exchange "interoperability layer".

Fig. 6.2.2. Digital health investments within the digital health enterprise architecture.



6.3 Link your digital health investments to the enterprise architecture

This Guide provides only an introductory overview for linking digital health investments within health programmes to the broader national digital health enterprise architecture. Executing this process will require more detailed consultations with personnel who have expertise in developing national digital health enterprise architectures. *Box 6.3.1* highlights key resources that can facilitate this process.

It is recommended that you identify or develop a diagram reflecting the current state of the national digital health enterprise architecture and include in your costed implementation plan a diagram detailing a future state that shows proposed investments in digital services and applications (see *Fig. 6.3.3* for an example). The current state depicts how different systems are currently implemented, which may be as disparate applications that are siloed or at best paired directly with other applications. In the future-state diagram, highlight planned new and emerging digital components that others are implementing, as well as the common and programme-specific functionalities that your digital health investment will focus on, specifying the applications, common services and interoperability requirements that your system will leverage or contribute towards. *Annex 6.1* provides a template for thinking through how the proposed digital health implementation can link to the broader architectural requirements.

As you begin linking your digital health investment to the broader architecture and planning for the costs that would entail, consider the following questions.

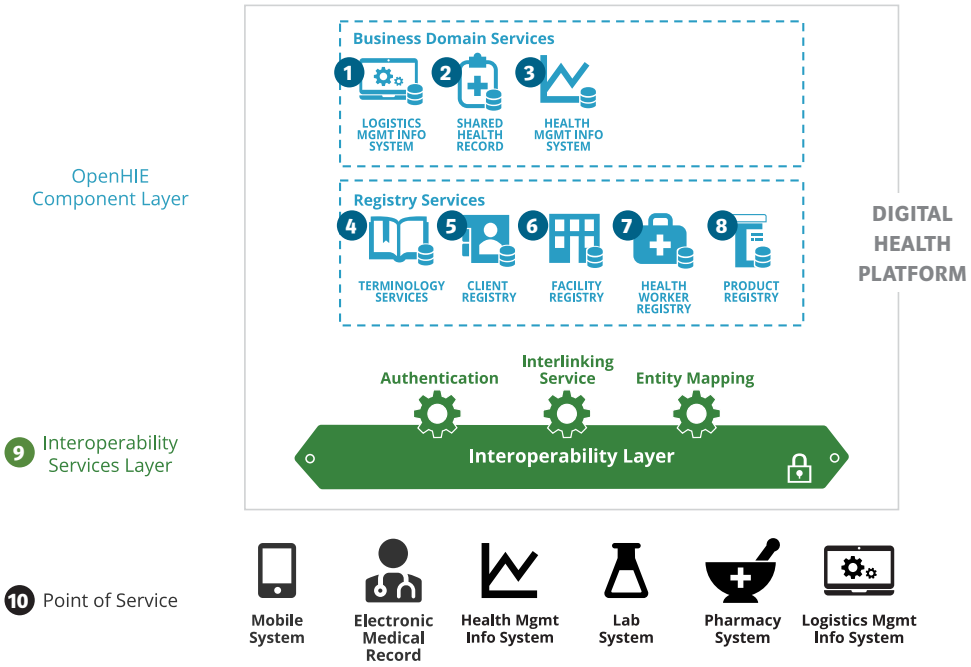
- What are the core components for this digital health implementation?
- Of those core components, which existing common components can be reused or leveraged from other health programme areas? For example, an analytics engine may be a required component that another programme area has already implemented and can be reused and shared (for example, as a shared service).
- What common components are new requirements that the digital health investment can support and contribute to the national digital health enterprise architecture?

Illustrative current- and future-state diagrams of Myanmar's national digital health enterprise architecture are provided as guidance (see *Fig. 6.3.3*), which you could use as a template to diagram existing (green, yellow) and planned (red, grey) common components of your costed implementation plan. In your diagram, note the use of specific digital health applications encompassing digital health interventions at the point of service, shared services and enabling components for each of your identified digital health interventions.

Box 6.3.1. Key resources for building towards a digital health enterprise architecture.

- Digital health platform handbook: building a digital information infrastructure (infostructure) for health focuses on combining digital health interventions into an interoperable whole, identifying the standards and interoperability requirements for enabling a cohesive digital health enterprise architecture *(14)*.
- *OpenHIE* describes a reusable architectural framework that leverages health information standards, enables flexible implementation by country partners and supports exchange of individual components (see *Fig. 6.3.2*). OpenHIE also serves as a global community of practice to support countries towards "open and collaborative development and support of country-driven, large-scale health information sharing architectures" *(18)*.
- *TOGAF* is an industry-standard enterprise architecture methodology providing detailed guidance to support the establishment of a flexible, integrated hierarchy of business, data, applications and technology architectures to optimize digital health interventions *(92)*.

Fig. 6.3.2. OpenHIE architectural diagram illustrating mechanisms for interoperability across different applications.

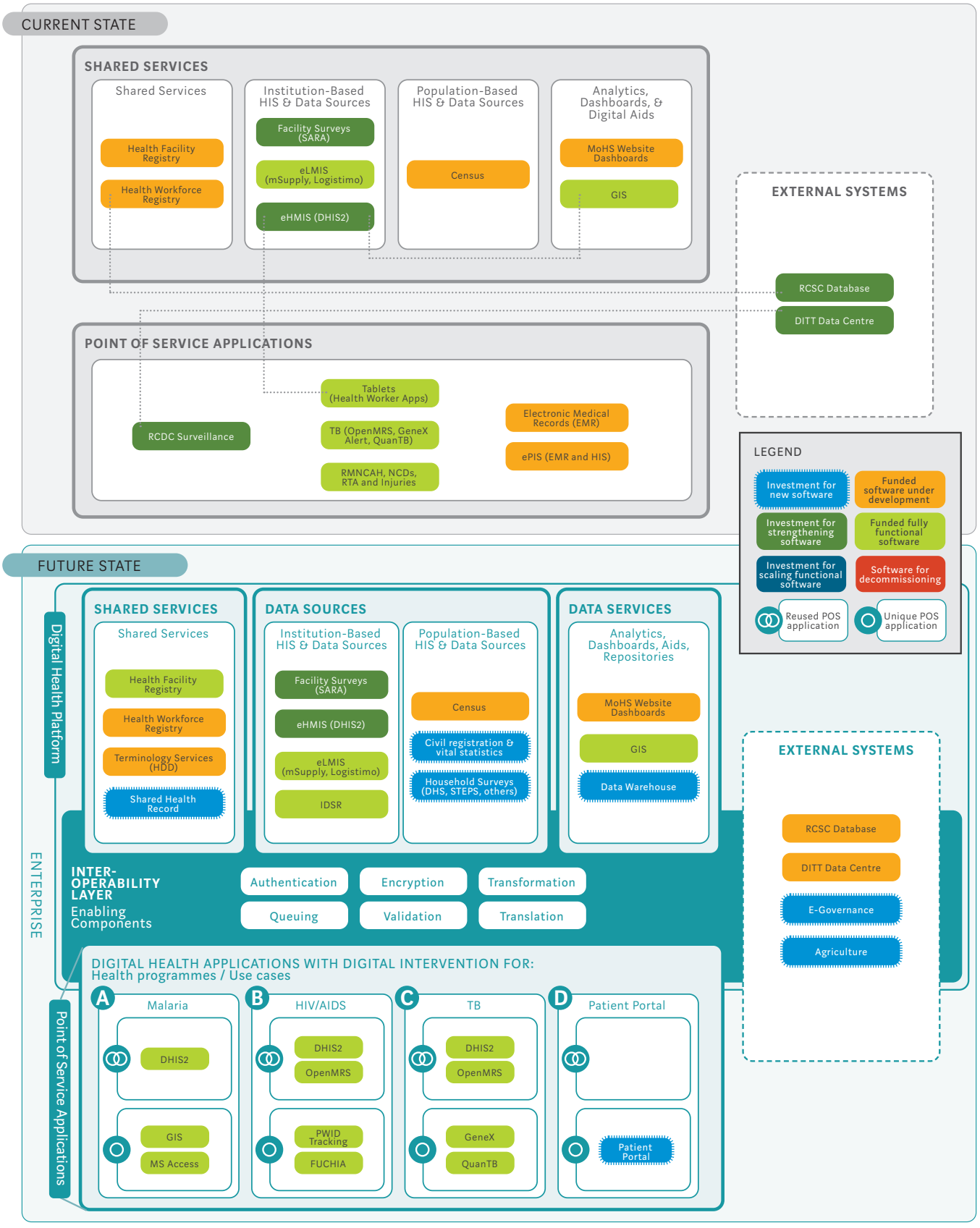


Legend

1. **Logistics Management Information System (LMIS)** stores and aggregates routine supply chain data and facilitates its analysis for improving supply chain management.
2. **Shared Health Record (SHR)** is a repository containing the normalized version of content created within the community after being validated against each of the previous registries. It is a collection of person-centric records for patients with information in the exchange.
3. **Health Management Information System (HMIS)** stores routinely collected aggregate health data and facilitates their analysis with the goal of improving the quality of health services.
4. **Terminology Service (TS)** serves as a central authority to uniquely identify the clinical activities that occur within the care-delivery process by maintaining a terminology set mapped to international standards, such as ICO10, LOINC, SNOMED and others.
5. **Client Registry (CR)** manages the unique identity of citizens receiving health services within the country.
6. **[Health] Facility Registry (HFR)** serves as a central authority to uniquely identify all places where health services are administered within the country.
7. **Health Worker Registry (HWR)** is the central authority for maintaining the unique identities of health providers within the country.
8. **Product Registry (PR)** is the central authority for defining products, such as health and medical commodities, and their categorization.
9. **Interoperability Services Layer** receives all communications from external services within a health geography and orchestrates data-exchange processing among the external systems and the OpenHIE component layer.
10. **Point of Service** [applications], such as the OpenMRS electronic medical records system and the RapidPro Communications Engine, are used by clinicians and community health workers to access and update a patient's person-centric shared health information and record healthcare transactions, and to interactively communicate, respectively.

Source: Figure and legend adapted from OpenHIE architecture v2, 2019 (93).

Fig. 6.3.3. Myanmar example of a national digital health enterprise architecture blueprint.



In the current state, there is a limited use of data exchange standards, and digital systems use a direct (integrated) connection to shared services. In the future state, data exchange standards and enabling components are used to facilitate interoperability across different digital health implementations and shared services.

CHAPTER

07 DEVELOP A BUDGET

This chapter will help you develop a budget for implementing and sustainably operating your digital health intervention within your specific digital health ecosystem. You will identify cost drivers for each phase of the digital health implementation, including budget considerations related to interoperability, and you will develop a budget for the life span of the investment. Cost considerations for specific digital health interventions are further detailed in *Annex 5.3*.

TOOLS	+ Budget template (*Annex 7.1*)
OBJECTIVES	+ Understand cost drivers by implementation phase. + Accurately calculate funding needs. + Identify co-financing opportunities across other health programmes and sectors.
INPUTS	+ Historical budgets and costs + Implementation considerations (*Chapter 5*)
OUTPUTS	+ Programme budget (Outputs 7.1, 7.2)

PRINCIPLES FOR
DIGITAL DEVELOPMENT

DESIGN FOR SCALE[1]

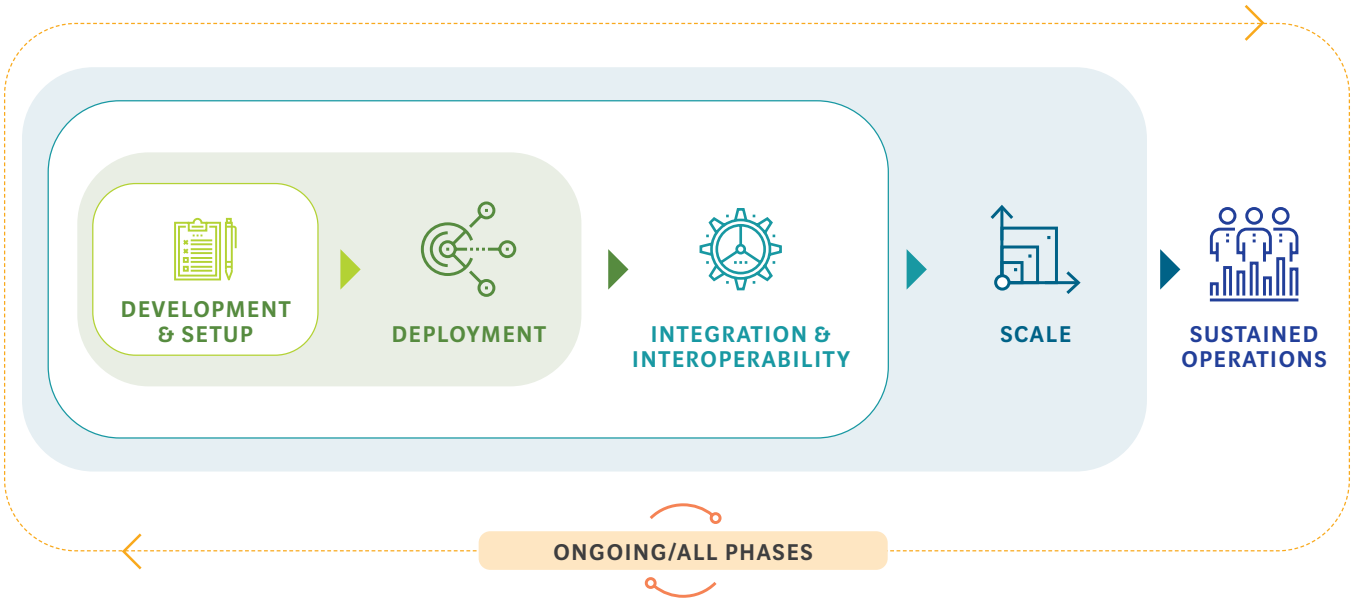
- **Plan and design for scale from the start.**
- **Develop a definition of scale** for your initiative.
- **Keep your design simple, flexible and modular** to make it easy to change your content and adapt to other contexts.
- As you make **technology choices,** think about whether those choices will make it easier or harder to scale.
- **Identify partners** early who can help scale your tool or approach.
- **Consider your funding model,** including the cost per end-user, options for generating revenue, social business models and other financial paths to sustaining the initiative.
- **Gather evidence and demonstrate impact** before attempting to scale.
- Don't attempt to scale without **fully validating that your initiative is appropriate** in a new context and addresses a priority need.

1 *Text adapted from Principles for Digital Development: Reuse and improve: Core tenets (7).*

This chapter will help you develop a budget for implementing and sustainably operating your digital health intervention within your specific digital health ecosystem. You will identify cost drivers for each phase of the digital health implementation, including budget considerations related to interoperability, and you will develop a budget for the life span of the investment. Cost considerations for specific digital health interventions are further detailed in *Annex 5.3*.

7.1 Costs by phase of implementation

Fig. 7.1.1. Phases of implementation.



The full costs of implementations of digital health interventions are frequently underestimated because budgets often focus on the costs related to the initial demonstration or deployment and do not take into account the resources needed for long-term operation and maintenance. Inaccurate budget estimates can thwart the sustainability of interventions, especially when demonstrations or pilot projects transition to programmes operating at scale.

Understanding the total cost of ownership, or the resources required to support a digital health intervention throughout its life cycle, will help you make more informed purchasing decisions and better communicate funding requirements to donors, partners and other stakeholders. When considering the total cost of ownership and developing a budget, it is important to consider costs associated with different phases of implementation (see *Fig. 7.1.1*).

ONGOING/ALL PHASES: This is not a distinct phase but instead refers to elements that affect the budget across the implementation life cycle, such as human resources and governance.

DEVELOPMENT AND SETUP: During this phase, you design and prepare for implementation. You will incur many of the costs during this phase, including workflow mapping and defining the future state. You will also begin working with technology vendors and purchasing the equipment needed to support the deployment. Within this phase, you should begin to think through requirements for interoperability and exchange with other systems, adopting appropriate standards and ensuring that the intervention leverages any relevant existing components or ICT systems, such as data exchanges, HMIS and registries.

DEPLOYMENT: During this phase, the digital health implementation goes live, often in a pilot setting. It is important to budget resources to support end-user testing and iteration for refinement during this phase.

INTEGRATION AND INTEROPERABILITY: Although these elements should be addressed during design and deployment, they are so important to long-term sustainability that they have been called out in a separate phase, as they may need to be reviewed and updated continuously. As your deployment expands and the digital health enterprise architecture evolves, reflect on the additional needs for your digital health implementation to integrate and exchange data with existing systems.

SCALE: You will begin to expand the reach of your digital health implementation during this phase, so consider the number of future end-users and the cost per end-user to deploy your intervention on a larger scale. During this phase, you may need to invest a significant portion of expenses in long-term assets, such as purchasing equipment or improving facilities, including network and electrical infrastructure, as well as the human resources needed to maintain the quality of the deployment.

SUSTAINED OPERATIONS: After your digital health implementation scales, you will enter into sustained operations. Consider recurring costs during this phase, as well as continued M&E, ongoing data-use activities and ways to share learnings with the larger community. The annual sustained operations costs will be key in determining feasibility of sustaining the digital implementation in the long run. The estimated annual sustained operations costs can be used to inform government budgetary allocations in future years.

7.2 Cost drivers

For each of the phases listed in *Section 7.1*, identify the specific cost categories and their related cost drivers that will affect your budget. *Table 7.2.1* lists several examples of cost categories and the factors, or cost drivers, that influence (increasing or decreasing) those cost categories that are associated with each phase of the implementation. *Table 7.2.1* also describes important considerations to take into account when estimating costs. For additional guidance, consider consulting other tools, such as ADB's digital health investment costing tool *(30)*.

Table 7.2.1. Illustrative costs throughout the implementation life cycle.[3]

Cost Categories	Cost Drivers	Considerations	Up-front versus recurring
ONGOING/ALL PHASES			
Management and staffing	» Complexity of intervention » Full-time Equivalents (FTEs) needed » Staff training needed » Turnover » Overhead	» What is the level of effort for programme management staff associated with training, vendor relationship management and other meetings? » Does staff capacity already exist on your team? Will you need to shift tasks or hire and train new resources? » Is there an opportunity to build capacity with existing staff at a lower cost than hiring new staff?	Recurring
Governance	» Number of stakeholders needed for co-ordination » Full-time Equivalents (FTEs) needed » Time needed for approvals » Amount of travel and meetings required for buy-in, co-ordination, and approvals » Translation required » Overhead	» What is the estimated time for development, approval and uptake of supportive policies? » Whose approval is needed to begin or finalize this work (for example, parliamentary approval or executive approval by the MOH)? » How many agencies or approval processes are needed to make changes to the health system? » Do you have technical staff available who are skilled in policy analysis and governance or advocacy? » Do you need to work with external consultants to analyse, create and institutionalize new governance structures? » How often will policies and regulations be renewed or revisited? » How frequently will the governance body meet? Will travel be required?	Recurring
DEVELOPMENT AND SETUP			
Software licensing cost per environment and per end-user	» Scale of implementation (i.e. number of end users, number of devices, etc.)	» What is the licensing model? For example, is it open source or proprietary? What are the licensing costs, and how will these change with scale? » Is there a flat fee per number of end-users or an individual fee per end-user or device? » Is there a platform fee or cost to add end-users?	Up-front
Software customization, including adding additional languages	» Complexity of features and functionality required » Staff training needed » Turnover » Full-time Equivalents (FTEs) needed » Translation required	» If you are working with a software vendor, what are the costs to add features now or in the future? » If the software is open source, is there a responsive, established end-user community that will provide ongoing support and help add features at no cost? » Do you have skilled, available technical staff who can customize the software? What is the level of effort required? Is the software well documented? Are there multiple vendors or a large community with experience providing support for this specific digital health tool? » What are the costs to contract with a consultant who is skilled and familiar with the software code to do the customizations? » What are the costs to translate terms and develop the software in additional languages, if needed?	Up-front
Application installation and configuration	» File size of the software application » Sophistication of hardware » Speed of internet connectivity	» What is the level of effort for staff to install and configure the application? If you are replacing an existing application, consider the time needed to uninstall the previous application and transfer data to the new system. » What are the requirements for accessing sensitive information? Are proper protocols in place? Has the proper delegation of duties, such as a data processor/data handler, been established?	Up-front

3 *Note that this table does not include additional overhead costs, such as utilities and office supplies, that would be required irrespective of the digital health implementation.*

Cost Categories	Cost Drivers	Considerations	Up-front versus recurring
Inter-operability with other systems	» Use of standards or lack thereof » Maturity of interoperability standards used	» What is the cost to interoperate with existing systems? » What efforts will be needed to ensure that the system complies with relevant standards, including open standards?	Recurring
Hardware	» Existence of "Bring your own device" policies/ number of devices needed » Sophistication of device(s) needed	» Where will data be stored (for example, in the cloud, on local servers or on backup servers)? » Do end-users need devices?	Recurring
DEPLOYMENT			
End-user testing	» Amount of travel and meetings required » Translation required	» How will you collect end-user feedback? » How frequently will you modify or iterate on the functionalities within the digital health implementation?	Recurring
Cost and availability of data connectivity and power	» Internet costs in country » Reliability of electricity in country	» What is the cost for the Internet bandwidth or mobile data needed for the system to operate properly? » Will you need to equip your office with generators to ensure that the system remains available during power outages? » Do you need solar chargers, car chargers or spare batteries for reliable device charging?	Recurring
Training	» Existing capacity gaps » Amount of travel required » Gaps in existing training materials and curriculum » Scale and frequency of training needed	» Is there a fee for initial training? » Are there travel and other logistical costs associated with training? » Do you need to create new training and capacity-building materials? » What training methodology will be employed (for example, on-the-job, classroom or mixed-use training)? » How long are the trainings? » How many people need to be trained? » How frequently will you offer training to new end-users as the tool scales?	Recurring
Roll-out	» Number of end users » Size of targeted geographic area	» Are there per diems, lodging, fuel and transport costs associated with transporting the needed hardware to the sites? » What are the costs associated with communicating? Are there marketing materials that need to be developed for communication purposes?	Up-front
INTEGRATION AND INTEROPERABILITY			
Data collection and use	» Existing data sharing policies » Existing data/terminology standards » Licensing fees associated with standard use » Use of standards or lack thereof in the current digital health enterprise	» Has an architecture for data sharing been established? » Are relevant standards for data exchange and coding available, or will they need to be developed? » Are there fees associated with using the coding standards? » Do the tools already support the identified standards? » Are there additional interoperability considerations?	Recurring
SCALE			
Any category that will be affected by expanding reach	» Number of end users » Complexity of intervention » Size of data collected and stored	» Are additional staff needed? What additional support structures are needed? » Will additional people need to be trained? » Is additional hardware or storage needed? » Are additional software licences needed? » Are additional voice or data services needed?	Recurring

Cost Categories	Cost Drivers	Considerations	Up-front versus recurring
SUSTAINED OPERATIONS			
Voice and data services *(mobile data plan, Internet, number of text messages)*	» Number of end users » Size of data collected and stored » Amount of information needed to disseminate	» How many text messages and voice minutes will be used? » How much mobile data will be needed for each end-user? » Can you negotiate a below-market rate with an MNO?	Recurring
Hardware maintenance, ongoing administration and replacement rate	» Number of end users and devices managed » Sophistication of the device » Amount of travel needed for on-site maintenance support	» How often will you replace hardware? (The typical replacement rate is approximately 20–25% per year.) » What are typical maintenance costs? » How many staff members are needed for ongoing administration of hardware? What are their costs related to travel to deployment sites?	Recurring
Subscriptions	» Number of end users » Per user subscription fee	» Is there a subscription fee? » Are there costs to receive software updates or to access specific features? » How will upgrades be verified?	Recurring
Software maintenance *(fixing bugs, adding features, maintaining customizations)*	» Number of end users » Per user licensing fee » Amount of bug fixes needed » Anticipated updates released per year	» Will you need to pay new licence fees when you update to new software versions? » Will volunteers from the open source community be able to do maintenance, or will you have to hire a developer? Consider that some updates may require additional development and testing. » Will you get support from a vendor or from programme staff? Consider the budget implications of operations support for system crashes or to address issues with software performance.	Recurring
Transfer of ownership	» Full-time Equivalents (FTEs) needed » Staff training needed » Turnover » Number of end users	» How much staff time will be needed to transition ownership to the government or another entity? What capacity-building will this require? » Will licensing costs change due to an increase in the number of end-users? » Will the new owner need to procure new hardware?	Recurring
Refresher training and additional training activities	» Complexity of training curriculum » Turnover » On the job training vs. formal training mechanism	» What is the staff attrition rate? » How frequently will you provide refresher training? » What other training activities and materials will you offer? » How will ongoing support and supervision be used?	Recurring
M&E and data-use activities	» Full-time Equivalents (FTEs) needed » Complexity and scope of intervention	» Who will monitor the use of the new tools and the quality of the data in the systems, and what are the associated costs to do so? » Will you conduct periodic evaluations of the introduction of the new tools, uptake of the systems or even the impact? If so, what are the associated costs? » What processes need to be strengthened or developed to build a culture of data use (such as consistent data review meetings, nonfinancial incentives to data champions and so on)?	Recurring
Collective benefit, such as sharing learnings	» Complexity and scope of intervention » Number of stakeholders needed for co-ordination	» How will you share learnings and findings with the larger community? What costs are associated with the sharing?	Recurring

Source: Adapted from Principles for Digital Development: How to calculate total lifetime costs of enterprise software solutions (94).

BID Initiative: How much does an EIR cost?

How much does it cost to implement BID Initiative interventions in the test sites in Tanzania and Zambia? What are the up-front and recurring costs of operating BID interventions? What are the resources required to implement interventions in each district? How do the costs of providing immunization services and reporting compare before and after BID interventions are implemented?

These are some of the key costing questions the BID team asked as it planned to implement interventions in health facilities in Tanzania and Zambia. The answers were used to make decisions about implementation, scaling and adaptation.

PATH health economists led an economic evaluation assessing both the financial and economic costs of implementing BID interventions in Tanzania and Zambia. A key component of this evaluation involved estimating the total cost of ownership of BID interventions, including the financial costs incurred to develop, deploy, integrate, scale and sustain the interventions (see *Table 7.2.2* for more detailed cost drivers). The data to estimate the total cost of ownership were gathered from project records and through tracking resources used by implementation teams.

Table 7.2.2. BID Initiative cost categories.

Cost category	Cost description
ONGOING/ALL PHASES	
Meetings	Meetings with government officials to get their buy-in and plan for implementation in their regions or provinces, including meetings associated with developing the rollout strategy for the region or province
Printing *Tanzania only*	Printing of guidelines
DEVELOPMENT AND SETUP	
System design and development *EIR that is being used*	Design and development of the EIR in each country; includes testing the EIRs
Learning costs	Design and development of first versions of EIRs in each country that were later shelved
Peer learning *Tanzania only*	A visit to Zambia for peer-learning exchange
Back-entry costs	Costs to enter previous immunization records of each child from the paper immunization registers into the EIR
Hardware	Tablets and covers, chargers and QR code/barcode scanners for health facilities

Cost category	Cost description
DEPLOYMENT	
Training	Training of staff responsible for rolling out the interventions to the health facilities
Roll-out	Per diems, lodging and transport associated with deployment of the EIR to health facilities and district immunization offices; transport includes vehicles purchased (one for each country) and expenditures for fuel and maintenance of those vehicles, as well as hiring other vehicles used for the deployment
SUSTAINED OPERATIONS	
Internet connectivity	Access to Internet for uploading data and transferring data to higher levels
Data hosting	Server for EIR data
Supportive supervision	Per diems and transport costs for BID Initiative or MOH staff to provide supportive supervision to health facilities after deployment of interventions
Printing	Printing of barcodes used on immunization cards

Adapted from Mvundera et al., 2019 (95).

The economic evaluation showed the following results.

- Costs of developing, deploying and maintaining EIRs are less than 10 US dollars per child under 1 year of age, but can be less than 5 US dollars per child in a country like Tanzania that has a large birth cohort.
- Hardware and deployment of the EIRs are the cost categories that account for a large share of these costs *(95)*.

BID believes that subsequent EIR development and deployment costs may be even less because of the ability of other low- and middle-income countries to leverage the EIR systems that were developed for Tanzania and Zambia as well as through leveraging learnings generated from these deployments.

Adapted from Di Giorgio & Mvundera, 2016 (96).

7.3 Budget matrix

Once you have identified your cost categories by investment phase and the related drivers of those cost categories, use a budget matrix (see *Table 7.3.1*) to create a detailed budget for your implementation across the expected life span before the intervention will require significant updates. This time frame is typically about five years but could be longer or shorter depending on the selected intervention. Budget matrices are also useful for comparing costs across digital health interventions. You could use financial data in historical procurement records and from past implementations, along with RFPs from developers and implementers, to complete the budget matrix.

In creating your budget, be sure to indicate components that would be funded through the existing programme to show country and partner co-investment. A detailed budget template is included in *Annex 7.1*.

Table 7.3.1. Summary budget matrix.

Budgeting category	Year 1 *pilot*	Year 2	Year 3	Year 4	Year 5	Five-year total
Ongoing/all phases						
Development and setup						
Deployment						
Integration and interoperability						
Scale						
Sustained operations						
TOTAL						

Source: Adapted from Principles for Digital Development: How to calculate total lifetime costs of enterprise software solutions (94).

While preparing your costed implementation plan, you should also be able to demonstrate how this investment will improve the status quo in terms of projected impact. This may include proving the comparative value of this digital health investment over other types of activities, including nondigital investments. Modelling methodologies, such as the Lives Saved Tool (LiST), can help project the overall health impact of the investment. More details on how to apply this tool to digital health investments and examples of impact projections for different digital health interventions can be found in the Asian Development Bank's Digital health impact framework *(97)*.

CHAPTER

08 MONITOR THE IMPLEMENTATION AND USE DATA EFFECTIVELY

Monitoring and evaluation and continuous improvement by responding to the changes induced by the digital health implementation, also known as adaptive management, are necessary components of ensuring the viability and ultimate impact of your efforts.

TOOLS	+ Monitoring and evaluating digital health interventions: a practical guide to conducting research and assessment *(26)* + Adaptive management checklist (*Annex 8.1*) + Reach, Effectiveness, Adoption, Implementation and Maintenance (RE-AIM) framework *(98)* + Logic model template (*Annex 8.2*)
OBJECTIVES	+ Develop and execute a plan to monitor fidelity and quality of the implementation. + Develop and execute a plan to assess the impact of the implementation on expected process and outcome indicators. + Determine activities required to build and promote a strong culture of data use. + Understand how adaptive management approaches may improve efficiencies and impact.
INPUTS	+ Historical and/or baseline data and analysis + Historical M&E and adaptive management plans
OUTPUTS	+ Logic model for digital health implementation (Output 8.1) + A plan to guide the M&E and adaptive management of the digital health implementation (Outputs 8.2, 8.3)

PRINCIPLES FOR
DIGITAL DEVELOPMENT

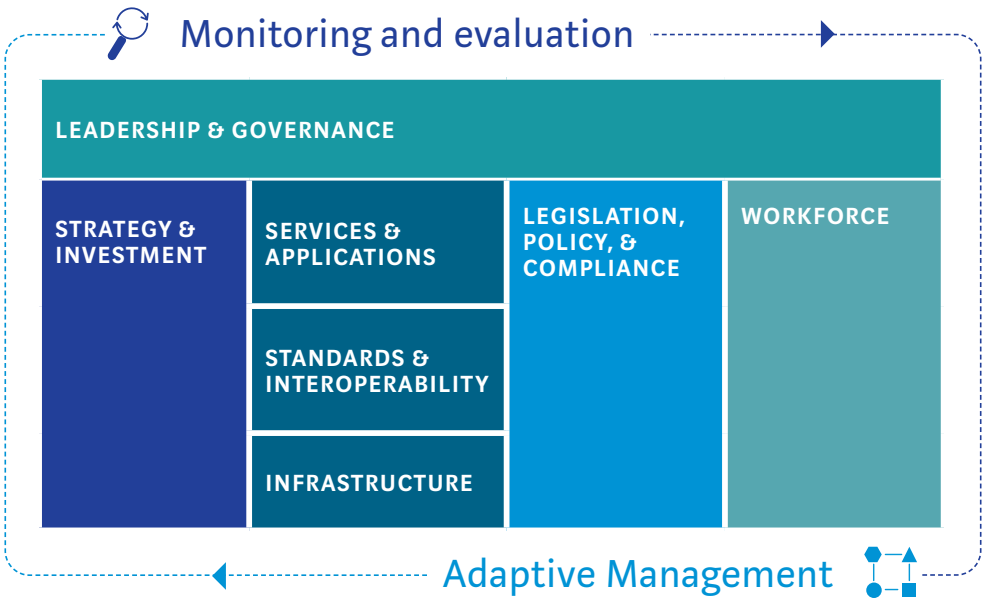
BE DATA DRIVEN[1]

+ **Design programmes so that impact can be measured continually and incrementally,** focusing on outcomes, not just outputs.
+ **Make use of existing data**, including open data sets and data from interoperable systems.
+ **Use rigorous data collection methods.** Consider and address potential biases and gaps in the data collected, perform data quality checks, and maintain strong documentation behind collected data.
+ **Close knowledge gaps** by contributing data to the development community and using data and interoperability standards.
+ **Use quality real-time or timely data** to support rapid decision-making, improve programming for end-users and inform strategy.
+ **Present data in formats that are easy to interpret and act on,** such as data visualizations.
+ **Create a culture of data use** by prioritizing capacity-building and data-use efforts across all stakeholder groups, including the groups whose data are being collected.
+ **Be holistic about data collection and analysis.** Collect data from multiple sources, and use a mix of data collection and analysis methods. Analyse your data collaboratively with stakeholders.
+ **Identify and use open data and interoperability standards.**
+ **Collect and use data responsibly** according to international norms and standards.

1 *Text adapted from Principles for Digital Development: Reuse and improve: Core tenets (7).*

After going through the steps to plan the digital health implementation but prior to deploying the implementation, you can embed mechanisms to monitor the implementation, such as collecting baseline data, and use the insights from the emerging data to increase your implementation's impact and efficiency. Continual monitoring of activities at different stages of the implementation is critical for ensuring its long-term success, as is responding to external changes and new learnings.

Fig. 8.1. **M&E and adaptive management as continual considerations for digital health implementations.**



Source: Batavia & Mechael, 2016 (59).

This chapter explores three important and interrelated concepts for continual assessment of your implementation:

1. monitoring and evaluation
2. establishing a culture of data use
3. adaptive management.

Together, these processes support flexible, responsive project design that will enable you to refine your digital health implementation as circumstances change and priorities shift. The backbone of this success, and of strong HIS in general, is rigorous, rapid and continual M&E, which enables a steady cycle of learning, iterating and adapting. Robust M&E efforts can help implementations achieve their objectives in a more effective and efficient way. Although M&E has historically been used as an accountability and reporting tool, it can also drive growth and improvement. Monitoring during deployment can ensure that the entire operation functions as intended, from the digital health intervention's performance to the way in which end-users interact with the intervention to the kind of data that the intervention generates *(99)*.

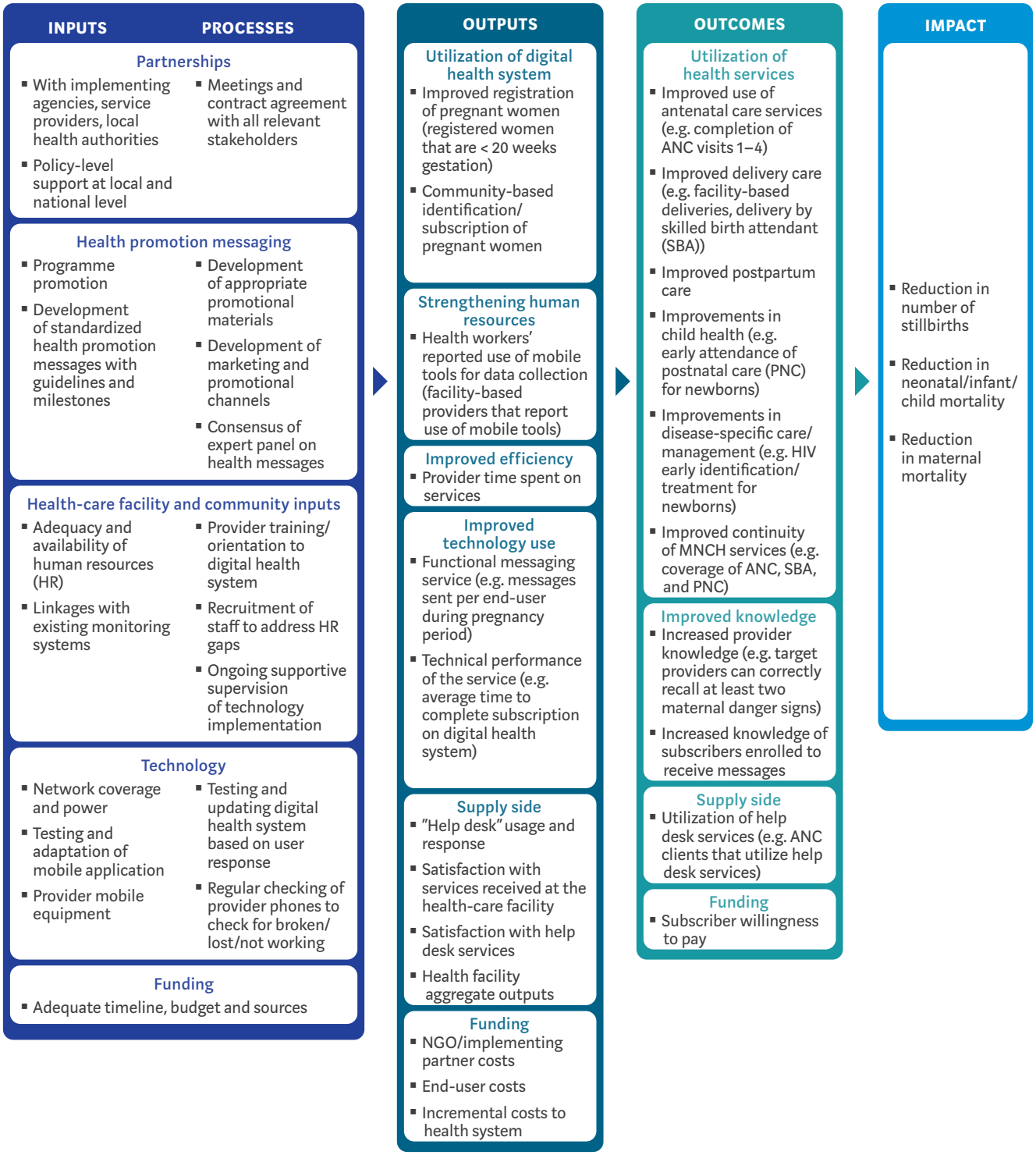
Ultimately, you will need to demonstrate the contribution of the digital health implementation to health system performance and, where possible, to improved health outcomes.

8.1 Establish a logic model for your implementation

Defining a framework in the form of a logic model will help you refine and understand your programme's goals and objectives and conceptualize the relationship between them, the underpinning programme activities required to achieve them and the anticipated outcomes.

Logic models aim to clarify programme objectives and aid in identifying expected causal links from inputs, processes, outputs, outcomes and impacts *(4)*. They provide a graphical representation, which may serve as a catalyst for engaging and communicating with key stakeholders, including implementers, in an iterative process, often in the wake of changes in design or programmatic implementation. *Fig. 8.1.1* is an illustrative logic model for MomConnect in South Africa *(26)*.

Fig. 8.1.1. Illustrative logic model of MomConnect digital health investment.



Logic models link *inputs* (programme resources) with *processes* (activities undertaken in the delivery of services), *outputs* (products of processes), *outcomes* (intermediate changes) and *impact*.

In the context of digital health implementations, **INPUTS** encompass all resources that go into the programme. In this model, technology inputs are differentiated from programmatic inputs aimed at providing health services. Programmatic inputs (human resources, training and other materials development) are also distinguished from policy inputs, which aim to improve linkages with treatment and care, as well as to consider factors related to affordability, including user fees. Technology inputs include not only the hardware and software, but also the feedback loop to ensure that technology is responsive to stakeholder needs, including clients and health workers. Inputs may also include the advocacy needed to secure necessary funding and policy changes.

PROCESSES are the activities undertaken in the delivery of digital health interventions. Processes fall into three distinct areas: technology (capacity-building and platform enhancements), developing a national implementation strategy and health capacity-building.

From the programmatic side, digital health interventions require two critical processes: a national implementation strategy and capacity-building. It is recommended that digital health implementations that fall within the latter stages of development and evaluation (such as effectiveness to implementation science) undergo a series of activities that help formulate a larger national implementation strategy, including identifying priority areas for rollout, linking with routine health services delivery, targeting cadres of health workers required to provide services and fostering public–private partnerships. With regard to capacity-building, introducing digital health interventions may require short- and long-term human-resource inputs, including initial and refresher training of health workers, as well as ongoing supportive supervision. Finally, and perhaps most critically, ensuring information security, including confidentiality of client records, and managing data are key required processes.

OUTPUTS are the products of process activities. From a technological perspective, technology inputs (such as hardware and software devices), coupled with the capacity-building to ensure their appropriate and sustained use, correspond to changes in program outputs, including improvements in performance and adoption by end-users. Ultimately, these technological outputs are anticipated to correspond to improved functioning of health systems (such as governance, human resources and commodity management) and service delivery (such as increased number of health-worker visits and increased proficiency of health workers in service delivery). Improvements in service delivery include increased outreach and follow-up, improved availability and quality of services, improved service integration and, among health workers, increased proficiency and accountability.

OUTCOMES refer to the intermediate changes that emerge as a result of inputs and processes. Outcomes may be considered according to three levels: health system, health worker and client. At the health-system level, outcomes encompass domains of efficiency (technical and productive), increased service responsiveness to meet client needs and increased coverage of targeted health services. At the health-worker level, increased knowledge, productive efficiency (time allocation) and quality of care are anticipated. Finally, at the client level, digital health interventions are anticipated to correspond to changes in knowledge, efficiency (technical and productive), service responsiveness, adherence to treatment protocol and, ultimately, demand for services.

IMPACT may be considered according to domains within your focus programme areas, such as performance of health systems (increased time health workers spend on clinical care), population health (reductions in morbidity and mortality) and other population benefits, including reductions of household out-of-pocket payments for care corresponding to catastrophic costs for care seeking.

8.2 Plan how you will conduct the monitoring and evaluation

Planning to deploy a digital health intervention includes determining what to monitor to ensure that the intervention is working as planned and what to evaluate to ensure that it is having the effects you expected. These efforts may include tracking performance, changes in processes, health outcomes, end-user satisfaction with health systems, cost-effectiveness or shifts in knowledge and attitudes.

MONITORING helps answer the question: Is the intervention working as intended? Monitoring digital health interventions, often using routinely collected data, can measure changes in performance over time and allow for adaptive management or course correction based on the results *(26)*. Monitoring, alongside processes for taking action, creates tight feedback loops that stimulate ongoing planning and learning, which is critical to creating a culture of data use and fostering adaptive management. Effectively monitoring your intervention enables you to identify issues in software code, recognize when end-users are facing challenges and make sure that the intervention is achieving the targets you have set. Plan for and support these essential monitoring activities early in the design process, but also be sure to build them into all stages of the implementation's life cycle.

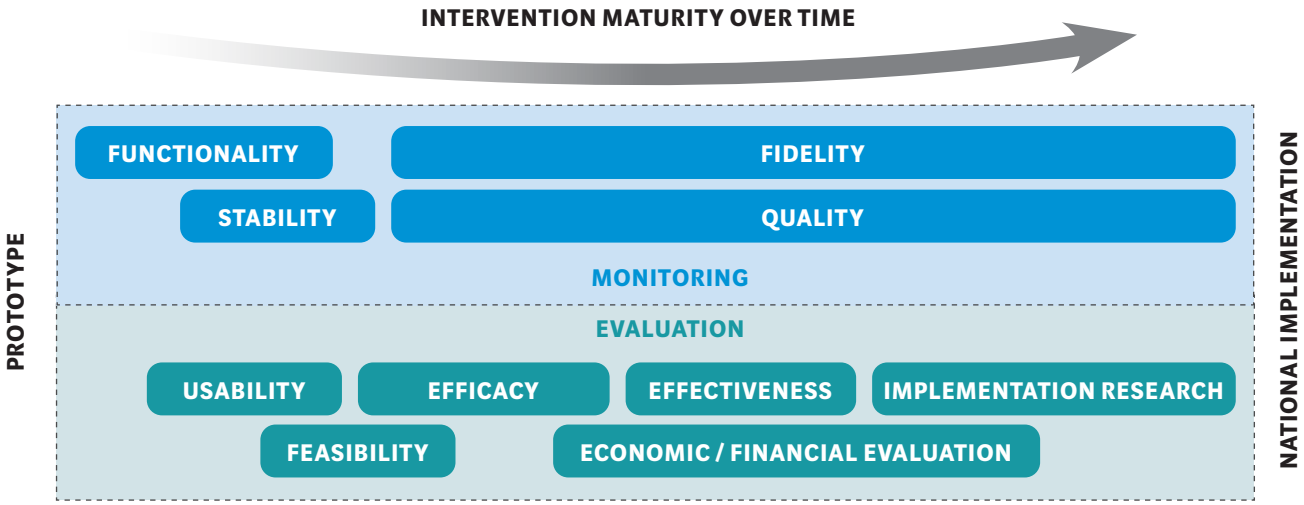
As the implementation matures, monitoring activities may focus on the digital health intervention's fidelity and quality: Do the realities of field implementation alter the functionality and stability of the intervention? Are the content and delivery of the intervention of high enough quality to yield intended outcomes? Finally, as the intervention scales, monitoring may increasingly focus on its integration with the broader health system and the policy environment surrounding, for instance, data privacy, management and use, as well as ensure that the appropriate levels of training and end-user support are in place to maintain fidelity of impact, within budget constraints.

EVALUATION is the systematic assessment of an ongoing intervention to determine whether it is fulfilling its objectives and to demonstrate an effect on health outcomes *(26)*. A formal evaluation allows you to attribute a range of outputs, outcomes or economic values to the intervention, which can show evidence of benefit. If you are planning an intervention that will require evidence to receive political or financial support for scale, generating this evidence in an early deployment will help you create a strong case. Evaluation is also an increasingly important consideration for the digital health field as it works to harmonize and learn from various deployments, shifting from small-scale pilots to the broader institutionalization of digital health. In addition, evaluation can help you understand if your intervention is having the intended programme impacts, such as on client access and use of services, efficiency of health workers and quality of care. However, evaluation can be resource intensive and requires staff with a strong background in research design and evaluation to support the work.

Evaluation needs will also evolve throughout the implementation life cycle. Initially, the evaluation may focus on determining whether the digital health intervention has an effect on health practices and outcomes, such as improving health workers' adherence to protocols or increasing timeliness of services. The focus of evaluations will gradually shift to economic assessments and implementation research questions that explore issues surrounding scale, sustainability and changes in policy and practices. Health economic assessments demonstrating a return on investment will be especially critical to justify the use of digital health interventions over other types of potential interventions.

Ideally, M&E occur in close balance with each other and are structured to answer questions that are most relevant at each stage of the implementation. At the early stages, you could use M&E results to iteratively redesign and test the digital health intervention to better meet the needs of end-users and the organization. *Fig. 8.2.1* illustrates the evolution of M&E needs during the development and deployment stages of implementation.

Fig. 8.2.1. Intervention maturity over time.



Maturity models can serve as measuring sticks or indicators of progress by helping identify opportunities for improvement and allowing teams to critically assess the resources, budget and time required of the intervention (see *Fig. 8.2.2*). Determining an implementation's maturity stage can also inform what must be monitored and to what degree the implementation is meeting the intended objectives or addressing the targeted health system challenges. If the implementation is not proving to be usable or stable, your team could consider improving or even potentially halting it, especially if it cannot pass thresholds for feasibility or demonstrate an added value over existing practices.

Fig. 8.2.2. Implementation maturity continuum.

Component	When	Potential Measures	Implementation Maturity Continuum & Guiding Questions
QUALITY	Pre-launch & during implementation	• End-user entry of phone number is correct • Rate of agreement in data recording between training rounds (i.e. end-user accuracy) • Quality control reports on end-users • Feedback from end-users on content • Incorrect schedules or content updates • Timestamps on form submissions • Number of form submissions/ worker • Data patterns similar across workers/geographic areas	How well and consistently are end-end-users able to operate the system? Are the content and use of the system adequate for yielding intended outcomes?
FIDELITY	During implementation	• Stability reports • Functionality reports • Phone loss or damage • Poor network connectivity • Power outages • End-user forgets password • Incorrect intervention delivery by end-user	Do the realities of field implementation alter the functionality and stability of the system? Is the system being used appropriately or as designed?
STABILITY	Pre-launch	• Server downtime • SMS failure rate • Network connectivity • Server operation capacity	Does the system consistently operate as intended? Is the system responsive during peak conditions or high volume of data transmission? What is the failure rate from the server side?
FUNCTIONALITY	Pre-launch	• SMS content • SMS schedules • SMS timing • Form content • Form schedules • Application functions • Comparison of requested system vs delivered system • QA test case adherence	Does the system meet the requirements for addressing the identified health system challenge? Does the system operate as intended?

Source: Adapted from WHO Monitoring and evaluating digital health interventions, 2016 (26).

CASE STUDY

Myanmar "Learning for Impact" model of continuous monitoring

UNFPA Myanmar developed the Love Question, Life Answer (LQLA) mobile application to promote accessibility of evidence-based information about life skills and sexual and reproductive health and rights to adolescents and young people in and out of school in Myanmar. Through active promotion on different channels, the number of downloads reached more than 43 000 end-users by the end of 2018. As the app was being deployed, UNFPA determined that it would not be sufficient to measure only the end-users.

To improve monitoring and uptake of the app, UNFPA designed a suite of routine practical tools known as Learning for Impact. The Learning for Impact monitoring approach looks at the categories of system performance, usage, engagement, health outputs and health outcomes, each linked to objective metrics. Through this continuous monitoring, implementation teams can make corrective actions to refine different aspects of the deployment.

Table 8.2.4. Examples of metrics from the Learning for Impact approach.

Category	Metric	Definition in the context of the implementation	Potential corrective actions
STABILITY	System uptime	Percentage of time for a given period for which a system is operational versus nonoperational	Poor system uptime requires the original software development team to optimize server performance.
FIDELITY	Monthly active end-users	Number of end-users in a given month	Consistently poor monthly active end-user numbers may be an indication of a need to: » improve system performance » increase advocacy or marketing efforts » improve engagement through upgrades.
QUALITY	Net promoter score	User satisfaction with the intervention, as measured by willingness to recommend it to others	A low net promoter score indicates that end-users may not be satisfied with the tool. This may prompt additional investigation to see what end-users are unsatisfied with (such as features, stability or utility), which can then lead to targeted improvements.
HEALTH OUTPUTS	Improvement of sexual and reproductive health knowledge	Percentage of women/men 15–24 years old who correctly identify both ways of preventing the sexual transmission of HIV and reject major misconceptions about HIV transmission	If the intervention is not increasing sexual and reproductive health knowledge, this indicates content areas that may need more focus, either in education efforts outside the use of the intervention or in the intervention itself.
HEALTH OUTCOMES	Uptake of sexual and reproductive health services	Number of adolescents/young people who have used integrated sexual and reproductive health services (disaggregated by services, age and gender)	If service uptake has not improved during the period of using the intervention, additional investigation should be done as to why (such as health system constraints, difficult-to-use clinic finder or delays to care).

The RE-AIM framework may also be considered as a comprehensive way to think through your M&E needs as you scale up the implementation. The following are the components of the RE-AIM framework *(98)*:

Reach: the level of penetration of an intervention in terms of the proportion of eligible participants who receive the intervention

Effectiveness: the impact on targeted outcomes, including potential negative effects

Adoption: the absolute number and proportion of organizational units, individuals or settings that adopt a given intervention

Implementation: the fidelity to the various elements of an intervention's protocol, including consistency of delivery as intended and the time and cost of the intervention; at the individual level, implementation refers to clients' use of the intervention strategies

Maintenance: the extent to which a program or policy becomes institutionalized or part of routine organizational practices and policies.

8.3 Establish a culture of data use

To sustain a digital health implementation, there needs to be a culture that values the collection of high-quality data, as well as the actions taken as a result of that information. M&E that produces believable data can help foster a culture of data use in which:

- people demand and seek out high-quality data to inform their decision-making
- people are motivated and empowered to act on the data
- managers support those who are collecting the data and reinforce transparent use of data
- leadership implements data policies that stress the value and systematic collection of data while modelling the use of data *(27)*.

Examples of data use include a national manager of a health area adjusting allocations of health workforce personnel to meet changing burdens on the local, district and regional levels or a minister of health using data visualizations to predict how much financial support a certain health programme will need over the next five years. See *Fig. 8.3.1* for additional examples of how data can be used to build and support a robust culture of data use.

Fig. 8.3.1. Examples of data use.

BENEFIT	EXAMPLES	HOW TO EVALUATE SUCCESS
BETTER INDICATORS FOR STRATEGIC PLANNING	• Targeted advocacy efforts help to address higher-than-average vaccination dropout rates in specific population groups. • Credible estimates of vaccine wastage rates for each health centre lead to tailored vaccination strategies to reduce wastage. • High failure rates in certain types of cold chain equipment lead to the discontinuation of that equipment.	• Did the system produce credible data for these indicators? • Were managers able to act on this information? • Did the information change decisions and how did that benefit the programme? • Was there any measurable impact on outcome indicators, such as vaccination coverage?
BETTER DAY-TO-DAY DECISION-MAKING	• A district officer validates a vaccine request based on the available stock, target population and average consumption in the health centre that sent the request. • A nurse uses the immunization register of her clinic to find the children who are falling behind their vaccination schedule. • A warehouse manager analyses average demand and makes sure that stock is kept between minimum and maximum levels.	• Did the system lead to operations that are more efficient? For example, was there a reduction in buffer stocks or wastage? • Did the system lead to better availability of stock? • Did it change the way people work and did that improve health outcomes (for example, higher coverage, lower dropouts)?
BETTER CONTROL AND OVERSIGHT	• In Senegal, some health programmes have outsourced the distribution of their commodities to the national pharmacy. With access to stock and delivery information, they can regularly monitor the arrangement. • In Turkey, pharmacists scan barcodes when they dispatch drugs to make sure that the insurance system is not overcharged. • Through a last-mile stock management system, managers can monitor whether some health centres or districts are regularly overstocked or experiencing stockouts.	• Do the system data accurately reflect reality? • Did the system highlight poor performance?
REDUCED ADMINISTRATIVE BURDEN	• Health workers enter monthly reports directly into a computer or mobile device and transmit them electronically. • Aggregate coverage reports are generated automatically by the system.	• Comparing how people spent their time before implementation of the system change and how they spend it since the change, what are the differences?

Source: WHO/PATH Planning an information systems project, 2013 (2).

Box 8.3.2. Immunization Data: Evidence for Action.

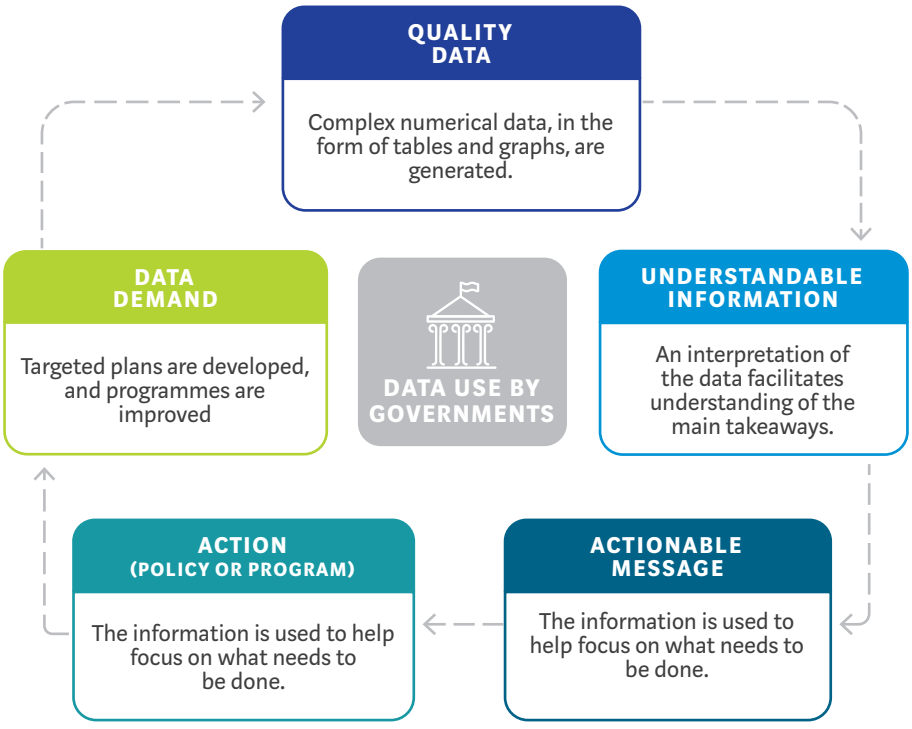
The Immunization Data: Evidence for Action (IDEA) review is a global synthesis of existing evidence aimed at increasing the use of high-quality data to improve immunization coverage *(100)*. It provides a clearer picture of what works to improve immunization data use, why it works and where knowledge gaps still exist. The systematic realist review considered nearly 550 documents, including published literature, working papers, project evaluations and reports. The following are some key findings from the review: interconnected and comprehensive strategies provide stronger results; data use leads to increase of quality of data; and efforts to systematize data use lead to long-term intervention success. Additional information and resources can be found at Technet-21 *(101)*.

Although the high quality of data is important, quality does not guarantee data use at an individual, facility, community or organizational level. Additionally, while a trained cadre of data end-users is critical, data must meet the requirements of multiple end-users and end-user scenarios, informing both national policy and service delivery among health workers. Furthermore, the right people (at all levels) must be able to get the information they need, when they need it, for their purposes.

Data must be translated into information at the right level of detail to inform national-level resource planning and state-, provincial- and local-level programme management, depending on the needs of the decision-maker. At the facility level, for example, an EIR may enable nurses to search for individual-level data about patients who have recently defaulted on a vaccine. The same registry, to be truly functional, must also convey immunization coverage data at the district, regional and provincial levels to meet the needs of higher-level health workers, who must track which facilities are meeting targets and which are underperforming. When presented with actionable information that has been aggregated to reflect the needs of different end-users, individuals are more likely to use data for decision-making.

Building a culture of data use requires careful planning, steady application and the decision-making infrastructure to allow for change. Data, in order to be actionable, must be translated from complex charts and figures into digestible information and a clear series of messages and directives (see *Fig. 8.3.3*). As the digital health intervention demonstrates success, an activity during scale may include changes in how the data outputs inform policy decision-making. As individuals increasingly use data in their day-to-day decisions, they will gradually become more invested in the quality of that data, even working to improve it. Data use is therefore a cyclical process. As the quality improves, end-users' confidence in that data will also increase, and they will be more likely to use the data to make decisions. Teams should also make a point of measuring progress along the way. A deliberate, systematic approach will bring about enduring improvements in data use, data maturity and sustainability-enabling factors.

Fig. 8.3.3. Data-driven accountability cycle.



Source: Moore et al., 2018 (102).

Four other factors can help complete cultural change, as described in *Table 8.3.4*.

Table 8.3.4. Cultural change factors.

Awareness of need	Earlier, you identified your health system challenges, along with the information needed to address these challenges. Implementing an awareness campaign that builds a case for action appropriate across different levels of the health system can increase support for the digital health intervention.
Motivation to act	Motivation can come from both external drivers (such as job performance indicators or financial incentives) and internal drivers (such as care for the community and country). Recognition by peer networks and data-use champions may also stimulate motivation.
Empowerment to act	Empowerment often entails changes to formal policies and job descriptions that support individuals' ability to identify and act on information.
Skills to use and improve quality	Individuals must feel reasonably confident in their ability to identify and review the relevant data, interpret the information and then develop conclusions and corresponding action items. Beyond initial training, there should be a feedback loop to monitor performance, as described earlier in this chapter, and ongoing performance support to continuously improve.

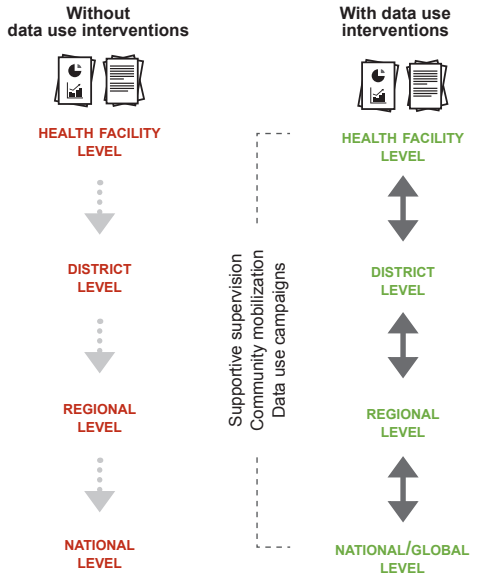
BID INITIATIVE CASE STUDY

BID Initiative: Building a culture of data use

What does a culture of data use look like on the ground? For Oliver Mlemeta, a nurse at the Usa River Health Facility in Tanzania, it means she will be trained on how to use data in a meaningful way so that she can better serve her patients. Simplified, automatically generated reports will reduce the chance of error and allow her more time to do what she loves most: care for patients. A monthly dashboard tells her how her facility is performing compared to neighbouring health centres and allows Oliver to adjust services accordingly. If she has questions, she can reach out to her peers using the WhatsApp platform, a communication forum where health workers provide peer support as they adopt new tools and practices.

A primary goal of the BID Initiative was to improve data use at all levels of the health system (see *Fig. 8.3.5*). Building a culture of data use requires products that ease data collection and visibility, policies to support the culture and people who can enforce the policies by establishing effective practices. To this end, BID introduced a number of different tools and approaches to strengthen data use, including data-use guides, readiness assessments and guidelines on supportive supervision that complemented the use of the EIR.

Fig. 8.3.5. The data journey, with and without data-use interventions.



Source: BID Initiative briefs: recommendations and lessons learned: data use (103).

BID INITIATIVE CASE STUDY

The following are key learnings from implementing these data-use interventions in Tanzania and Zambia.

- **Teach data-analysis skills with the facility's existing data to help nurses identify challenges currently affecting service delivery and pinpoint ways to address those issues.** This foundation in data analysis better prepares nurses to adopt new tools and to adapt their data-analysis skill sets to different service areas, such as malaria.
- **Electronic tools, as well as revised paper forms, must go through an iterative process with feedback from facility, district, regional and provincial members of UAGs.** This allows software developers to understand how health workers will use data and information and ensures the creation of intuitive tools that enable access to data for planning and service delivery.
- **Use targeted, supportive supervision and tools, such as job aids and dashboards, for data visualization to identify low-performing facilities.** These tools should also present a methodology to walk through the challenges associated with the facility's performance, as well as an approach to identify steps to improve performance.
- **Create peer-support networks to connect health workers with other facilities in their district.** These networks provide an opportunity for nurses to ask questions of one another and to receive support in real time using messenger platforms like WhatsApp. For instance, health workers may pose questions about how to calculate indicators. Regional leads may also use the network to communicate with nurses and facility in-charges by sharing immunization updates.
- **Engage regional-, provincial- and national-level stakeholders.** Although nurses at the facility and district level are the critical data end-users and will benefit from greater data visibility, stakeholders at all levels should be involved to foster a culture of data use across the health system. Readiness assessment tools and data dashboards for decision-making enable management of that change.

The following are additional tools developed by the BID Initiative for building a culture of data use:

- *Spot check form (104)*
- *Data-use culture job aid (105)*

Adapted from BID Initiative briefs: recommendations and lessons learned: data use (103).

8.4 Adaptive management: Use data to optimize interventions

Adaptive management requires realizing that change happens and building in the ability to respond to the change *(106)*. Emerging from the interdisciplinary need and understanding that complex development issues require nimble solutions, adaptive management calls for incremental, steady iteration *(107)*. Adaptive management ensures that M&E plan outputs are continuously used to improve the digital health intervention or larger digital health investment.

Adaptive management may include adjusting interventions, trying out new workflows, retiring unsuccessful processes or scaling approaches that have demonstrated value. It is a continuous process of learning by doing, steady feedback and ongoing stakeholder engagement. It uses cycles of structured decision-making and, increasingly, real-time data to make strategic and operational decisions throughout the implementation's life cycle. Adaptive management is only possible to the extent that data on performance are available.

Real-time data empowered by digital health interventions can facilitate adaptive management by enabling rapid, timely feedback in the form of behavioural changes, performance metrics and M&E indicators, allowing for prompt course correction. Adaptive management fosters changes to traditional management approaches in several ways (see *Table 8.4.1*).

Table 8.4.1. Traditional versus adaptive management.

Traditional management	Adaptive management
» Relies on fixed best practices and standardization determined at the start of an implementation » Change is top-down and driven by the organization and donors » Requires management planning and repetition	» Reinforces participatory approaches, iteration and flexibility throughout the implementation life cycle » Change is contextual and informed by end-users and other key stakeholders » Requires the capacity for constant change and strategic course correction

An ongoing cycle of decision-making, monitoring, assessment and feedback leads to a better understanding of development issues and an improved management strategy based on what is learned.

Be aware that transforming how data are used can generate resistance throughout all levels of the health system because of changes in accountability, collaboration, communication, decision-making, job descriptions and other operational practices. Although the digital health intervention may be functional, stable, usable and effective, this resistance can affect the overall efficacy of the intervention. Combining an effective monitoring approach with improved data-culture practices can help mitigate this risk.

When developing your adaptive management plan to optimize and sustain interventions, consider the following questions.

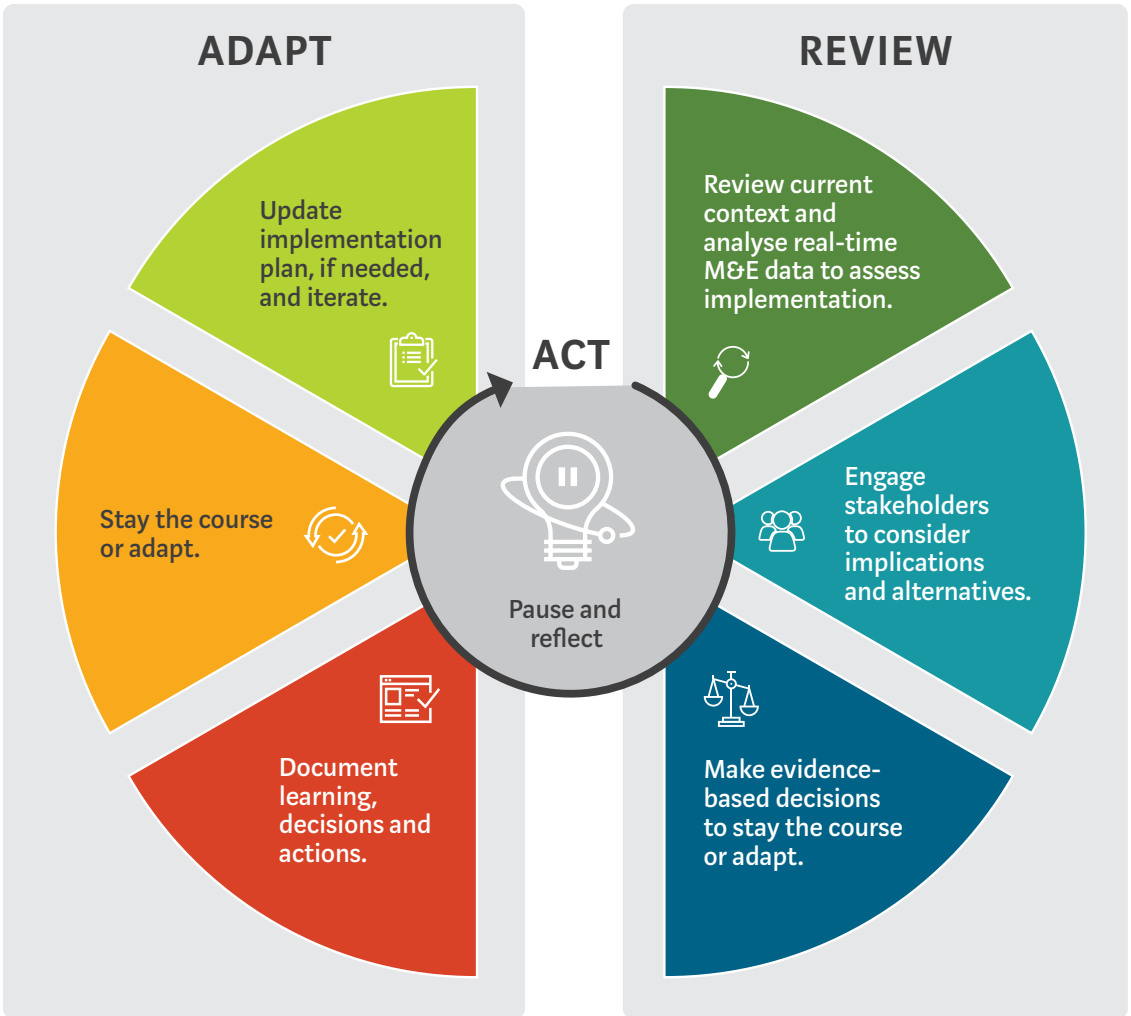
- Are your programming and interventions based on evidence or following a logical theory of change?
- How does your organization identify and mitigate uncertainties and risks?
- Who is involved in decision-making at an implementation, programme or organizational level?
- What mechanisms does your team or organization have to periodically pause and reflect?
- How does your team or organization discuss and learn from missteps or failures? What mechanisms for knowledge management does your team or organization have to capture and share lessons learned?

- Does your team have mechanisms for translating learnings into change? If so, how do you integrate change at an implementation, programme or organizational level?
- What tools and mechanisms does your team use to determine the appropriate approach to interventions (such as theories of change, benefit analyses, stakeholder analyses and so on)?
- How do you evaluate progress, taking into account uncertainties and repeated cycles of learning and change?
- How do you analyse and communicate results?

A full checklist of considerations can be found in *Annex 8.1*. *Fig. 8.4.2* illustrates the steps you could take to apply adaptive management during your implementation. When planning your digital health intervention, schedule regular moments to pause and reflect. Ideally, these reviews occur regularly throughout implementation, but they are critical during times of uncertainty or when key milestones are delivered. Contextual factors, M&E data, learnings and other data recorded throughout the process can all inform these intentional pause-and-reflect moments.

Engage stakeholders to consider the implications of how work is progressing and if the data indicate that a change is needed; if so, allow stakeholders to inform the possible alternatives. Analyse all of these inputs to make an evidence-based decision to stay the course or redirect. Throughout the process, document learnings, alternatives that were considered, decisions and actions, as these may be used to inform future pause-and-reflect moments. If action has been taken to redirect, schedule time to reassess the new plan and identify new areas where uncertainty may call for additional reflection.

Fig. 8.4.2. Adaptive management cycle.



8.5 Progress check

At this point in the process, you should have the following outputs:

- ❒ Problem statement detailing specific challenges and needs in the health system
- ❒ Identified digital health interventions to address the current challenges
- ❒ Enabling-environment assessment defining possible constraints
- ❒ Implementation plan that is appropriate for the environmental limitations
- ❒ Linkages of this specific investment to the broader set of digital health activities and enterprise architecture
- ❒ High-level financial plan and costing
- ❒ M&E plan, including for adaptive management and data use.

CHAPTER 09

VALUE PROPOSITION AND NEXT STEPS

Fig. 9.1 provides an overview of the key components to complete as you finalize your costed implementation plan. You may use this costed implementation plan to obtain the necessary digital health investment for your proposed implementation. Beyond resource mobilization, following this process should give you more confidence that the selected digital health interventions that you plan to implement within a larger digital health enterprise architecture:

- **address identified bottlenecks and health programme needs**
- **align with the existing national digital health strategy**
- **fit within your local context and ecosystem**
- **promote an exchanged digital health enterprise system architecture that can contribute to broader health sector goals.**

While this process takes time, it should result in long-term cost savings by reducing resources wasted on misaligned, ineffective or siloed digital health enterprise system architectures, while increasing the likelihood for health impact by addressing identified health system challenges. Additionally, the selected interventions should fit within the existing national digital health strategy, enterprise architecture and context, ensuring long-term sustainability of the investment.

Lastly, as you embark on the digital health implementation, continue to consider evolution of the larger ecosystem. How can your investment continue to contribute to the broader digital health enterprise architecture? How can you use the data effectively to continually improve your investment and its health impact? Remember that building sustainable digital health enterprises is a dynamic process, and as the local context changes over time, you may need to consider new or additional digital health interventions or refine your thinking on the health system challenges to be addressed.

Fig. 9.1. **Summary of outputs towards a costed investment plan.**

Health Goals

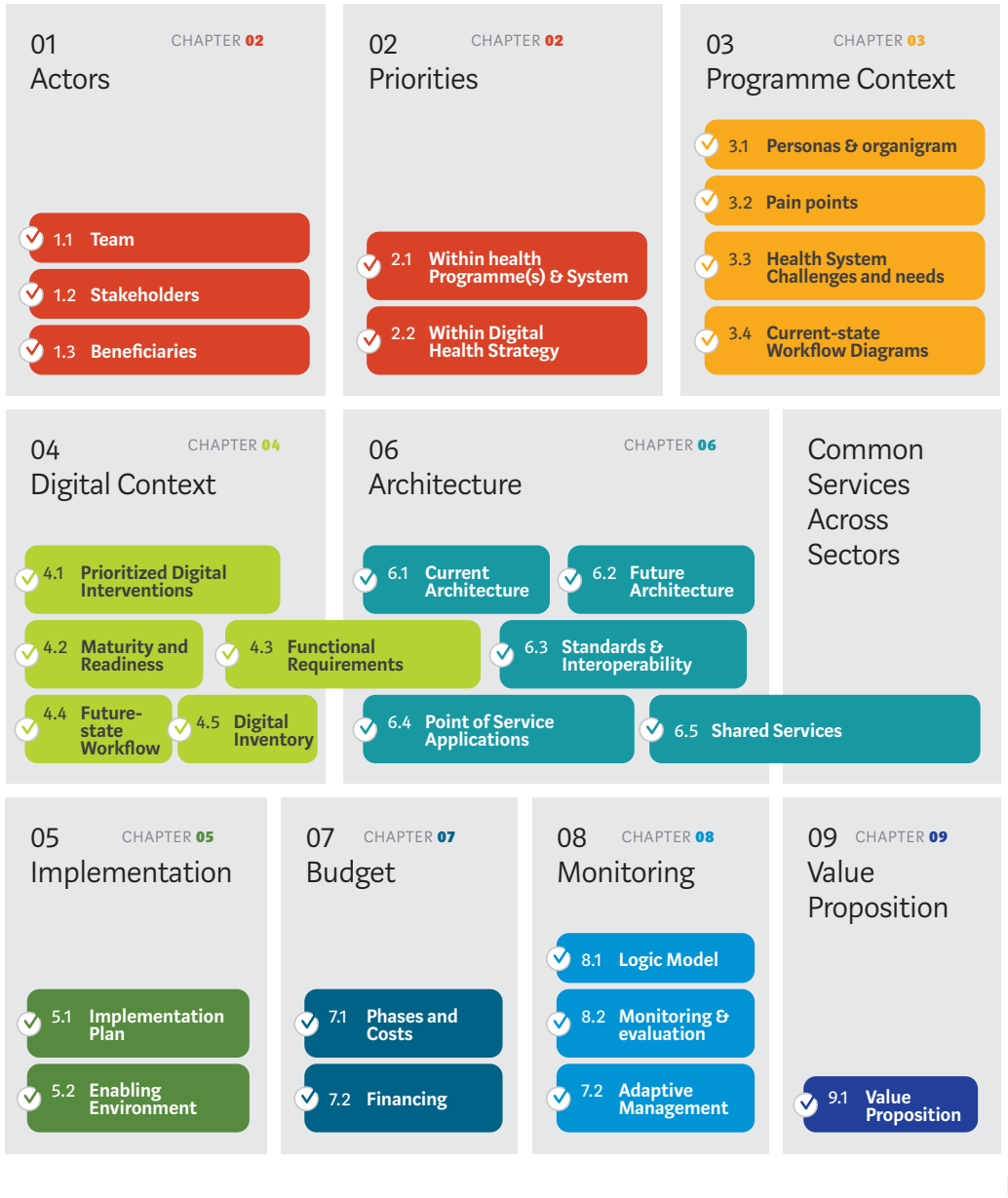
- Form the team and establish goals
- Establish personas and needs in health structure
- Assess and document user and data workflows
- Identify pain points and health system challenges
- Articulate expected outcomes, benefits, impact

Digital Context

- Review digital maturity and readiness
- Detail priority digital interventions in optimized flows
- Inventory digital assets and gaps, ability to reuse
- Articulate required functions and systems
- Detail standards and interoperability needs
- Diagram current state and proposed future state architecture

Financial and Operational Considerations

- Describe policy and enabling environment
- Explain investment phases and budget
- Highlight governance mechanisms and risk mitigation strategies
- Present detailed actions including scale-up, operation and maintenance, training, monitoring and change management
- Outline logic model, and value proposition of the investment on expected outcomes

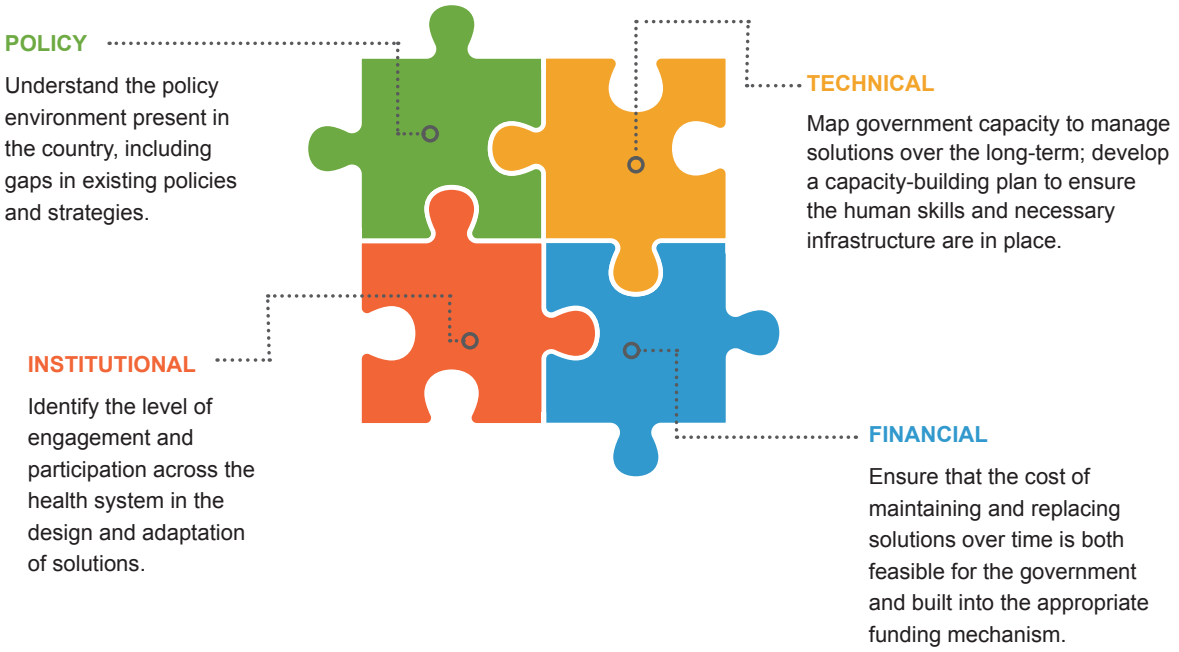


BID INITIATIVE CASE STUDY

BID Initiative: Sustainability

An important component of sustaining a digital health enterprise is sharing lessons learned with the larger community. Here are a few from the BID Initiative that consider policy, technical, institutional and financial elements (see *Fig. 9.2*).

Fig. 9.2. Critical sustainability elements.



Work from the beginning with a core group of stakeholders across the government and other key organizations. This will ensure a complete understanding of the challenges to be addressed and that the solutions address those challenges and meet end-user needs.

Build key champions within the government and key stakeholder groups. These champions are essential to advocate for adopting solutions and long-term funding.

Balance the need for a "proof of concept" (seeing it to believe it works) with the need to begin sustainability planning. The key issues of technical capacity, policy environment and financing need to be considered from the beginning.

Create a realistic, shared vision among partners and the government from the start. This vision will cover what needs to be in place for sustainability (infrastructure, policy, capacity and financing) and determine how to implement process or system changes.

Secure costing data as quickly as possible (including cost estimates if necessary). This will build understanding of both the level of financing required and the savings possible in other budget areas because of greater efficiencies and smoother processes.

Adapted from BID Initiative briefs: recommendations and lessons learned: sustainability (108).

References

1. WHO guideline: recommendations on digital interventions for health system strengthening. Geneva: World Health Organization; 2019. Licence: CC BY-NC-SA 3.0 IGO.
2. World Health Organization, PATH. Planning an information systems project: a toolkit for public health managers. Seattle: PATH; 2013 (https://path.org/resources/planning-an-information-systems-project-a-toolkit-for-public-health-managers/, accessed 18 February 2020).
3. World Health Organization, International Telecommunication Union. National eHealth strategy toolkit. Geneva: International Telecommunication Union; 2012 (https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-E_HEALTH.05-2012-PDF-E.pdf, accessed 17 February 2020).
4. World Health Organization. Classification of digital health interventions: a shared language to describe the uses of digital technology for health. Geneva: World Health Organization; 2018 (WHO/RR/18.06; https://www.who.int/reproductivehealth/publications/mhealth/classification-digital-health-interventions/en/, accessed 18 February 2020).
5. Resolution WHA71.7. Digital health. In: Seventy-first World Health Assembly, 26 May 2018. Geneva: World Health Organization; 2018 (https://apps.who.int/gb/ebwha/pdf_files/WHA71/A71_R7-en.pdf, accessed 18 February 2020).
6. Global strategy on digital health 2020–2024. World Health Organization; draft (https://www.who.int/docs/default-source/documents/gs4dh.pdf?sfvrsn=cd577e23_2, accessed 18 February 2020).
7. Principles for Digital Development [website] (https://digitalprinciples.org/principles/, accessed 18 February 2020). Licence: CC BY-SA 4.0.
8. Digital Health Atlas [website] (https://digitalhealthatlas.org/en/-/, accessed 18 February 2020).
9. Global Digital Health Index [website] (https://www.digitalhealthindex.org/, accessed 18 February 2020).
10. Digital health investment review tool. Maternal and Child Survival Program; 2018 (https://www.mcsprogram.org/resource/digital-health-investment-review-tool/, accessed 17 February 2020).
11. HIS stages of continuous improvement toolkit. Chapel Hill (NC): MEASURE Evaluation; 2019 (https://www.measureevaluation.org/his-strengthening-resource-center/his-stages-of-continuous-improvement-toolkit/, accessed 17 February 2020).
12. Principles of Donor Alignment for Digital Health [website] (https://digitalinvestmentprinciples.org/, accessed 17 February 2020).
13. International Telecommunication Union, Digital Impact Alliance. SDG digital investment framework and call to action. Geneva: International Telecommunication Union; 2018 (https://digitalimpactalliance.org/research/sdg-digital-investment-framework/, accessed 17 February 2020).
14. Digital health platform handbook: building a digital information infrastructure (infostructure) for health. Geneva: International Telecommunication Union; in press.
15. Digital Square. The global goods guidebook. Seattle: PATH; 2019 (https://digitalsquare.org/global-goods-guidebook/, accessed 18 February 2020).
16. Human-centered design toolkit. UNICEF; in press.
17. Digital identity toolkit: a guide for stakeholders in Africa. Washington (DC): World Bank Group; 2014 (https://openknowledge.worldbank.org/handle/10986/20752/, accessed 17 February 2020). Licence: CC BY 3.0 IGO.
18. OpenHIE [website] (https://ohie.org/, accessed 18 February 2020).
19. The TOGAF Standard: version 9.2. The Open Group; 2018 (https://www.opengroup.org/togaf/, accessed 18 February 2020).
20. Drury P, Roth S, Jones T, Stahl M, Medeiros D. Guidance for investing in digital health. Manila: Asian Development Bank; 2018 (ADB Sustainable Development Working Paper Series, No. 52; https://www.adb.org/sites/default/files/publication/424311/sdwp-052-guidance-investing-digital-health.pdf, accessed 18 February 2020).
21. Handbook for digitalizing primary health care: optimizing person-centered tracking and decision-support systems across care pathways. World Health Organization; in press (https://www.who.int/reproductivehealth/publications/handbook-digitalizing-primary-health-care/en/).
22. Digital accelerator kits. World Health Organization; in press (https://www.who.int/reproductivehealth/publications/digital-accelerator-kits/en/).
23. Implementation guide. In: FHIR Release 4 [website]. Ann Arbor (MI): HL7 International; 2019 (https://www.hl7.org/fhir/implementationguide.html, accessed 17 February 2020).
24. World Health Organization, International Telecommunication Union. Be he@lthy, be mobile handbooks. In: Noncommunicable diseases and their risk factors [website]. Geneva: World Health Organization; 2020 (https://www.who.int/ncds/prevention/be-healthy-be-mobile/handbooks/en/, accessed 17 February 2020).
25. 2018 global reference list of 100 core health indicators (plus health-related SDGs). Geneva: World Health Organization; 2018 (https://www.who.int/healthinfo/indicators/2018/en/, accessed 17 February 2020). Licence: CC BY-NC-SA 3.0 IGO.
26. Monitoring and evaluating digital health interventions: a practical guide to conducting research and assessment. Geneva: World Health Organization; 2016 (https://www.who.int/reproductivehealth/publications/mhealth/digital-health-interventions/en/, accessed 18 February 2020).
27. Arenth B, Bennett A, Bernadotte C, Carnahan E, Dube M, Thompson J et al. Defining and building a data use culture. Seattle: PATH; 2017 (https://www.path.org/publications/files/DHS_Data_Use_Culture_wp.pdf, accessed 18 February 2020).
28. Data demand and use. In: MEASURE Evaluation [website]. Chapel Hill: Carolina Population Center, University of North Carolina at Chapel Hill (https://www.measureevaluation.org/our-work/data-demand-and-use/, accessed 18 February 2020).
29. WHO Department of Reproductive Health and Research, United Nations Foundation, Johns Hopkins University Global mHealth Initiative. The MAPS toolkit: mHealth assessment and planning for scale. Geneva: World Health Organization; 2015 (https://www.who.int/reproductivehealth/topics/mhealth/maps-toolkit/en/, accessed 18 February 2020).

30. Standards and Interoperability Lab – Asia. Digital health investment: costing tool. Manila: Asian Development Bank; 2020 (http://sil-asia.org/costing-tool/, accessed 17 February 2020).

31. CRVS digitisation guidebook: a step-by-step guide to digitising civil registration and vital statistics processes in low resource settings. African Programme for the Accelerated Improvement of CRVS (http://www.crvs-dgb.org/en/, accessed 18 February 2020).

32. Common requirements for maternal health information systems: produced with the Collaborative Requirements Development Methodology. Seattle: PATH; 2012 (https://path.azureedge.net/media/documents/MCHN_mhis_crdm.pdf, accessed 18 February 2020).

33. Pan American Health Organization. Electronic immunization registry: practical considerations for planning, development, implementation and evaluation. Washington (DC): PAHO; 2017 (http://iris.paho.org/xmlui/handle/123456789/34865, accessed 18 February 2020).

34. World Health Organization, Management Sciences for Health, KNCV Tuberculosis Foundation. Electronic recording and reporting for tuberculosis care and control. Geneva: World Health Organization; 2012 (WHO/HTM/TB/2011.22; https://www.who.int/tb/publications/electronic_recording_reporting/en/, accessed 18 February 2020).

35. Mobile solutions for malaria elimination surveillance systems: a roadmap. Vital Wave; 2017 (https://vitalwave.com/wp-content/uploads/2017/08/VITALWAVE-BMGF-Mobile-Tools-for-Malaria-Surveillance-Roadmap.pdf, accessed 18 February 2020).

36. Digital Health and Interoperability Working Group. Annual meeting, Washington (DC), 11 December 2019.

37. IHE quality research and public health (QRPH) white paper: extracting indicators from patient-level data. Integrating the Healthcare Enterprise; in press.

38. Vota W. Every African country's national eHealth strategy or digital health strategy. ICTworks. 4 December 2019 (https://www.ictworks.org/african-national-ehealth.strategy-policy/#.Xkqhg5NKiu5, accessed 17 February 2020).

39. Directory of eHealth policies. In: Global Observatory for eHealth [website]. Geneva: World Health Organization; 2020 (https://www.who.int/goe/policies/countries/en/, accessed 17 February 2020).

40. National Ebola recovery strategy for Sierra Leone 2015–2017. Government of Sierra Leone; 2015 (https://ebolaresponse.un.org/sites/default/files/sierra_leone_recovery_strategy_en.pdf, accessed 18 February 2020).

41. Detailed meeting report. In: Sierra Leone Health Information Systems Interoperability Workshop, Freetown (Sierra Leone), 2–4 August 2016:18 (https://www.healthdatacollaborative.org/fileadmin/uploads/hdc/Documents/SL_HIS_Interoperability_Meeting_Report_Final__2_.pdf, accessed 18 February 2020).

42. Digital health: a call for government leadership and cooperation between ICT and health. Broadband Commission for Sustainable Development; 2017 (https://www.broadbandcommission.org/Documents/publications/WorkingGroupHealthReport-2017.pdf; accessed 18 February 2020).

43. Digital health convergence meeting toolkit. Asian Development Bank; 2018 (https://www.adb.org/sites/default/files/publication/468216/digital-health-converge-meeting-tool-kit.pdf; accessed 18 February 2020).

44. Mwanyika H. Capturing the end user's perspective: BID's user advisory group. In: BID's Latest [blog]. BID Initiative; 2014 (https://bidinitiative.org/blog/capturing-the-end-user-perspective-bids-user-advisory-group/, accessed 18 February 2020).

45. Njobvu FS. User advisory group established in Zambia. In: BID's Latest [blog]. BID Initiative; 2014 (https://bidinitiative.org/blog/user-advisory-group-established-in-zambia/, accessed 18 February 2020).

46. BID Initiative. Stakeholder analysis tool [document]. Seattle: PATH; 2018 (http://bidinitiative.org/wp-content/uploads/1.-TOOL_StakeholderAnalysis_FINAL.docx, accessed 17 February 2020).

47. BID Initiative. User advisory group terms of reference [document]. Seattle: PATH (http://bidinitiative.org/wp-content/uploads/13.-TOOL_UserAdvisoryGroup_TOR_FINAL.docx, accessed 17 February 2020).

48. National health ICT strategic framework 2015–2020. Government of Nigeria; 2016 (https://www.who.int/goe/policies/Nigeria_health.pdf?ua=1; accessed 18 February 2020).

49. BID Initiative. Product vision for the BID Initiative. Seattle: PATH; 2014 (https://www.path.org/publications/files/VAD_bid_product_vision.pdf, accessed 18 February 2020).

50. Collaborative Requirements Development Methodology (CRDM) [website]. Decatur (GA): Public Health Informatics Institute, The Task Force for Global Health; 2016 (https://www.phii.org/crdm/, accessed 18 February 2020).

51. Business process. In: Business Dictionary [website]. WebFinance Inc.; 2020 (http://www.businessdictionary.com/definition/business-process.html, accessed 17 February 2020).

52. The expanded programme on immunization. Geneva: World Health Organization; 2013 (http://www.who.int/immunization/programmes_systems/supply_chain/benefits_of_immunization/en/; accessed 18 February 2020).

53. Optimizing person-centric record systems: a handbook for digitalizing primary health care. World Health Organization; in press.

54. Determine the root cause: 5 whys. In: iSixSigma [website] (https://www.isixsigma.com/tools-templates/cause-effect/determine-root-cause-5-whys/, accessed 18 February 2020).

55. Universal health coverage (UHC) fact sheet. Geneva: World Health Organization; 2018 (https://www.who.int/news-room/fact-sheets/detail/universal-health-coverage-(uhc)), accessed 18 February 2020).

56. Mehl G, Labrique A. Prioritizing integrated mHealth strategies for universal health coverage. Science. 2014;345(6202):1284–7. doi:10.1126/science.1258926.

57. Nonfunctional requirements. In: SAFe Framework 5.0 [website]. Boulder (CO): Scaled Agile Inc.; 2020 (http://www.scaledagileframework.com/nonfunctional-requirements/, accessed 17 February 2020).

58. Health information systems interoperability maturity toolkit. Chapel Hill (NC): MEASURE Evaluation; 2019 (https://www.measureevaluation.org/resources/tools/health-information-systems-interoperability-toolkit/, accessed 17 February 2020).

59. Batavia H, Mechael P. Toolkit: assessing the enabling environment for establishing a contextualized national digital health strategy. Washington (DC): United Nations Foundation; 2016 (http://ict4somlnigeria.info/wp-content/uploads/2016/03/Toolkit-assessing-enabling-environment_FINAL.pdf, accessed 18 February 2020).

60. Information and communication technologies for women's and children's health: a planning workbook. Geneva: World Health Organization (https://www.who.int/pmnch/knowledge/publications/ict_mhealth.pdf, accessed 18 February 2020).

61. BID Initiative. Implementing solutions. In: The BID Initiative Story [website]. Seattle: PATH (https://bidinitiative.org/story/implementing-solutions/, accessed 17 February 2020).

62. Global Digital Health Network [website]. Baltimore: The Johns Hopkins University Center for Communication Programs; 2019 (https://www.globaldigitalhealthnetwork.org/, accessed 18 February 2020).

63. Asia eHealth Information Network (AeHIN) [website]. Manila: AeHIN; 2016 (http://www.aehin.org/, accessed 18 February 2020).

64. Accessing the enabling environment for ICTs for health in Nigeria: a landscape and inventory. Washington, DC: United Nations Foundation; 2014 (http://ict4somlnigeria.info/wp-content/uploads/2016/03/nigeria-landscape-report.pdf, accessed 18 February 2020).

65. Bangladesh eHealth inventory report. Bangladesh Knowledge Management Initiative; 2014.

66. mHealth in Malawi: landscape analysis. Malawi Ministry of Health and Population; 2018 (https://static1.squarespace.com/static/548487dce4b08bf981fe60d5/t/5b18fb5f6d2a73891c7a2a1f/1528363963131/FINAL_malawi_mhealth_landscape_analysis_May_2018.pdf, accessed 18 February 2020).

67. What are global goods. In: Digital Square Wiki [website]. Washington (DC): Digital Square; 2018 (https://wiki.digitalsquare.io/index.php/What_are_Global_Goods, accessed 18 February 2020).

68. BID Initiative. Equipment support strategy [document]. Seattle: PATH (http://bidinitiative.org/wp-content/uploads/12.-TOOL_Equipment_Support_Strategy_FINAL.docx, accessed 17 February 2020).

69. Global Digital Health Index Indicator Guide. In: Global Digital Health Index [website] (http://gdhi-showcase-lb-602552207.us-east-1.elb.amazonaws.com/indicators_info, accessed 18 February 2020).

70. Marcelo A, Medeiros D, Ramesh K, Roth S, Wyatt P. Transforming health systems through good digital health governance. Manila: Asian Development Bank; 2018 (ADB Sustainable Development Working Paper Series, No. 51; https://www.adb.org/publications/transforming-health-systems-good-digital-health-governance, accessed 18 February 2020).

71. Empel S. Way forward: AHIMA develops information governance principles to lead healthcare toward better data management. Journal of AHIMA. 2014;85(10):30–32 (https://library.ahima.org/doc?oid=107468 - .XkvrXpNKiu6, accessed 18 February 2020).

72. Risks, harms and benefits assessment tool. In: UN Global Pulse [website] (https://www.unglobalpulse.org/policy/risk-assessment/, accessed 17 February 2020).

73. Right to erasure ('right to be forgotten'). In: General Data Protection Regulation, Chapter 3, Art. 17 (https://gdpr-info.eu/art-17-gdpr/, accessed 18 February 2020).

74. African Union Convention on cyber security and personal data protection. Addis Ababa: African Union; 2014 (https://au.int/en/treaties/african-union-convention-cyber-security-and-personal-data-protection/, accessed 18 February 2020).

75. Software as a medical device (SaMD): key definitions. In: International Medical Device Regulators Forum, 9 December 2013 (IMDRF/SaMD WG/N10FINAL:2013; http://www.imdrf.org/docs/imdrf/final/technical/imdrf-tech-131209-samd-key-definitions-140901.pdf, accessed 18 February 2020).

76. International Medical Device Regulators forum [website] (http://www.imdrf.org/, accessed 18 February 2020).

77. Medical devices: regulations. In: World Health Organization [website] (https://www.who.int/medical_devices/safety/en/, accessed 18 February 2020).

78. The journey to scale: moving together past digital health pilots. Seattle: PATH; 2014 (https://www.path.org/resources/the-journey-to-scale-moving-together-past-digital-health-pilots/, accessed 18 February 2020).

79. Beyond scale: how to make your digital development program sustainable [e-book]. Digital Impact Alliance; 2017 (https://digitalimpactalliance.org/research/beyond-scale-how-to-make-your-digital-development-program-sustainable/, accessed 18 February 2020).

80. BID Initiative briefs: recommendations and lessons learned: change management. Seattle: PATH; 2017 (http://bidinitiative.org/wp-content/uploads/VAD_BID_LessonsLearned_ChangeMngmt_v1_rev03.pdf, accessed 17 February 2020).

81. BID Initiative briefs: recommendations and lessons learned: rollout strategy. Seattle: PATH; 2017 (http://bidinitiative.org/wp-content/uploads/VAD_BID_LessonsLearned_Rollout_v1_rev04.pdf, accessed 17 February 2020).

82. BID Initiative. Facility and district visit strategy for introducing data quality and data use interventions [document]. Seattle: PATH; 2018 (http://bidinitiative.org/wp-content/uploads/2.-TOOL_FacilityVisitStrategy_FINAL.docx, accessed 17 February 2020).

83. BID Initiative. Spotting and addressing resistance to change [document]. Seattle: PATH (http://bidinitiative.org/wp-content/uploads/6.-TOOL_Addressing-Resistance_FINAL.doc, accessed 17 February 2020).

84. BID Initiative. Change readiness assessment tool for health workers [document]. Seattle: PATH (http://bidinitiative.org/wp-content/uploads/7.-TOOL_Change-Readiness-Assessment-Facilities_FINAL.docx, accessed 17 February 2020).

85. BID Initiative. Coaching/supportive supervision job aid [document]. Seattle: PATH (http://bidinitiative.org/wp-content/uploads/11.-TOOL_Coaching_Supervision_Guide_FINAL-1.docx, accessed 17 February 2020).

86. Mobile device management. In: Wikipedia [website] (https://en.wikipedia.org/wiki/Mobile_device_management, accessed 18 February 2020).

87. Vendor lock-in. In: Wikipedia [website] (https://en.wikipedia.org/wiki/Vendor_lock-in, accessed 18 February 2020).

88. Health Level 7. In: Wikipedia [website] (https://en.wikipedia.org/wiki/Health_Level_7, accessed 18 February 2020).

89. What is interoperability in healthcare? In: HIMSS Resource Library [website]. Chicago: Healthcare Information and Management Systems Society; 2019 (https://www.himss.org/what-interoperability, accessed 18 February 2020).

90. mHero [website]. Chapel Hill (NC): IntraHealth International; 2017 (https://www.mhero.org/, accessed 18 February 2020).

91. OpenHIE architecture specification, version 2.0. OpenHIE; 2019 (https://ohie.org/architecture-specification/, accessed 17 February 2020).

92. TOGAF content metamodel [presentation]. In: TOGAF standard courseware V9 edition, module 7. The Open Group; 2009 (http://www.togaf.info/togaf9/togafSlides9/TOGAF-V9-M7-Metamodel.pdf, accessed 18 February 2020).

93. OpenHIE architecture. OpenHIE; 2019 (https://ohie.org/#arch, accessed 17 February 2020). Licence: CC BY 4.0.

94. How to calculate total lifetime costs of enterprise software solutions. In: Principles for Digital Development [website] (https://digitalprinciples.org/resource/howto-calculate-total-cost-enterprise-software/, accessed 18 February 2020).

95. Mvundera M, Di Giorgio L, Lymo D, Mwansa FD, Ngwegwe B, Werner L. The costs of developing, deploying and maintaining electronic immunisation registries in Tanzania and Zambia. BMJ Global Health 2019;4:e001904. doi:10.1136/bmjgh-2019-001904.

96. Di Giorgio L, Mvundera M. What are the costs and benefits of implementation? In: BID's Latest [blog]. BID Initiative; 2016 (http://bidinitiative.org/blog/what-are-the-costs-and-benefits-of-implementation/, accessed 17 February 2020).

97. Jones T, Drury P, Zuniga P, Roth S. Digital health impact framework user manual. Manila: Asian Development Bank; 2018 (ADB Sustainable Development Working Paper Series, No. 57; https://www.adb.org/sites/default/files/publication/465611/sdwp-057-digital-health-impact-framework-manual.pdf, accessed 18 February 2020).

98. What is RE-AIM. In: RE-AIM [website] (http://www.re-aim.org/about/what-is-re-aim/, accessed 18 February 2020).

99. Agarwal S, Lefevre A, Labrique A, Mehl G, Cargo M. Evidence for scale: the development of a monitoring and evaluation framework for mHealth – MomConnect case study. London: GSMA; 2014 (https://www.gsma.com/mobilefordevelopment/programme/mhealth/evidence-for-scale-the-development-of-a-monitoring-and-evaluation-framework-for-mhealth-momconnect-case-study/, accessed 18 February 2020).

100. Immunization data: evidence for action. A realist review of what works to improve data use for immunization, evidence from low- and middle-income countries [précis]. Seattle: PATH, Pan American Health Organization; 2019 (https://path.azureedge.net/media/documents/PATH_IDEA_Precis_R1.pdf, accessed 18 February 2020).

101. Immunization Data: Evidence for Action (IDEA). In: Technet-21 [website] (https://technet-21.org/en/topics/idea/, accessed 18 February 2020).

102. Moore M, Faherty LJ, Fischer SH, Bouskill KE, DaVanzo J, Setodji CM et al. Data and family planning: an evaluation of two programs of the Bill & Melinda Gates Foundation. Santa Monica: Rand Corporation; 2018 (https://www.rand.org/pubs/research_briefs/RB9984.html, accessed 18 February 2020).

103. BID Initiative briefs: recommendations and lessons learned: data use. Seattle: PATH; 2017 (http://bidinitiative.org/wp-content/uploads/VAD_BID_LessonsLearned_DATAUSE_v1_rev06.pdf, accessed 17 February 2020).

104. BID Initiative. Spot check form [document]. Seattle: PATH (http://bidinitiative.org/wp-content/uploads/3.-TOOL_SpotCheck_FINAL.xlsx, accessed 17 February 2020).

105. BID Initiative. Data use culture job aid [document]. Seattle: PATH (http://bidinitiative.org/wp-content/uploads/8.-TOOL_Data_Use-Culture_FINAL.docx, accessed 17 February 2020).

106. Kareiva C, Bernadotte C, Gilbert S, Goertz H. Compasses when there are no maps: the growing importance of adaptive management to the development sector and the role of real-time data. Seattle: PATH; in press.

107. What is adaptive management? In: Learning lab [website]. Washington (DC): United States Agency for International Development, 2018 (https://usaidlearninglab.org/lab-notes/what-adaptive-management-0, accessed 18 February 2020).

108. BID Initiative briefs: recommendations and lessons learned: sustainability. Seattle: PATH; 2017 (http://bidinitiative.org/wp-content/uploads/VAD_BID_LessonsLearned_Sustainability_v1_rev03.pdf, accessed 17 February 2020).

ANNEXES

Annex 1.1 Glossary

ADAPTIVE MANAGEMENT. The process of building in the ability to respond to change using incremental, steady iteration to continually improve a digital health implementation.

API. Stands for application programming interface. A code that allows two software programs to communicate with each other. The API defines the correct way for a developer to write a program that requests services from an operating system or other application.[1]

BENEFICIARY. Clients or members of the community who may benefit from the digital health implementation when used by another end-user.

BOTTLENECK. A specific problem or gap in the delivery of health services that reduces optimal implementation of the health programme; may also be referred to as pain point. A generic or nonprogramme-specific bottleneck is a health system challenge.

CLIENT. An individual who is a potential or current user of health services; may also be referred to as patient or beneficiary.

COMMON COMPONENTS. Core functionalities of applications that can be generalized and reused for other health programme areas or beyond the health sector; also called reusable components.

COSTED IMPLEMENTATION PLAN. A document that describes, in sequence, an identified set of challenges, accompanied by a contextually appropriate and financially justified mitigation strategy. A costed implementation plan, or proposal, can be used to obtain financial support to implement the proposed activities of a government-driven digital health investment.

CURRENT STATE. The flow of events that a client experiences when seeking or receiving a particular health service as they currently occur.

DIGITAL HEALTH. Digital health is the systematic application of information and communications technologies, computer science, and data to support informed decision-making by individuals, the health workforce, and health systems, to strengthen resilience to disease and improve health and wellness.[2]

DIGITAL HEALTH APPLICATION. The software, ICT system or communication channel that delivers or executes the digital health intervention and health content.[3]

DIGITAL HEALTH ECOSYSTEM. The combined set of digital health components representing the enabling environment, foundational architecture and ICT capabilities available in a given context or country.

1 *Adapted from Digital health terminology guide. AeHIN; 2018 (https://aehin.hingx.org/Share/Details/3819/, accessed 24 January 2019).*

2 *Consensus definition of digital health, Digital Health and Interoperability Working Group Key terms and theory of change small working group; [Presentation] 2019 (https://docs.google.com/presentation/d/1TnTFaunk-1WLlG4sKJQ_aSfjmfmivvcENil4mY4XxJs, accessed 18 February 2020).*

3 *Adapted from Digital health platform handbook: building a digital information infrastructure (infostructure) for health. Geneva: International Telecommunication Union (in press).*

DIGITAL HEALTH ENTERPRISE. The business processes, data, systems and technologies used to support the operations of the health system, including the digital health applications, point-of-service software applications, other software, devices, hardware, standards, governance and underlying information infrastructure (such as the digital health platform) functioning in a purposeful and unified manner. This guide distinguishes between four different types of digital health enterprise system architectures along a continuum of maturity: siloed, ball of mud, integrated and exchanged.

DIGITAL HEALTH IMPLEMENTATION. The development and deployment of digital health application(s), platform(s) or enterprise within a given context, accompanied by an operational plan, human resources, training and related activities for successful execution.[4]

DIGITAL HEALTH INTERVENTION. A discrete technology function designed to achieve a specific objective addressing a health system challenge in order to improve a health programme process and help strengthen the overall health system.

DIGITAL HEALTH INVESTMENT. Financial and other resources, including human resources, that are directed towards digital health implementations. This document aims to guide the development of a costed digital health investment for an exchanged digital health implementation.

DIGITAL HEALTH MOMENT. A point in the process of providing health services where gaps and inefficiencies occur and at which a digital health intervention can be applied, providing functionality that can improve the health programme process.

DIGITAL HEALTH OUTCOME. What will be achieved or changed in the health system or services by using digital health interventions; may also be known as an eHealth outcome.[5]

DIGITAL HEALTH PLATFORM. A shared digital health information infrastructure (infostructure) on which digital health applications are built to support consistent and efficient healthcare delivery. The infostructure comprises an integrated set of common and reusable components that support a diverse set of digital health applications. The components consist of software and shared information resources to support integration, data definitions and exchange standards for interoperability and to enable the use of point-of-service applications across health programme areas and use cases.[6]

DIGITAL HEALTH PROJECT. A time-bound implementation of a siloed digital health application, usually to demonstrate proof of concept.

DIGITAL HEALTH STRATEGY. An overarching plan that describes high-level actions required to achieve national health system goals. These actions may describe how new digital health components will be delivered or how existing components will be repurposed or extended. The foundational building blocks of a digital health strategy include infrastructure, legislation, policies, leadership and governance, standards and interoperability, and financing. May also be known as an eHealth strategy.

DIGITAL HEALTH SYSTEM. A digital health system comprises all of the digital technology used to support the operations of the overall health system. Included in this system are software applications and systems, devices and hardware, technologies, and the underlying information infrastructure.[7]

ENABLING ENVIRONMENT. Attitudes, actions, policies and practices that stimulate and support effective and efficient functioning of organizations, individuals and programmes. The enabling environment includes legal, regulatory and policy frameworks and political, sociocultural, institutional and economic factors.

END-USER. An individual, such as a health worker, manager or client, who interacts directly with the intervention once implemented.

4 *Adapted from Classification of digital health interventions: a shared language to describe the uses of digital technology for health. Geneva: WHO; 2018 (https://www.who.int/reproductivehealth/publications/mhealth/classification-digital-health-interventions/en/).*

5 *Adapted from National eHealth strategy toolkit. Geneva: World Health Organization and International Telecommunication Unit; 2012 (https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-E_HEALTH.05-2012-PDF-E.pdf, accessed 22 January 2019).*

6 *Adapted from Digital health platform handbook: building a digital information infrastructure (infostructure) for health. Geneva: International Telecommunication Union (in press).*

7 *Adapted from Digital health platform handbook (in press).*

ENTERPRISE ARCHITECTURE. A blueprint of business processes, data, systems and technologies used to help implementers design increasingly complex systems to support the workflow and roles of people in a large enterprise, such as a health system.[8]

EVALUATION. The systematic assessment of an ongoing or completed intervention to determine whether the intervention is fulfilling its objectives and to demonstrate an effect on health outcomes.[9]

EXCHANGED SYSTEM ARCHITECTURE. A system architecture consisting of multiple applications connected through a health information exchange to address collective needs across the health sector, operating in a coordinated manner within a digital health enterprise.

FUNCTIONAL REQUIREMENTS. Description of what the digital system needs to do to support the tasks that make up the health system process and address the identified health system challenges.

FUNDER. Private foundation, NGO, bilateral or multilateral agency, or private-sector organization that provides resources to design, develop and implement digital health investments or projects.

FUTURE STATE. The desired flow of events where the digital health intervention has overcome the bottlenecks.

HEALTH INFORMATION SYSTEM. A system that integrates data collection, processing, reporting, and use of the information necessary for improving health service effectiveness and efficiency through better management at all levels of health services.[10]

HEALTH MANAGEMENT INFORMATION SYSTEM. An information system specially designed to assist in the management and planning of health programmes, as opposed to delivery of care.[11]

HEALTH PROGRAMME. Operational unit within a government ministry supporting formal activities institutionalized at a national or subnational level to address clear priority health objectives. Health programmes are government led and persist across budget cycles as long as the underlying need persists. EPI and malaria control programmes are some examples of health programmes.

HEALTH PROGRAMME PROCESS. A set of activities involving different personas that is required to achieve an objective or carry out a function of a health programme; also referred to as a business process.

HEALTH SYSTEM CHALLENGE. A generic (not health domain specific) need or gap that reduces the optimal implementation of health services. Health system challenges represent a standardized way of describing bottlenecks.

INDICATOR. A quantitative or qualitative factor or variable that provides a simple and reliable means to measure achievement.[12]

INTEGRATED SYSTEM ARCHITECTURE. A digital health enterprise system architecture in which two or more digital health applications are directly connected to one another (without an intermediary data exchange), intended to address one or more health system challenges and fulfil health programme goals.

INTEGRATION. Integration is the inter-connectivity requirements needed for two applications to securely communicate data to and receive data from another.

INTEROPERABILITY. Interoperability is the ability of different applications to access, exchange, integrate and cooperatively use data in a coordinated manner through the use of shared application interfaces and standards, within and across organizational, regional and national boundaries, to provide timely and seamless portability of information and optimize health outcomes.

8 *Adapted from Digital health platform handbook (in press).*

9 *Adapted from WHO evaluation practice handbook. Geneva: World Health Organization; 2013 (http://www.who.int/iris/handle/10665/96311, accessed 11 September 2019).*

10 *World Health Organization. Developing health management information systems: a practical guide for developing countries. Manilla: World Health Organization; 2004 (https://iris.wpro.who.int/bitstream/handle/10665.1/5498/9290611650_eng.pdf)*

11 *WHO. Developing health management information systems: a practical guide for developing countries*

12 *WHO evaluation practice handbook, 2013.*

LOGIC MODEL. A graphic depiction of the shared relationships between the resources, activities, outputs, outcomes and impact of a health programme, showing the relationship between the programme's activities and its anticipated effect.[13]

MATURITY MODEL. A framework used in ICTs and digital health to help situate implementations based on technological, organizational or environmental characteristics.

MONITORING. The process of collecting and analysing routinely collected data to compare how well an intervention is being implemented against expected results and measure changes in performance over time.[14]

MUD (MONOLITHIC UNARCHITECTED SOFTWARE DISTRIBUTION). Software characterized by an evolving agglomeration of functions, originating without a predetermined scope or design pattern, which accumulate technical debt.[15]

NONFUNCTIONAL REQUIREMENTS. General attributes and features of the digital system to ensure usability and overcome technical and physical constraints. Examples of nonfunctional requirements include ability to work offline, multiple language settings, and password protection.

PERSONA. A generic aggregate description of a person involved in or benefiting from a health programme.

PLANNING TEAM. The group of stakeholders responsible for guiding the development of the digital health implementation.

REQUEST FOR PROPOSALS (RFP). A document that solicits proposals, often made through a bidding process, by an agency or company interested in procuring a commodity or service.[16]

ROOT CAUSE ANALYSIS. The process of identifying the underlying factors causing a bottleneck in the health programme.

SCENARIO. A set of simple statements that summarizes what the end-user needs the digital health intervention to do.

SILOED APPLICATION. A stand-alone digital health application consisting of one or more digital health interventions to address one or more health system challenges and fulfil the project goals.

STAKEHOLDER. Any person who is affected by or interested in the consequences of the digital health implementation; stakeholders include the planning team, end-users, beneficiaries and funders.

STANDARD. In software, a standard is a specification used in digital application development that has been established, approved and published by an authoritative organization. These rules allow information to be shared and processed in a uniform, consistent manner independent of a particular application.

TASK. A specific action in a health programme process.

TECHNICAL DEBT. Technical debt in software development and systems architecture describes the risk of taking shortcuts and making short-term fixes (which later require costly revisions and add-ons); rather than investing in carefully designed, robust solutions (which cost more upfront, but have lower maintenance and feature development costs over time).[17]

TOTAL COST OF OWNERSHIP. The resources required to support a digital health intervention throughout its life cycle.

WORKFLOW. A visual representation of the progression of activities, events and decision points in a logical flow illustrating the interactions within the business process; the diagram also maps how information moves through the process and helps visualize where bottlenecks are occurring.

13 *Adapted from Logic models. In: CDC Approach to Evaluation [website] (https://www.cdc.gov/eval/logicmodels/index.htm).*

14 *Adapted from WHO evaluation practice handbook, 2013.*

15 *Adapted from Foote B & Yoder J. Big ball of mud. Pattern Languages of Programs Conference, Monticello (IL), September 1997.*

16 *Adapted from Request for proposal. In: Wikipedia [website] (https://en.wikipedia.org/wiki/Request_for_proposal, accessed 24 January 2019).*

17 *Adapted from Technical Debt. Wikipedia [website]. Available from: https://en.wikipedia.org/wiki/Technical_debt#cite_note-2 [Accessed 29 September 2020].*

Annex 1.2 Additional resources for planning and implementing a digital health enterprise

Phase	Steps	Resources
PHASE 1 Assessing the current state and enabling environment	Conduct an inventory of existing or previously used software applications, ICT systems and other tools to better understand the requirements for reuse and interoperability.	» *Health information systems interoperability maturity toolkit*: assessment tool. MEASURE Evaluation; 2017 (*https://www.measureevaluation.org/resources/publications/tl-17-03b*). » *Information and communication technologies for women's and children's health: a planning workbook*. WHO (*https://www.who.int/pmnch/knowledge/publications/ict_mhealth.pdf?ua=1*).
PHASE 2 Establishing a shared understanding and strategic planning	Develop a national digital health strategy outlining overarching needs, desired activities and outcomes. Define a vision for how the health system will be strengthened through the use of digital technology.	» *Data Use Partnership: the journey to better data for data health in Tanzania.* PATH; 2016 (*http://www.path.org/publications/detail.php?i=2734*).
PHASE 3 Defining the future state	Formulate a digital health investment roadmap to support the national digital health strategy. Plan and identify appropriate digital health interventions, alongside the health and data content, to improve health system processes and address programmatic needs.	» *Collaborative Requirements Development Methodology: participant tools.* PATH and Public Health Informatics Institute; 2019 (*https://www.path.org/resources/collaborative-requirements-development-methodology-participant-tools/*). » Keisling K. *Introduction to mHealth: how to approach mHealth*. 2014 (*http://healthenabled.org/wordpress/wp-content/uploads/2017/09/mhealth_approaches-1.pdf*). » *Planning an information systems project: a toolkit for public health managers.* WHO and PATH; 2013 (*https://path.azureedge.net/media/documents/TS_opt_ict_toolkit.pdf*).
PHASE 4 Planning the enterprise architecture	Review the current state and develop an architecture blueprint for the design of the digital health implementations. Identify validated open standards to ensure data exchange, systems integration and future proofing of digital health implementations.	» *Connecting health information systems for better health: leveraging interoperability standards to link patient, provider, payor and policymaker data*. PATH; 2014 (*http://www.jointlearningnetwork.org/resources/connecting-health-information-systems-for-better-health/*).
PHASE 5 Determining health content requirements	Identify validated health content appropriate for the implementation context. Ensure use of content aligned with identified standards for the future state.	

Phase	Steps	Resources
PHASE 6 M&E of digital health implementations and fostering data use	Monitor your implementation to ensure systems are functioning as intended and having the desired effect. Foster data-driven adaptive change management within the overall health system.	» *Bridging real-time data and adaptive management: ten lessons for policy makers and practitioners.* US Agency for International Development; 2018 (*https://www.usaid.gov/digital-development/rtd4am/policy-design-lessons/*). » *Defining and building a data use culture.* PATH; 2017 (*https://www.path.org/publications/files/DHS_Data_Use_Culture_wp.pdf*). » *Integrating big data into the monitoring and evaluation of development programmes.* UN Global Pulse; 2016 (*https://www.slideshare.net/unglobalpulse/integrating-big-data-into-the-monitoring-and-evaluation-of-development-programmes*).
PHASE 7 Implementing, maintaining and scaling	Maintain and sustain digital health implementations. Identify risks and appropriate mitigations.	» *Beyond scale: how to make your digital development program sustainable.* DIAL; 2017 (*https://digitalimpactalliance.org/research/beyond-scale-how-to-make-your-digital-development-program-sustainable/*). » *The journey to scale: moving together past digital health projects.* PATH; 2014 (*https://www.path.org/resources/the-journey-to-scale-moving-together-past-digital-health-pilots*).

Annex 2.1 Planning and implementation charter

As you determine roles and responsibilities and develop a common goal, you can you use this charter template to list out the overall vision, scope, health programmes to be targeted and other key information related to your planning and implementation efforts. See *Chapter 2* for more details.

VISION/OBJECTIVES	
A concise description of what outcomes are expected from the planning and implementation. Describe how the organization will benefit at the end of the project.	
BACKGROUND	
Current situation that requires a change; inventory of existing tools and systems; context diagram that visually represents the project participants, problems and opportunities.	
FUNCTIONAL SCOPE	
A brief description of the main functional blocks or modules that will be included.	
HEALTH AREA SCOPE	
Which of the Ministry of Health departments and programmes will eventually use this intervention? Will it include only a subset at first, and then be expanded?	
GEOGRAPHIC SCOPE	
Where will the intervention be implemented over time? Where will it be piloted? Who will be using it? District people or also at the health center level?	
PARTICIPANTS	
List of individuals whose input has been gathered as part of the scope definition.	
TIMING	
By when do you expect the intervention to be operational at the pilot level? And at scale?	

Annex 2.2 Persona worksheet

This persona worksheet can be used to think through the different potential end-users and better understand their needs and challenges as you design the digital health implementation. Use this persona worksheet as a starting point; you may conduct more detailed persona descriptions as you engage further with the end-users. See *Chapter 2* for more details.[18]

Demographics	Name, Photo and Type of Persona
» Gender » Age » Community » Language(s) used	» Name (can be real or illustrative) » Photo of persona to help with visualization and storytelling

Roles and Responsibilities

Context Description
» Does this end-user own a digital device? Is yes, what kind? » Level of familiarity with digital tools? » Rural or urban? » Internet connectivity? » Availability of electricity and water? » Homogeneous or heterogeneous population? » Distance to nearest health facility?

Challenges
» What are the routine challenges this end-user faces? » Long distances travelled without reliable mode of transportation? » Sufficient training and performance monitoring? » Workload? » It would be beneficial to include quotes given directly in interviews for the persona you are creating

What does success look like from the perspective of the persona?
» What are their motivations? For example: When clients are happy with the services? Not having to wait a long time before seeing a health worker?

18 *For more examples of persona-mapping templates, please see Demand for health services workbook: a human-centred approach. UNICEF (http://hcd4i.org/wp-content/uploads/2018/10/unicef_digitalhealthinterventions_final2018-1.pdf).*

Annex 3.1 Process matrix worksheet

This process matrix worksheet will allow you to identify the different health programme processes and tasks, so you can map the workflow and identify bottlenecks within these processes. See *Chapter 3* for more details.

#	Process	Objective	Task set	Outcomes	Bottlenecks	Health system challenge
A *Illustrative example*	Antenatal care referral	To provide timely and appropriate referrals to a higher level facility or healthcare provider.	» Assess pregnant woman's danger signs. » Stabilize pregnant woman's conditions. » Arrange emergency transport.	» Women receive appropriate care and are referred in a timely manner.	» Health worker did not check for all the danger signs. » Health worker was unaware of whether or where to refer. » Referral facility is too far away.	» Poor adherence to guidelines (HSC 3.7) » Insufficient health worker competence (HSC 3.2) » Geographic inaccessibility (HSC 5.2)
B						
C						
D						
E						

Annex 3.2 Worksheet for mapping bottlenecks to health system challenges

This worksheet continues from *Annex 3.1*, where you identified key tasks within the targeted processes, as well as possible bottlenecks. Use this worksheet to elaborate on the different bottlenecks within your workflows and begin determining which ones you will address. See *Chapter 3* for more detail.

UHC Layer affected	Illustrative bottleneck	Health system challenge	Rank by stakeholder team
EFFECTIVE COVERAGE/ QUALITY	» "Health workers do not show at their health posts/facilities." » "Health workers turn away clients." » "There is a high attrition of health workers." » "It is hard to retain health workers."	3.4 Low health worker motivation	
	» "Health workers do not counsel clients appropriately." » "Health workers are not following their counselling/treatment protocols." » "Health workers are not sure of what services to provide." » "The guidelines are difficult to interpret for health workers."	3.7 Poor adherence to guidelines	
	» "Clients do not receive care on time." » "Clients have to wait a long time before receiving appropriate treatment."	6.4 Delayed provision of care	
CONTINUOUS COVERAGE	» "Clients do not continue taking their medication." » "Clients do not complete the recommended number of visits/treatments."	5.3 Low adherence to treatments	
	» "Clients do not return for [XX] services and appointments." » "Clients discontinue or drop out of services." » "Health workers are unable to trace clients." » "Clients move around a lot and do not come back to the same place for services."	5.4 Loss to follow-up	
CONTACT COVERAGE	» "Clients do not want to use [XX] service." » "Clients do not know where they can access [XX] service."	5.1 Low demand for services	
	» "Services are too far for clients." » "Roads are inaccessible during rainy season [or other period]."	5.2 Geographic inaccessibility	
	» "There is a lot of stigma with accessing [XX] service." » "Clients feel afraid/ashamed to seek [XX] service."	4.1 Lack of alignment with local norms	

Annex 5.1 Questions for software developers

As you select the specific applications that you will use in the digital health implementation, it is critical to have some background information on the level of support that software developers will provide, as well as the capabilities of the software application. This worksheet provides key questions that can be used to guide your discussion with a particular software developer. This worksheet could also be used as a guide for creating a proposal scoring rubric.[19]

Question	Reasoning
What is your largest implementation? How many end-users are part of that implementation? How many records are in that database?	Determine if the vendor has experience or evidence that they are able to support the size of your desired implementation.
How many end-users can use the software at the same time?	If your end-users typically access the system and provide all of their reports on Friday afternoons, you do not want the system to fail or have very poor performance during those times.
What components of the proposed intervention use proprietary software; commercial, off-the-shelf software; open source software?	To follow a principle such as technology independence, knowing the licensing requirements early is important. For system maintenance, knowing the underlying technology and corresponding robustness of either the software provider or the open-source community can be important.
What service-level agreement for uptime do you guarantee each month? How many hours of maintenance is the system unavailable each month and when are those typically scheduled?	What amount of time is tolerable for the system to be unavailable? A total of 95 percent uptime translates to eight hours each week. Usually, the vendor will apply security updates to the software on your behalf. Yet, you would not want this to occur during key periods of system use.
How would you integrate with our health information system? Can you provide examples of how you have done this before?	If an integrated system is a key principle, knowing that the application has a demonstrated architecture for data exchange is necessary. If the integration has never been done before, it may be considered an unsupported customization that requires ongoing maintenance fees.
How do you safeguard the security and privacy of our data? What were the results of your most recent external audit?	Data security is critical for health information systems. Information such as patient records can be hard to replace and should not fall into the wrong hands. Data can be lost due to disasters such as a flood or fire but also to hackers or a malware infection.
How often would our data be backed up? Can you provide your disaster recovery plans? When was the last exercise and what were the results?	If data are an asset, knowing that the vendor has processes to store and restore your system in the event of an emergency is important.
What training and support services do you provide? What times are support services available?	Early clarification of roles and responsibilities for deploying the software is needed to understand the overall costs. Training end-users is often a large part of the deployment budget. Sometimes, the vendor will provide training for administrators and train your trainers. Do your normal hours of operation coincide with the support hours provided?
What languages does your software support?	For ease of use, the system user interface should be in the language of your end-users. If the language is not currently supported, ideally the vendor has capabilities that allow you to localize the various terms.
What are the annual maintenance and licensing fees? How much are these fees expected to increase annually?	Sometimes hidden fees obscure the true costs of the system. Maintenance fees of upwards of 20 percent of the software license may be required when the contract is signed.
What interoperability standards does your system support? Have you demonstrated conformity with specific standards? With which use cases and other systems have you achieved interoperability?	It is valuable to understand the software vendors attention to data exchange standards, and their ability to implement the software within a broader digital health enterprise environment using standards.

19 *Source: Planning an information systems project: a toolkit for public health managers, Annex 7. PATH; 2013 (https://path.azureedge.net/media/documents/TS_opt_ict_toolkit.pdf).*

Annex 5.2 Implementation considerations summary template

Using the following worksheet, compile your implementation considerations for each digital health intervention, taking into account the different factors within the enabling environment.

See *Chapter 5* for more detail, as well as the *Who Guideline: Recommendations on Digital Interventions for Health System Strengthening* for implementation considerations for selected interventions.

Enabling environment factors	Implementation considerations for digital health intervention 1	Implementation considerations for digital health intervention 2
1. STRATEGY AND INVESTMENTS		
2. INFRASTRUCTURE		
3. LEGISLATION, POLICY AND COMPLIANCE		
4. LEADERSHIP AND GOVERNANCE		
5. WORKFORCE		
6. SERVICES AND APPLICATIONS		
7. STANDARDS AND INTEROPERABILITY		
8. HEALTH CONTENT		

Annex 5.3 Implementation considerations for specific digital health interventions

This annex describes specific implementation considerations for a selected set of digital health interventions. These specific considerations are in addition to the factors discussed in *Chapter 5* that relate to general implementation considerations for all interventions.

The interventions listed in this appendix are based on the interventions that were prioritized in the *WHO Guideline: Recommendations on Digital Interventions for Health System Strengthening*, which include:

- birth and death notification
- stock notification and commodity management
- client-to-provider telemedicine
- provider-to-provider telemedicine
- targeted client communication
- health worker decision support
- digital health record for tracking of patients'/clients' health status and services
- provision of training and educational content to health workers via mobile devices (mLearning).

INTERVENTION 1: BIRTH AND DEATH NOTIFICATION

DESCRIPTION OF THE DIGITAL HEALTH INTERVENTION	Digital approaches to support the notification of births and deaths in order to trigger subsequent steps of birth registration and certification and compile vital statistics[20]
COMMONLY ASSOCIATED HEALTH SYSTEM CHALLENGES	» Lack of access to information or data (lack of reporting of events) » Lack of population denominator » Lack of quality/reliable data » Inadequate understanding of beneficiary populations » Lack of unique identifier
CONSIDERATIONS *BEFORE* DEPLOYING	» Align to national policies and laws for legal identity, as well as issuance of unique IDs. This intervention should strengthen the entire CRVS and avoid developing systems that do not link to health services or CRVS systems. For example, is the health system allowed to notify about vital events? » Align to national policies and laws around electronic storage of data, data privacy, data protection and so on. » Explore sociocultural barriers associated with communicating about births/deaths and address the way these dynamics will influence notifications via digital devices.

20 *Adapted from Classification of digital health interventions: a shared language to describe the uses of digital technology for health. Geneva: WHO; 2018 (https://www.who.int/reproductivehealth/publications/mhealth/classification-digital-health-interventions/en/).*

CONSIDERATIONS *DURING* DEPLOYMENT	» Consider mechanisms to ensure the completeness of the data and whether demand-generation activities are needed to incentivize reporting by explaining its benefits. Implementers should be aware, however, of any reporting targets placed on health workers and ensure that birth and death data are validated before being released to the civil registration system. » Consider processes for deduplication/validation of the notification. Strengthen processes to ensure that all notifications lead to both legal registration and issuance of certificates. » Consider how best to ensure the quality and timeliness of birth and death data, such as by checking on low performers identified through digital performance data or spot checks. Other ways to help improve data quality include standardizing the definitions associated with reporting birth and death events, such as for stillbirths, and making these definitions accessible to those inputting the data.
OPPORTUNITIES FOR INTEROPERABILITY AND LINKAGES TO OTHER DIGITAL HEALTH INTERVENTIONS	Consider linking birth notification to health services that have high coverage, such as immunization services or health facilities that offer very high rates of institutional delivery. It is important, however, to consider whether the civil registration system can absorb an increase in notifications.
RISKS AND MITIGATION STRATEGIES	There is a risk in overinvesting in notifications without a robust civil registry system on the back end. Without this, notifications will have no legal value, and the data are less likely to be properly stored and managed. Implementers should note that increases in notifications will in turn require that the health system and civil registration services be prepared to absorb higher demand for registration. This is a potential bottleneck in the registration and validation process and could deter populations from continuing notifications. Consider how to improve accessibility and shorten the connection between the health workers or communities providing the notifications and the CRVS sector undertaking the registration. Data on births/deaths may be particularly vulnerable for financial value (for example, information used for advertising and marketing). Establish mechanisms to preserve data privacy, ownership, access, integrity and protection of patient information.
ADDITIONAL RESOURCE	CRVS digitisation guidebook: a step-by-step guide to digitising civil registration and vital statistics processes in low resource settings. African Programme for the Accelerated Improvement of CRVS (*http://www.crvs-dgb.org/en/*).

Considerations for cost categories for birth/death notification

Cost category	Description
ONGOING/ALL PHASES	
Governance	Personnel for partnership building and coordination meetings to align with stakeholders (such as Technical Working Group members, implementing partners and MNOs) Meeting costs (e.g. transportation, personnel time)
Management and staffing	Personnel to oversee overall programme
DEVELOPMENT AND SETUP	
Outreach and raising awareness	Dissemination to the community about the intervention and how to make notifications, which may be conducted by outreach through community health workers, pamphlets, billboards and/or mobile message blasts
	Personnel for system setup and end-user support

DEPLOYMENT	
Equipment/ hardware	Devices (such as mobile phones, tablets and computers) used by key informants for conducting birth notifications Setup of cloud hosting or physical server, which would require physical and virtual security and authentication
Initial training	Development/adaptation of training curricula and standard operating procedures, which can include materials for train-the-trainer approaches Training on standard operating procedures for the recipient of the birth/death notifications (health workers and civil registrar personnel)
INTEGRATION AND INTEROPERABILITY	
Content adaptation	Development/adaptation of content and requirements for the registration system; for death registration, this may require mapping to processes for death certificates, death surveillance and ICD codes,[21] as well as requirements for insurance closure and social protection mechanisms Design of technology architecture to link the notification with the birth registration system or with health records; for death registration, this may require linkages to verbal autopsy systems Review and incorporation of policies related to identity management and civil registration, including for obtaining unique identifiers
Technology adaptation	Software customization of the digital system for completing birth registration information, including generation of unique identifiers Embedding of security features, such as authorization for end-user access control and data encryption to ensure protection of data Definition of integration or interoperability requirements, including data definition and message formats Software linkage between birth registration application and the health record, ideally using a unique identifier, such as a unique personal ID (e.g. a national ID number)
Human resources	Additional personnel for increased coordination with partners to follow up on software integrations and governance
SCALE	
Training and adaptive management	Training for additional personnel interacting with the birth registration software system Additional training for supervisory personnel on continuous monitoring of the system at scale Additional training for ICT support staff to provide end-user support, troubleshooting, backup and recovery at scale Periodic review meetings to discuss feedback on system performance and challenges
SUSTAINED OPERATIONS	
Refresher training and adaptive management	Additional personnel to ensure ongoing maintenance of the integrated system and integration of data Refresher training or continued community outreach to facilitate uptake of notification processes Periodic review meetings to discuss feedback on system performance and challenges Incentives for reporting birth and death notifications, particularly if relying on community members and key informants for the notifications

21 *See International classification of diseases. WHO (http://www.who.int/classifications/icd).*

Communication/ data exchanges	SMS text message, USSD voice call and/or data transmission charges based on volume of communication content and communication channel; note that both SMS and USSD are unsecure channels and that, unlike with USSD, with SMS an unencrypted record will remain on the sender's phone, creating an additional risk Short code maintenance fee, which represents a simplified number for clients to use when registering for the service Aggregator maintenance fees, which enable communication across multiple network carriers
Technology maintenance	Data hosting (such as server maintenance or cloud-hosting fees) Software maintenance, licensing and upgrade fees Hardware maintenance, including insurance and repair/replacement of hardware

INTERVENTION 2: STOCK NOTIFICATION AND COMMODITY MANAGEMENT

DESCRIPTION OF THE DIGITAL HEALTH INTERVENTION	Digital approaches for monitoring stock levels and distribution of medical commodities, which can include using communication systems (such as SMS) and data dashboards to manage and report on supply levels of medical commodities[22]
COMMONLY ASSOCIATED HEALTH SYSTEM CHALLENGES	» Insufficient supply of commodities (which could be attributed to wastage of expired stocks due to lack of good planning, forecasting and redistribution systems) » Geographic inaccessibility » Lack of effective resource allocation » Lack of transparency in commodity transactions » Delayed reporting of events
CONSIDERATIONS *BEFORE* DEPLOYING	Consider the need for training at all levels of the health system, including training of health workers to send stock reports, of support staff (such as cold-chain technicians) to manage stock and of facility workers to assess stock levels. Reinforce training by the basic processes of inventory management and stock distribution. Since management staff at national and subnational levels make decisions according to the data on whether or not to supply health facilities and health workers with stock replenishments, introducing the digital system should also be accompanied by refresher training on the basic processes of supply chain management.
CONSIDERATIONS *DURING* DEPLOYMENT	» Ensure that the digital systems and ordering routines are flexible enough to respond to local needs. For instance, where systems deal with quarterly stock orders, ensure that they can also accommodate unexpected or seasonal needs.
OPPORTUNITIES FOR INTEROPERABILITY AND LINKAGES TO OTHER DIGITAL HEALTH INTERVENTIONS	Prioritize integrating notifications with existing data reporting systems, including national or subnational information management systems where available, such as supply chain, logistics and warehouse management information systems. Consider integrating the stock notification system with a data dashboard that displays the notification, receipt of commodity at the station and action taken, among other data, to ensure transparency.
RISKS AND MITIGATION STRATEGIES	The digital reporting of stock levels will introduce a level of transparency in commodity transactions that may be new to the health system. Ensure that there is no harm or reprisal to health workers for reporting stockouts or wastage; instead, emphasize explaining the benefits of reporting stockouts so that they can be addressed. To motivate continued reporting, ensure that some action is possible when stockouts are reported.
ADDITIONAL RESOURCE	*Critical success factors for deploying digital LMIS.* John Snow, Inc. (*https://www.jsi.com/JSIInternet/Inc/Common/_download_pub.cfm?id=18286&lid=3*).

22 *Adapted from Classification of digital health interventions, 2018.*

Considerations for cost categories for stock notification

Cost category	Description
ONGOING/ALL PHASES	
Governance	Personnel for partnership building and coordination meetings to align with stakeholders (such as Technical Working Group members, implementing partners and MNOs) Meeting costs (e.g. transportation, personnel time)
Management and staffing	Personnel to oversee overall programme Personnel for system setup and end-user support (such as monitoring stability of software and troubleshooting system failures) Personnel to monitor data generated by the system and provide feedback, corrective actions and so on.
DEVELOPMENT AND SETUP	
Content adaptation	Defining list of commodities to be monitored and mapping their identification codes to global standards Human-centred design process to define requirements within appropriate context, including mapping business processes, understanding personas of intended end-users and documenting functional and nonfunctional requirements Development/adaptation of dashboards for monitoring data collected by the system
Technology adaptation	Software customization to adapt the stock notification system to the commodities that need to be tracked and thresholds for notifying stockouts (such as commodities for notification or logic of when to trigger a notification) Dashboards for monitoring the performance of the system and visualizing aggregated data End-user testing among targeted populations to ensure optimal end-user experience Refinement of the intervention in response to feedback from end-user testing to ensure that requirements and context are taken into account
DEPLOYMENT	
Equipment/ hardware	Devices (such as, mobile phones and tablets) for operating the stock notification system and for health workers to use to track commodity levels Server/cloud for storing data generated by the system, which includes ensuring there is a locked, air-conditioned physical space for a server; some contexts may store data in a cloud, in which case a physical server may not be required Computers at the district and/or national level for monitoring system performance and viewing reporting dashboards
Initial training	Development/adaptation of training curricula and standard operating procedures for using the system Initial training for health workers interacting with the system Training for supervisory staff on standard operating procedures and continuous monitoring
INTEGRATION AND INTEROPERABILITY	
Technology adaptation	Design of technology architecture to link the notification with the broader LMIS Software integration with broader LMIS
Human resources	Additional personnel to define interoperability requirements and data exchanges Additional personnel to ensure the ongoing maintenance of the integrated system Additional personnel for increased coordination with partners to follow up on software integrations and governance

SCALE	
Training and adaptive management	Additional training for personnel interacting with the LMIS Additional training for supervisory personnel on continuous monitoring of the LMIS Additional training for ICT support staff to provide end-user support, troubleshooting, backup and recovery
SUSTAINED OPERATIONS	
Refresher training and adaptive management	Refresher training for health workers interacting with the system Refresher training for supervisory staff on continuous monitoring and use of data emerging from the system Periodic review meetings to discuss feedback on system performance and challenges
Communication/ data exchanges	SMS, voice call and/or data transmission charges for submitting data on stock levels
Technology maintenance	Software maintenance and licence fees Hardware maintenance, including insurance and repair/replacement

INTERVENTION 3: CLIENT-TO-PROVIDER TELEMEDICINE

DESCRIPTION OF THE DIGITAL HEALTH INTERVENTION	The delivery of healthcare services where clients/patients and health workers are separated by distance[23]
COMMONLY ASSOCIATED HEALTH SYSTEM CHALLENGES	» Geographic inaccessibility » Insufficient (coverage) supply of qualified health workers » Delayed provision of care » Inadequate access to transportation » Client-side expenses
CONSIDERATIONS *BEFORE* DEPLOYING	» Determine the mechanisms for outreach and raising awareness about this intervention, such as through mass media communication, community outreach and so on. » Clarify clinical protocols to explain what can and cannot be done in the remote consultation. For example, determine what type of cases still warrant face-to-face contact. Consider whether it is possible or desirable for clients to meet health workers in person before making connections over digital services. » Involve the relevant professional bodies as well as the health workers and clients in the planning, design and implementation of the telemedicine programme to ensure that their needs and concerns are met, such as to educate health workers on the legal frameworks governing telemedical exchanges.
CONSIDERATIONS *DURING* DEPLOYMENT	» Ensure that use of the technology does not negatively affect the relationship between the patient and health worker, particularly when end-users are learning about the technology and how to operate the devices. » Pay special attention to the needs, preferences and circumstances of particularly disadvantaged or hard-to-reach groups, including people with low literacy or few digital literacy skills and people with limited control over or access to mobile devices. » Consider how services can be made available to people with disabilities, such as sight or hearing impairments, or with poor access to electricity or poor network coverage. Strategies to increase access to telemedicine in these cases may include providing public kiosks, for example.

23 *Adapted from Classification of digital health interventions, 2018.*

OPPORTUNITIES FOR INTEROPERABILITY AND LINKAGES TO OTHER DIGITAL HEALTH INTERVENTIONS	Integrate with provider-to-provider telemedicine in cases where referral to another health worker is required. Link with targeted client communication to follow up on clients/patients following the consultation.
RISKS AND MITIGATION STRATEGIES	There may be risks with unaccredited or unlicensed health workers using a client-to-provider telemedicine system. Establish a clear legal framework for implementing telemedicine, including licensing and regulation of health workers using it. Ensure that there is capacity for and a plan to respond to calls requiring an emergency response. It may be hard to predict adoption and growth. Prediction and usage modelling needs to be in place, with plans and resources to scale, if required.
ADDITIONAL RESOURCES	*Telemedicine toolkit*. Novartis Foundation (*https://www.novartisfoundation.org/telemedicine-toolkit*). *Framework for the Implementation of a Telemedicine Service*. WHO PAHO (*https://iris.paho.org/handle/10665.2/28414*)

Considerations for cost categories for client-to-provider telemedicine

Cost category	Description
ONGOING/ALL PHASES	
Governance	Personnel for partnership building and coordination meetings to align with stakeholders (such as Technical Working Group members, implementing partners and MNOs) Meeting costs (transportation, personnel time)
Management and staffing	Personnel to oversee overall programme Clerical staff to answer and triage incoming calls (may not be necessary if clinical staff can also do the call intake) Clinical staff to provide consultations or refer to a specialist, if needed, which may be particularly expensive if the service needs to be available 24-7 Access to referral specialists in cases requiring expertise not currently provided by available clinical staff (such as dermatology or radiology) Personnel for routine monitoring of system performance, including tracking of dropped calls and use of the service Personnel for system setup and end-user support
DEVELOPMENT AND SETUP	
Outreach and raising awareness	Development of materials on how to access the intervention (such as pamphlets and billboards displaying the number to dial) Dissemination to clients about the intervention (such as messages sent to a phone bank of numbers to communicate availability of the telemedicine service)
Technology adaptation	Software customization for communication and exchanging health content based on the modalities/communication channels to be used, such as video conferencing, transmission of data/images, voice calls and so on Security features, such as end-user authentication schemes when recording callers' demographic and health information

DEPLOYMENT	
Equipment/ hardware	Computer with dedicated software system for audio and/or video connections for health workers to conduct the consultation Audio- or videoconferencing equipment, which may include headsets and trunk lines (central lines that can direct voice calls, images and video to multiple lines and across different network operators)
Initial training	Development/adaptation of training protocols and standard operating procedures, including call intake, consent and referral processes Initial training to health workers on how to use the telemedicine system
INTEGRATION AND INTEROPERABILITY	
Technology adaptation	Design of technology architecture to link the telemedicine system with other interventions, such as targeted client communication Software customization to reflect integration
Human resources	Additional personnel to define interoperability requirements and data exchanges Additional personnel to ensure the ongoing maintenance of the integrated system Additional personnel for increased coordination with partners to follow up on software integrations and governance
SCALE	
Training and adaptive management	Additional training for health workers conducting the telemedicine Additional training for supervisory personnel on continuous monitoring Additional training for ICT support staff to provide end-user support, troubleshooting, backup and recovery Periodic review meetings to discuss feedback on system performance and challenges
SUSTAINED OPERATIONS	
Refresher training and adaptive management	Refresher training and continuous support to health workers on how to use the telemedicine system Periodic review meetings to discuss system performance and workflow integration
Communication/ data exchanges	Airtime and/or transmission of data files, depending on the volume and modality of the client-to-provider communication (modalities/communication channels may include videoconferencing, transmission of data or images, web-based platforms, voice calls and interactive voice response; the caller may incur these costs unless there are provisions for the service to be toll-free, enabling costs to be absorbed by the organization/facility providing the remote consultation) Support line for client experiences and feedback
Technology maintenance	Software maintenance and licence fees Hardware maintenance, including insurance and repair/replacement of hardware

INTERVENTION 4: PROVIDER-TO-PROVIDER TELEMEDICINE

DESCRIPTION OF THE DIGITAL HEALTH INTERVENTION	The delivery of healthcare services where two or more health workers are separated by distance, often a lower level health worker consulting with a specialist or more skilled health worker[24]
COMMONLY ASSOCIATED HEALTH SYSTEM CHALLENGES	» Insufficient supply of qualified health workers » Insufficient (coverage) supply of services » Geographic inaccessibility » Insufficient health worker competence » Lack of or inappropriate referrals » Delayed provision of care » Inadequate access to transportation
CONSIDERATIONS *BEFORE* DEPLOYING	» Develop protocols to educate health workers on the use of the technology. » Explore whether changes to licensing and legislation are necessary to support any changes in health workers' scopes of practice.
CONSIDERATIONS *DURING* DEPLOYMENT	» Ensure that the distribution of roles and responsibilities among different health workers is clear, including through regulations and job descriptions. » Explore whether changes to salaries or incentives for health workers are needed to reflect any changes in scopes of practice. » Build trust between professionals who are considering establishing links between facilities across institutions, such as through twinning programmes.
OPPORTUNITIES FOR INTEROPERABILITY AND LINKAGES TO OTHER DIGITAL HEALTH INTERVENTIONS	Use master facility lists/registries and health worker registries to facilitate information exchange across facilities and health workers, respectively. Link with digital client records through unique identifiers in order to have the patient/client history during the consultation.
RISKS AND MITIGATION STRATEGIES	Clarify liability issues for health workers using telemedicine systems and determine what can and cannot be done during remote consultations; the approach should not be a substitute for the adequate training of health workers.

Considerations for cost categories for provider-to-provider telemedicine

Cost category	Description
ONGOING/ALL PHASES	
Governance	Personnel for partnership building and coordination meetings to align with stakeholders (such as Technical Working Group members, implementing partners and MNOs)
Management and staffing	Personnel to oversee overall programme Health worker providing the assistance with clinical case, which may be particularly expensive if the service needs to be available 24-7 Referral providers/specialists (such as dermatology or radiology) providing the consultations Personnel for system maintenance and end-user support
DEVELOPMENT AND SETUP	
Outreach and raising awareness	Dissemination to health workers about the telemedicine service

24 *Adapted from Classification of digital health interventions, 2018.*

Technology adaptation	Software customization for communication and exchanging health content, which may be based on the modalities/communication channels to be used for videoconferencing, transmission of data or images and voice calls Security features, such as end-user authentication schemes, when relaying clients' health information End-user testing among health workers to ensure optimal end-user experience and alignment with workflows Refinement in response to feedback from end-user testing to ensure that requirements and context are taken into account
DEPLOYMENT	
Equipment/ hardware	Computer with dedicated software for audio and/or video connections for health workers to conduct the consultation Audio- or videoconferencing equipment, which may include headsets and trunk lines (central lines that can direct voice calls, images and video to multiple lines and across different network operators) Database to log all incoming calls, audio and images Server/cloud for storage of recorded calls, audio and images, including a locked, air-conditioned physical space for the server; some contexts may store data in the cloud, which would require cloud-hosting fees
Initial training	Development/adaptation of training protocols and standard operating procedures, including referral processes Initial training of health workers on how to use the telemedicine system
INTEGRATION AND INTEROPERABILITY	
Technology adaptation	Design of technology architecture to link the telemedicine system with other interventions Software customization and incorporation of data-exchange mechanisms
Human resources	Additional personnel to define interoperability requirements and data exchanges Additional personnel to ensure the ongoing maintenance of the integrated system Additional personnel for increased coordination with partners to follow up on software integrations and governance
SCALE	
Training and adaptive management	Additional training for health workers conducting the telemedicine Additional training for supervisory personnel on continuous monitoring Additional training for ICT support staff to provide end-user support, troubleshooting, backup and recovery Periodic review meetings to discuss feedback on system performance and challenges
SUSTAINED OPERATIONS	
Refresher training and adaptive management	Refresher training to health workers on how to use the telemedicine system Periodic review meetings to discuss system performance and workflow integration
Communication/ data exchanges	Airtime and/or transmission of data files, depending on the volume and modality of the provider-to-provider communication
Technology maintenance	Software maintenance, updates and licence fees Hardware maintenance, including insurance and repair/replacement of hardware

*See resources under *Client-to-provider telemedicine* for additional resources

INTERVENTION 5: TARGETED CLIENT COMMUNICATION

DESCRIPTION OF THE DIGITAL HEALTH INTERVENTION	Transmission of customized health information for different audience segments (often based on health status or demographic categories), which may include transmission of 1. health-event alerts to a specific population group; 2. health information based on health status or demographics; 3. alerts and reminders to clients; and 4. diagnostic results (or the availability of results)[25]
COMMONLY ASSOCIATED HEALTH SYSTEM CHALLENGES	» Low demand for services » Low adherence to treatments » Loss to follow-up » Insufficient patient engagement » Unaware of service entitlement » Lack of access to information » Lack of alignment with local norms (stigma)
CONSIDERATIONS *BEFORE* DEPLOYING	» Determine the mechanisms to enrol the targeted population in the service, such as through health appointments, advertised short codes, community outreach and so on. » Ensure that clients are actively made aware of how to opt out of receiving the targeted client communication. Attention needs to be paid to clearly communicating consent procedures to clients. Inform clients on the intended uses of their data, including to enable subsequent further contact with them and over what period of time, and their right to be forgotten/opt out. » Ensure that the content of the communication accurately reflects the reality of the available commodities and services. For example, encouraging women to seek family planning at their nearest health facility is appropriate if a full range of contraception and advice is available there, including the relevant commodities. » Consider testing to ensure that the messages are understood as intended and that any necessary colloquial translations are used. Consider the languages used for the content to reach the target audiences, including whether they are in active spoken or written use. Also consider anti-spam regulations and test that messages are not caught in spam filters. » Consider whether to include two-way communication with clients to enable their interaction and response to the health system.
CONSIDERATIONS *DURING* DEPLOYMENT	Pay attention to the circumstances of people who have poor access to electricity or poor network coverage, people who cannot afford a mobile device or voice and data charges, and people who have limited autonomy, because their access to phones is controlled by another person, for example. Give particular attention to the needs, preferences and circumstances of especially disadvantaged or hard-to-reach groups, including people with low literacy or few digital literacy skills, people speaking minority languages, migrant populations in new settings, people affected by emergency situations and people with disabilities, such as sight or hearing impairment. Ensure that any sensitive content or personal data transmitted and stored are held on a secure server with protocols in place for destroying the data when appropriate.
OPPORTUNITIES FOR INTEROPERABILITY AND LINKAGES TO OTHER DIGITAL HEALTH INTERVENTIONS	Link with the digital health record as a mechanism to tailor messages and content delivered to clients. Link with personal health tracking interventions, such as "access by client to own medical record" and "self-monitoring of health/diagnostic data client."
RISKS AND MITIGATION STRATEGIES	There is a risk of disclosing sensitive health content, particularly in the context of shared phones or when individuals do not have full access to their devices. Consider any demographic or health characteristics that could put the targeted population at greater risk and ensure that the way the information is provided and accessed is sensitive to this. Procedures need to be in place to ensure that individuals are not unduly pressured to provide personal information.

25 *Adapted from Classification of digital health interventions, 2018.*

ADDITIONAL RESOURCES	*mHealth mobile messaging toolkit*. PATH; 2014 (*https://www.path.org/publications/files/TS_mhealth_mobile_messaging_toolkit.pdf*). *Making content meaningful: a guide to adapting existing global health content for different audiences*. Johns Hopkins Center for Communication Programs; 2014 (*https://www.kmtraining.org/sites/default/files/supplement-making-content-meaningful.pdf*).

Considerations for cost categories for targeted client communication

Cost category	Description
ONGOING/ALL PHASES	
Governance	Personnel for partnership building and coordination meetings to align with stakeholders (such as Technical Working Group members, implementing partners and MNOs) Meeting costs (transportation, personnel time)
Management and staffing	Personnel to oversee overall programme Personnel for partnership building and coordination meetings to align with stakeholders (such as MOH counterparts, other implementing partners and MNOs) Personnel for routine system performance and delivery of communication content (such as monitoring read receipts and failures) Personnel to review incoming messages/calls, if there is bidirectional communication
DEVELOPMENT AND SETUP	
Content adaptation	Development/adaptation of health content to be communicated with clients, which may be developed by reviewing existing clinical guidelines to ensure that the health content is validated and from a trusted source; the adaptation process may require translating the content to the different health literacy levels and languages spoken among the targeted population, as well as ensuring optimal format and mode of delivery Adaption to the appropriate communication channel(s), which may include additional adaptations to the different communication channels: text-based communication (SMS, WhatsApp); audio communication, which can vary by dialect; or the use of visual aids (pictures, interactive features and videos) for less literate populations
Technology adaptation	Software customization for transmitting the communication content, which can include the frequency and logic of when communication content should be transmitted Short code setup, which represents a simplified number for clients to use when registering for the service Database to log incoming and outgoing communication exchanges End-user testing among targeted populations to ensure optimal end-user experience Refinement of the intervention in response to feedback from end-user testing to ensure that requirements and context are taken into account
DEPLOYMENT	
Outreach and raising awareness	Registration of clients to enrol in the service, which could be done through a number that clients can use to register/subscribe themselves to receive messages or through recruitment by health workers or other staff Dissemination to clients about the service and how to subscribe (such as pamphlets, billboards and/or SMS blasts)
Equipment/ hardware	Computers for monitoring system performance and uptake Server/cloud for storage of recorded calls, audio and images Mobile devices (often leveraging the devices that clients/individuals already own)

INTEGRATION AND INTEROPERABILITY	
Content adaptation	Content may be adapted to reflect direct linkages to medical records
Technology adaptation	Integration of client identification: unique client identification, ideally by means of a unique personal identifier, needs to be built into the system design and registration process to ensure the fidelity of message delivery; in some cases, a proxy identifier, such as a mobile phone number, is used where it can be ascertained that it is valid and consented Integration and interoperability standards, profiles and APIs to enable data integration and interoperability with other systems, such as client health records and call centres
Human resources	Personnel to implement system and data integrations to enable interoperability between communication systems and other national systems, such as medical records Personnel to monitor system and data integration to ensure merging of data between systems Personnel to ensure the ongoing maintenance of the integrated system and integration of data
SCALE	
Training and adaptive management	Additional training for ICT support staff to provide end-user support, troubleshooting, backup and recovery Periodic review meetings to discuss feedback on system performance and challenges
Human resources	Personnel for increased coordination with partners to follow up on software integrations and governance for unique identifiers Personnel for monitoring intervention coverage, particularly for hard-to-reach populations
SUSTAINED OPERATIONS	
Communication/ data exchanges	SMS, USSD, voice call and/or data transmission charges based on volume of communication content and communication channel
Technology maintenance	Software maintenance, updates and licence fees Short code maintenance fees

INTERVENTION 6: HEALTH WORKER DECISION SUPPORT

DESCRIPTION OF THE DIGITAL HEALTH INTERVENTION	Digitized job aids that combine an individual's health information with the health worker's knowledge and clinical protocols to assist health workers in making diagnosis and treatment decisions[26]
COMMONLY ASSOCIATED HEALTH SYSTEM CHALLENGES	» Poor adherence to guidelines » Inadequate supportive supervision » Lack of or inappropriate referrals » Insufficient supply (coverage) of qualified health workers » Insufficient health worker competence
CONSIDERATIONS *BEFORE* DEPLOYING	» Check the relevance and quality of the decision-support content (such as algorithms) and that it aligns with evidence-based clinical guidance, such as WHO or national guidance. This type of validation can be done through mechanisms like an independent review and using mock cases to test the intended output from the algorithms. Also consider built-in mechanisms to update content remotely as algorithms evolve. » Assess health workers' skills and knowledge to ensure that they have adequate capacity to obtain accurate data before input, to avoid erroneous outputs.
CONSIDERATIONS *DURING* DEPLOYMENT	» Make sure that health workers understand during training that the support provided is based on existing guidelines and policy. While health workers may deviate from the recommendations, they should be clear about their rationale for doing so. Where possible, enable cases to be documented in which health workers feel they need to deviate from the guidance proposed by the decision-support system. » Health workers should consider explaining the use of devices and seeking clients' permission before using them to improve the acceptability to patients of using digital decision-support devices. Patients should also be made aware that the information from the counselling may be saved and used at future visits to improve quality and continuity. Any concerns with acceptability may be mitigated by, for example, health workers showing the patient the inputs and results or listening to the messages or videos together so that the device does not become a barrier in the consultation. » Improve awareness among staff and supervisors about the value of portable devices, and develop ground rules or codes of conduct for when and how devices should be used.
OPPORTUNITIES FOR INTEROPERABILITY AND LINKAGES TO OTHER DIGITAL HEALTH INTERVENTIONS	Consider integrating decision-support tools with patient health records, such as digital health records for tracking clients' health status and services, to more easily incorporate the patient's health history. Consider integrating decision-support tools with digital tools for planning and scheduling health worker activity.
RISKS AND MITIGATION STRATEGIES	Issues with unvalidated or erroneous content/algorithms can result in poor quality of care. The underlying content needs to undergo thorough rounds of validation and testing and be rooted in reliable sources, such as national clinical protocols and global guidelines. Decision-support algorithms can be quite complex, so be sure to build in adequate time for testing all the paths of the algorithm with any changes to the software. Consider using automated tools for testing. Consider that following the algorithm may mean that health workers spend more time with clients (rather than skipping steps). This may result in frustration for health workers who have an increased workload and clients who face longer waiting periods. Share results of improved adherence to guidelines with health workers and explain the benefits of higher quality care to clients (to justify waits); in some settings, many of the follow-up visits may be eliminated because correct care is given the first time, thus ultimately saving the clients and health workers time. Referral linkages may need to be strengthened to support possible increases in the number of patients seeking care for previously undetected needs now being revealed by the decision-support system.

26 *Adapted from Classification of digital health interventions, 2018.*

Considerations for cost categories for health worker decision support

Cost category	Description
ONGOING/ALL PHASES	
Governance	Personnel for partnership building and coordination meetings to align with stakeholders (such as Technical Working Group members, implementing partners and MNOs) Meeting costs (transportation, personnel time)
Management and staffing	Personnel to oversee overall programme Personnel for system setup and end-user support (such as monitoring stability of software and appropriate functioning of algorithms and troubleshooting system failures)
DEVELOPMENT AND SETUP	
Content adaptation	Development/adaptation of decision-support pathways/algorithms based on clinical guidelines; national guidelines may not always be as clear as needed for programming, so an expert group may need to be engaged for clarity and consensus Validation of algorithms and decision-support logic to be embedded into the decision-support system
Technology adaptation	Software customization adapted to the validated decision-support logic End-user testing among targeted populations to ensure optimal end-user experience Refinement of the intervention in response to feedback from end-user testing to ensure that requirements and context are taken into account
DEPLOYMENT	
Equipment/ hardware	Devices (such as mobile phones, tablets and so on) for operating the decision-support software system used by the health workers Computers for monitoring system performance and end-user management
Initial training	Development/adaptation of training curricula and standard operating procedures for using the decision-support system Initial training for health workers interacting with the decision-support system
INTEGRATION AND INTEROPERABILITY	
Technology adaptation	Review and incorporation of policies related to identity management
Human resources	Software customization to enable interoperability with external systems, such as DHIS2 for aggregate-level reporting; these integrations are most commonly done through an API, which details the rules and protocols for communicating between different systems
SCALE	
Training and adaptive management	Additional training for ICT support staff to provide end-user support, troubleshooting, backup and recovery Periodic review meetings to discuss feedback on system performance and challenges
Human resources	Additional personnel for increased coordination with partners to follow up on software integrations and governance for unique identifiers

SUSTAINED OPERATIONS	
Refresher training and adaptive management	Refresher training for health workers interacting with the decision-support system Periodic review meetings to discuss feedback on system performance and challenges
Technology maintenance	Software maintenance and licence fees Hardware maintenance, including insurance and repair/replacement of hardware Ongoing adaptation and updating of decision-support logic as new clinical recommendations emerge

INTERVENTION 7: DIGITAL TRACKING OF CLIENTS' HEALTH STATUS AND SERVICES

DESCRIPTION OF THE DIGITAL HEALTH INTERVENTION	Digitized record used to capture, store, access and share health information on a client or grouping of clients, which may include digital service records, digital forms of paper-based registers for longitudinal health programmes and case management logs within specific target populations, including migrant populations[27]
COMMONLY ASSOCIATED HEALTH SYSTEM CHALLENGES	» Delayed reporting of events » Lack of quality/reliable data » Insufficient continuity of care » Delayed provision of care » Poor planning and coordination
CONSIDERATIONS *BEFORE* DEPLOYING	» Ensure that adequate policy and legal processes and protections, using either a card-based or biometric-based identifier, and telecommunications infrastructure are consistently available across facilities and programmes to provide accurate patient identification and facilitate the digital tracking of health services. » Consider whether the digital health records for tracking clients' health status and services have adequate infrastructural support to be maintained over time. Start-up costs and infrastructural requirements for a digital tracking system tend to be higher than for paper-based interventions. When used appropriately and effectively, the costs of digital health interventions are amortized, and cost savings may be realized in the long run. However, in contexts where basic health infrastructure is limited, including human resources like supervisors and managers, the digital tracking system may be very resource intensive.
CONSIDERATIONS *DURING* DEPLOYMENT	» Consider an incremental approach in transitioning from a paper-based data collection form to a digital form. Closely following the layout of the paper-based form in the digital format may reduce end-users' learning curve. Additionally, instead of creating an application that captures all disease or health areas simultaneously, consider a step-by-step approach, introducing end-users to modules gradually before adding new ones. » Improve awareness among staff and supervisors about the value of portable devices, and develop ground rules or codes of conduct for when and how devices should be used.
OPPORTUNITIES FOR INTEROPERABILITY AND LINKAGES TO OTHER DIGITAL HEALTH INTERVENTIONS	Link to unique identifiers, such as a local or national ID system, to provide a foundational digital identity that can facilitate longitudinal follow-up and linkages to other systems and digital health interventions; such unique IDs would help health workers search for clients and reduce the potential for duplicate registration of clients in community and facility systems. Link digital health records with decision support to enhance the delivery of care while maintaining the health record and tracking patient history. Integrate with commodity-reporting systems/LMIS to record supplies used during visits (rapid diagnostic tests, medicines, condoms distributed and so on).

27 *Adapted from Classification of digital health interventions, 2018.*

RISKS AND MITIGATION STRATEGIES	Health workers may face the added work burden of operating a dual system when using both a manual/paper-based system and the digital tool. Establish a plan or processes to replace manual/paper-based systems or account for the dual burden of managing these two systems. Consider local policies on digital identities when designing a programme to ensure that the programme does no harm. Digital tracking of individuals' health status may be controversial in some circumstances, such as among refugees or other groups who lack firm legal status in particular settings. The extent to which such groups may trust tracking depends on who is doing the tracking and how the information is likely to be used.
ADDITIONAL RESOURCE	*Electronic immunization registry: practical considerations for planning, development, implementation and evaluation.* Pan American Health Organization; 2018 (*http://iris.paho.org/xmlui/handle/123456789/34865*). *Handbook for digitizing primary health care: optimizing person-centred digital tracking and decision support systems.* World Health Organization; in print (*www.who.int/reproductivehealth/publications/handbook-digitalizing-primary-health-care/en/*)

Considerations for cost categories for digital tracking of clients' health status and services

Cost category	Description
ONGOING/ALL PHASES	
Governance	Personnel for partnership building and coordination meetings to align with stakeholders (such as MOH counterparts, other implementing partners and MNOs) Meeting costs (transportation, personnel time)
Management and staffing	Personnel to oversee overall programme Personnel for system setup and end-user support (such as monitoring stability of software and troubleshooting system failures) Personnel to monitor data generated by the system and provide feedback, corrective actions and so on
DEVELOPMENT AND SETUP	
Content adaptation	Mapping of healthcare cadres' workflows and responsibilities across the different levels of the health system, used to determine the content to be included in the system Development/adaptation of the data dictionary for the digital forms recording client health information in the system, which may include aligning the data-collection form with global data-coding standards, such as the ICD Development/adaptation of algorithms from clinical guideline recommendations, if being integrated with decision support
Technology adaptation	Software customization to adapt to the data-collection and decision-support needs Dashboards for monitoring the performance of the system and visualizing aggregated data End-user testing to ensure optimal end-user experience Refinement of the intervention in response to feedback from end-user testing to ensure that requirements and context are taken into account

DEPLOYMENT	
Equipment/ hardware	Devices (such as mobile phones and tablets) for operating the decision-support system used by the health workers Security features, such as end-user authentication schemes, passwords and data encryption for recording and sharing client health information Computers for monitoring system performance and viewing reporting dashboards
Initial training	Development/adaptation of training curricula and standard operating procedures for using the system Initial training for health workers interacting with the system Training for supervisory staff on standard operating procedures and continuous monitoring
INTEGRATION AND INTEROPERABILITY	
Content adaptation	Review and incorporation of policies related to identity management
Technology adaptation	Software customization to enable interoperability with external systems, such as DHIS2 for aggregate-level reporting; these integrations are most commonly done through an API, which details the rules and protocols for communicating between different systems
SCALE	
Training and adaptive management	Additional training for ICT support staff to provide end-user support, troubleshooting, backup and recovery Periodic review meetings to discuss feedback on system performance and challenges
Human resources	Personnel for increased coordination with partners to follow up on software integrations and governance for unique identifiers Personnel for monitoring intervention coverage, particularly for hard-to-reach populations
SUSTAINED OPERATIONS	
Refresher training	Refresher training for health workers interacting with the system Refresher training for supervisory staff on continuous monitoring and use of data emerging from the system Periodic review meetings to discuss feedback on system performance and challenges
Communication/ data exchanges	Data (such as 3G), SMS or wireless connection (or other forms of communication) for submitting data-collection forms
Content adaptation	Ongoing adaptation and update of decision-support logic as new clinical recommendations emerge
Technology maintenance	Server/cloud for storing data generated by the system, including a locked, air-conditioned physical space for the server; some contexts may store data in the cloud, which requires cloud-hosting fees Software maintenance and licence fees Hardware maintenance, including insurance and repair/replacement of hardware

INTERVENTION 8: DIGITAL PROVISION OF TRAINING AND EDUCATIONAL CONTENT TO HEALTH WORKERS

DESCRIPTION OF THE DIGITAL HEALTH INTERVENTION	Management and provision of education and training content in electronic form for health professionals; in contrast to decision support, health worker training does not need to be used at the point of care[28]
COMMONLY ASSOCIATED HEALTH SYSTEM CHALLENGES	» Insufficient health worker competence » Poor adherence to guidelines » Inadequate supportive supervision » Lack of or inappropriate referrals
CONSIDERATIONS *BEFORE* DEPLOYING	» Ensure that the information is from a source considered trustworthy and credible by health workers in your setting. For example, the information loaded on the mLearning system should be based on validated content or should align with national or WHO clinical guidance. » Ensure that the programme is end-user tested among health workers, both those in practice and those in training, to ensure that their needs and concerns are met. » Consider network capacity and coverage, especially if mLearning materials may be videos, which can be time-consuming to download in certain settings. » Consider usage needs of the mLearning content, as to whether or not you need to report on which resources are accessed more frequently than others, how many times and during what times of day, and then ensure that systems/applications can support these needs.
CONSIDERATIONS *DURING* DEPLOYMENT	» Improve awareness among staff and supervisors about the value of portable devices and develop ground rules or codes of conduct for when and how devices should be used to increase the acceptability of mLearning. » Consider if health workers can earn credits for continuing education using these materials as a way of increasing their uptake. » Involve the relevant professional bodies, including national certification or institutional boards, to ensure that the content of the mLearning programmes aligns with current scopes of practice and national training curricula for health workers.
OPPORTUNITIES FOR INTEROPERABILITY AND LINKAGES TO OTHER DIGITAL HEALTH INTERVENTIONS	Embed mLearning content on devices used by health workers for other digital health interventions to help maximize resources and enable health workers to access content on a routine basis. Link mLearning with human resource information systems to update certification of health workers.
RISKS AND MITIGATION STRATEGIES	Issues with unvalidated or erroneous educational and training content can result in poor quality of care. The underlying content needs to undergo thorough rounds of validation and testing and be rooted in reliable sources, such as national clinical protocols and global guidelines.
ADDITIONAL RESOURCE	Open Deliver [app]. mPowering Frontline Health Workers; 2018 (*https://partnerships.usaid.gov/partnership/mpowering-frontline-health-workers/*).

28 *Adapted from Classification of digital health interventions, 2018.*

Considerations for cost categories for mLearning

Cost category	Description
ONGOING/ALL PHASES	
Governance	Personnel for partnership building and coordination meetings to align with stakeholders (such as MOH counterparts, other implementing partners and MNOs) Meeting costs (transportation, personnel time)
Management and staffing	Personnel for system setup and end-user support (such as monitoring stability of software and troubleshooting system failures) Personnel to provide technical support related to exams and feedback on assignments
DEVELOPMENT AND SETUP	
Content adaptation	Development/adaptation of mLearning content in a digital format (videos and other forms of multimedia, for example), which may include adapting existing digital training modules or creating new modules based on validated health content or clinical guidelines and customization from global repositories of digital training materials; the adaptation process may also require translating the content to different languages or skill levels of targeted health workers
Technology adaptation	Software customization to incorporate the adapted training content to be transmitted End-user testing among health workers to ensure optimal end-user experience and alignment with workflows Refinement in response to feedback from end-user testing to ensure that requirements and context are taken into account
DEPLOYMENT	
Equipment/ hardware	Devices (such as mobile phones and tablets) for use by the health workers (if they are not using their own devices) Computers at the district and/or national level for monitoring system performance
Initial training	Initial training for health workers interacting with the system
INTEGRATION AND INTEROPERABILITY	
Technology adaptation	Software integration with accreditation databases held by healthcare professional councils or registration bodies Software integration with human resource information systems or registries
SCALE	
Training and adaptive management	Additional training for ICT support staff to provide end-user support, troubleshooting, backup and recovery Periodic review meetings to discuss feedback on system performance and challenges
SUSTAINED OPERATIONS	
Refresher training	Refresher training for health workers interacting with the system
Communication/ data exchanges	Data-transmission charges if the training content is not stored on the device or requires periodic updates
Technology maintenance	Software maintenance and licence fees Ongoing adaptation and updating of new training content Hardware maintenance, including insurance and repair/replacement of hardware

Annex 5.4 Illustrative considerations to mitigate data management risks

The following is a list of illustrative considerations to think through when mitigating risks associated with data management and protecting data privacy broken down by phases: before, during and after data collection. Note that this is not an exhaustive list, and it will have to be reviewed alongside national policies, where available. Please see *Chapter 5* for more information.[29,30]

BEFORE DATA COLLECTION

1	❒	Who is responsible and accountable for determining the purposes of data collection for this implementation or determining what personal data to collect from whom? Please provide the name(s) of the entity/entities (separated by semicolons), which may assist legal with updating any agreements.
2	❒	What is the purpose of collecting personal data and is it truly necessary?
3	❒	Will the personal data collected during the implementation serve multiple purposes (such as contact management and fundraising, assessment of eligibility for benefits and research and so on)?
4	❒	Who is the personal data about?
5	❒	Who will supply the data?
6	❒	What kind of personal data will you be collecting?
7	Will you be collecting any of these categories of special data?	
	a ❒	Association data (religious, political, trade association)
	b ❒	Racial or ethnic data
	c ❒	Biometric data
	d ❒	Genetic data
	e ❒	Criminal or disciplinary history
	f ❒	Health data
	g ❒	Sexual orientation, gender identity or sexual activity data
8	❒	Will any of the personal data be about key populations (for example, commercial sex workers, people who inject drugs or LGBTQIA) or other specific population groups, such as children and adolescents?
9	❒	Could the data realistically identify specific individuals, alone or in combination with other data sources?
10	❒	Would collection of these data put certain individuals or groups of individuals at risk of harm?

29 *Adapted from Ali J, Labrique AB, Gionfriddo K, Pariyo G, Gibson DG, Pratt B. et al. Ethics considerations in global mobile phone–based surveys of noncommunicable diseases: a conceptual exploration. Journal of Med Internet Research. 2017;19(5),e110. doi:10.2196/jmir.7326.*

30 *Adapted from UN High-Level Committee on Management. Personal data protection and privacy principles. United Nations; 2018 (https://www.unsystem.org/personal-data-protection-and-privacy-principles).*

11	Does your implementation involve any of the following technologies or any other technologies that appear to present a high risk to the rights of data subjects?	
	a	❒ Innovative technology like artificial intelligence
	b	❒ Automated processing of benefits
	c	❒ Social media networks or other online services for children
	d	❒ Large-scale profiling of data subjects
	e	❒ Biometric data
	f	❒ Genetic data
	g	❒ Data matching from multiple data sources
	h	❒ Invisible processing (processing significant amounts of data not obtained from the data subjects or their representatives)
	i	❒ Tracking data (IP or geolocation)
12	❒ What technological measures will be taken to ensure the data is secure (such as encryption)?	

DURING DATA COLLECTION

1	❒ How will you obtain and store the personal data?
2	❒ Where will personal data be stored?
3	❒ What measures will be taken to obtain informed consent?
4	❒ Who will own the data? Will the data subjects have access to their own data?

AFTER DATA COLLECTION

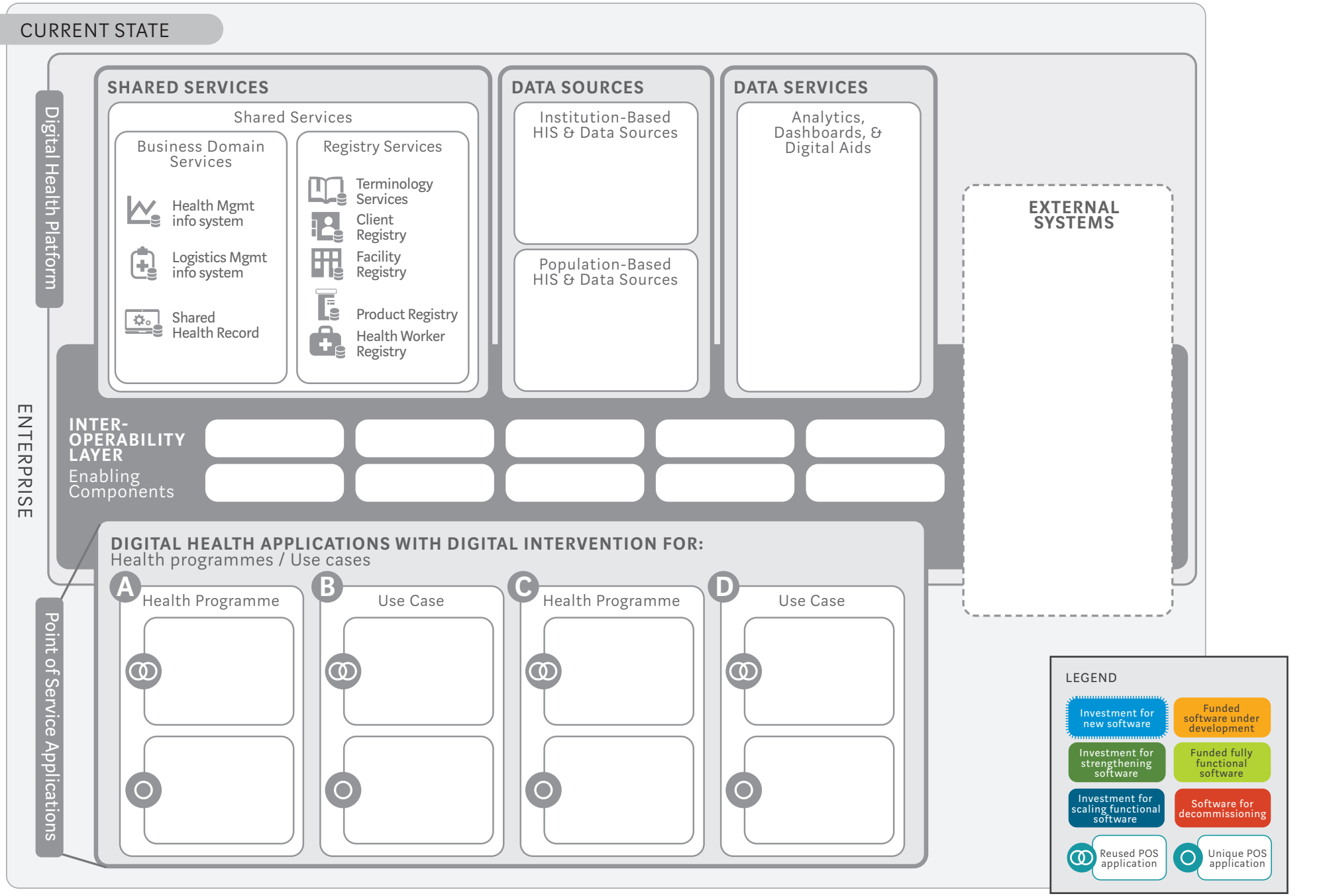
1	❒ Do you expect the personal data to move internationally? How will the data be processed? (This may possible require information notice or determine need for particular legal clauses.)
2	❒ Who will have access to personal data? Who will the data be shared with? How will the data be shared? (This may possibly require information notice or may determine new required legal agreements.)
3	❒ For how many years do you currently anticipate keeping the personal data?

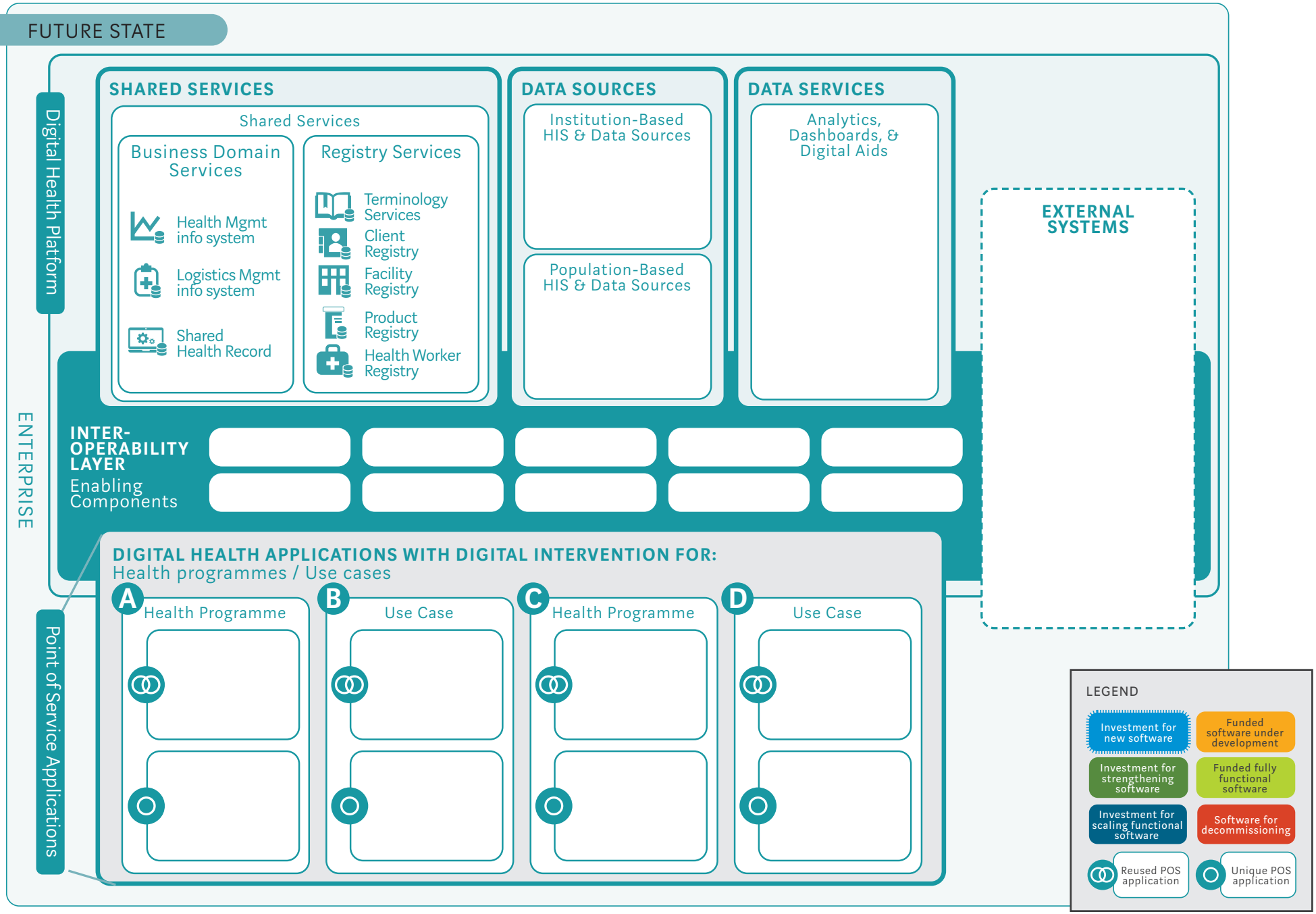
Annex 6.1 Linking digital health implementations to a national digital health enterprise architecture

This template aims to transition the digital health implementation that you have designed to one that links to the broader architectural requirements within an exchanged digital health system architecture.

The current state depicts how different systems are currently implemented, which may be as disparate applications that are siloed or at best paired directly with other applications.

In the future-state diagram, highlight planned new and emerging digital components that others are implementing, as well as the common and programme-specific functionalities that your system will focus on, specifying the applications as common services and interoperability requirements that your system will leverage or contribute towards.


CURRENT STATE
Digital Health Platform
ENTERPRISE
Point of Service Applications
SHARED SERVICES
Shared Services
Business Domain Services
Health Mgmt info system
Logistics Mgmt info system
Shared Health Record
Registry Services
Terminology Services
Client Registry
Facility Registry
Product Registry
Health Worker Registry
DATA SOURCES
Institution-Based HIS & Data Sources
Population-Based HIS & Data Sources
DATA SERVICES
Analytics, Dashboards, & Digital Aids
EXTERNAL SYSTEMS
INTER-OPERABILITY LAYER
Enabling Components
DIGITAL HEALTH APPLICATIONS WITH DIGITAL INTERVENTION FOR:
Health programmes / Use cases
A
Health Programme
B
Use Case
C
Health Programme
D
Use Case
LEGEND
Investment for new software
Funded software under development
Investment for strengthening software
Funded fully functional software
Investment for scaling functional software
Software for decommissioning
Reused POS application
Unique POS application


FUTURE STATE
ENTERPRISE
Digital Health Platform
SHARED SERVICES
Shared Services
Business Domain Services
Health Mgmt info system
Logistics Mgmt info system
Shared Health Record
Registry Services
Terminology Services
Client Registry
Facility Registry
Product Registry
Health Worker Registry
DATA SOURCES
Institution-Based HIS & Data Sources
Population-Based HIS & Data Sources
DATA SERVICES
Analytics, Dashboards, & Digital Aids
EXTERNAL SYSTEMS
INTER-OPERABILITY LAYER
Enabling Components
DIGITAL HEALTH APPLICATIONS WITH DIGITAL INTERVENTION FOR:
Health programmes / Use cases
A
Health Programme
B
Use Case
C
Health Programme
D
Use Case
Point of Service Applications
LEGEND
Investment for new software
Funded software under development
Investment for strengthening software
Funded fully functional software
Investment for scaling functional software
Software for decommissioning
Reused POS application
Unique POS application

Annex 7.1 Budget template

This template can be used to estimate costs across common cost categories outlined in *Chapter 7*. You may also consider reviewing *Annex 5.3* to identify costs for interventions for specific digital health interventions. A digital version may be downloaded here: *https://tinyurl.com/DIIGBudgetTemplate*.

Phase	Cost driver	Up-front versus recurring	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
 ONGOING/ ALL PHASES	Management and staffing	Recurring						
	Governance	Recurring						
 DEVELOPMENT AND SETUP	Software licensing cost per environment and per end-user	Up-front						
	Software customization, including adding additional languages	Up-front						
	Application installation and configuration	Up-front						
	Interoperability with other systems	Recurring						
	Hardware	Recurring						
 DEPLOYMENT	End-user testing	Recurring						
	Cost and availability of data connectivity and power	Recurring						
	Training	Recurring						
	Roll-out	Up-front						
 INTEGRATION AND INTER-OPERABILITY	Data collection and use	Recurring						
 SCALE	Any category that will be affected by expanding reach	Recurring						

Phase	Cost driver	Up-front versus recurring	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
SUSTAINED OPERATIONS	Voice and data services *(mobile data plan, Internet, number of text messages)*	Recurring						
	Hardware maintenance, ongoing administration and replacement rate	Recurring						
	Subscriptions	Recurring						
	Software maintenance *(fixing bugs, adding features, maintaining customizations)*	Recurring						
	Transfer of ownership	Recurring						
	Refresher training and additional training activities	Recurring						
	M&E and data-use activities	Recurring						
	Collective benefit, such as sharing learnings	Recurring						
		TOTAL						

Annex 8.1 Adaptive management checklist

This checklist includes specific adaptive management practices that you can integrate into your planning and implementation processes.

PLANNING

Budget for adaptive management	❒ Ensure there is a dedicated budget for time to implement your adaptive management processes. ❒ Allow for some flexibility in the overall budget to enable course correction as needed.
Engage stakeholders	❒ Identify key stakeholders and decision-makers, including data generators, data analysts, decision-makers reviewing progress and authorities who can authorize changes in plans and/or redirect funds as needed. ❒ Clarify mechanisms for coordination between stakeholders/decision-makers (such as technical working groups). ❒ Develop a communications plan.
Design a learning log	❒ Design a learning log and other knowledge management platforms based on the communications plan.
Establish and refine digital health intervention goals and objectives	❒ Articulate the expected outcomes, goals and objectives of your digital health intervention; this process typically takes place during M&E planning and can usually be taken directly from the M&E plan.
Develop and refine a theory of change	❒ Develop an evidence-based theory of change articulating your hypothesis for how change will happen throughout the life of your digital health intervention in order to achieve each goal and objective. Clearly map your evidence-based assumptions on how inputs and activities will lead to expected outputs and outcomes. This step is also typically part of designing a monitoring plan, and you may not need to develop this from scratch.
Map areas of uncertainty within the theory of change for each objective	❒ Identify areas where there may be risks to implementation fidelity or where achieving desired outcomes may be uncertain given implementation or contextual factors. ❒ Identify specific stakeholders and decision-makers to engage in discussions on these areas of uncertainty.
Plan intentional pause-and-reflect cycles. Identify time points and milestones when progress will have to be verified and course corrections will need to be made	❒ Schedule regular times to pause and reflect on implementation data and progress. ❒ Schedule appropriate data review meetings or technical working group meetings well in advance to ensure that necessary stakeholders will be able to attend. These may include routine meetings (like quarterly team meetings) prior to work planning, at a point in time when an identified risk may occur or directly after major deliverables have been completed.

From the M&E plan, identify and map monitoring measures and specific assessments required to assess implementation fidelity, whether outputs are being realized and if risks are arising that need to be mitigated	❒ Identify the feedback frequency that is feasible to allow for rapid identification of potential issues. ❒ Find the appropriate balance between rigorous and rapid methodologies for feedback. Frequency and rapid feedback need to be balanced with understanding the burden of collecting, analysing and reporting back those data.
Develop matrix of alternative options and costs	❒ For areas of uncertainty or risk, identify the appropriate decision-makers to engage, alternative implementation options and critical costs associated with the alternatives. ❒ Costing may be time-consuming, so if resources are constrained at implementation-planning stages, at least clarify the process for developing this matrix of alternative options and costing those options.
Develop adaptive management flow; articulate the steps to get from decision to action	❒ Map decision-flow processes, identifying who needs to be informed, how and if budgets need to be adjusted, who has authority to make decisions and when those decisions will be acted upon regarding different areas of uncertainty.

IMPLEMENTATION

Monitor and assess interventions to determine performance	❒ Implement the routine monitoring and assessments articulated in the M&E and adaptive management plans.
Pause and reflect on data regularly	❒ Conduct data review meetings. ❒ Provide feedback to appropriate decision-makers at the appropriate decision milestones to verify if things are on track or determine if course corrections are needed. ❒ Define recommendations and action steps needed based on data review.
Take evidence-based action	❒ Engage necessary actors to make decisions and approve any needed adjustments. ❒ Make evidence-based adjustments and course corrections. ❒ Adapt the implementation as required, and be sure to update any necessary assessments or monitoring measures needed to track the new implementation plan.
Document findings and learnings in a learning log	❒ Keep a record of lessons learned along the way. A learning log can be used to track issues identified, data reviewed, decisions made and course corrections needed and acted upon.
Repeat and continue to monitor, reflect, adapt, document and learn throughout the life cycle of the implementation	

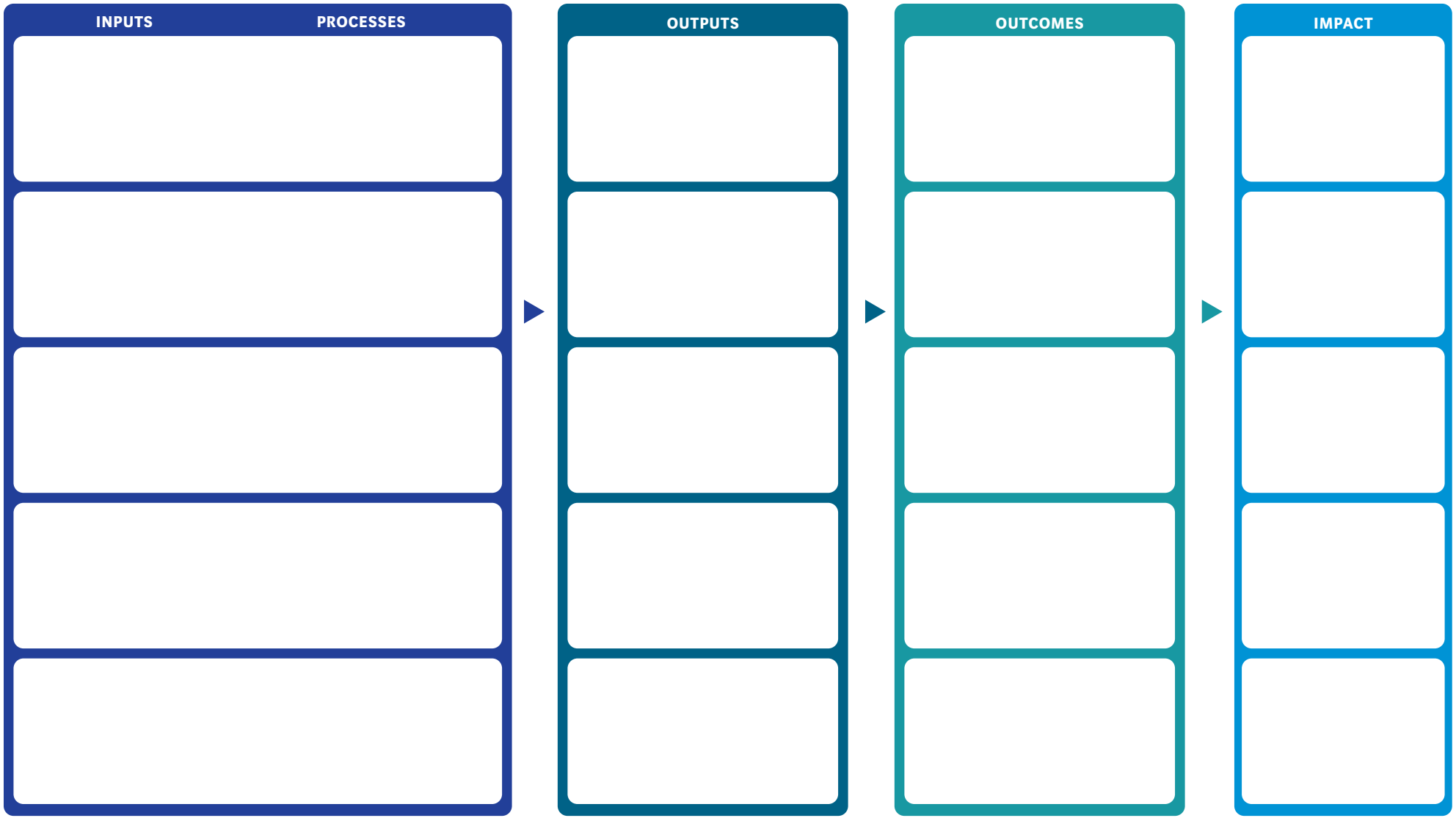
Also see the following additional resources:

» Guidelines for adaptive management: outcome of the OzAM 2003 workshop, Brisbane. University of Queensland School of Natural and Rural Systems Management; 2004 (*https://espace.library.uq.edu.au/view/UQ:84380*).

» PIMPAC adaptive management guidance. Pacific Islands Managed and Protected Area Community; 2018 (*https://data.nodc.noaa.gov/coris/library/NOAA/CRCP/NMFS/PIRO/Projects/427/PIMPAC2018_Adaptive_Management_Guidance.pdf*).

Annex 8.2 Logic model template

Logic models link inputs (programme resources), with processes (activities undertaken in the delivery of services), outputs (products of processes), outcomes (intermediate changes) and impact. You can use the template below to map out the different inputs, processes, outputs and outcomes, including the specific indicators you will use to measure your outputs and outcomes.



World Health Organization

PATH

UNFPA

unicef
for every child

human reproduction programme hrp
research for impact
UNDP · UNFPA · UNICEF · WHO · WORLD BANK

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