CDC Global Digital Health Strategy

May 2022

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Sections highlighted in dark blue correspond to high-level descriptions and key takeaways of the strategy.

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FOREWORD

Lack of timely, accurate data has long hampered global efforts to combat and prevent disease. The global response to COVID-19 has brought greater attention to these challenges, underscoring the global community's vulnerability to infectious disease.

To better prepare for response to future threats, CDC has launched the Data Modernization Initiative (DMI), to improve the quality, availability, and use of pandemic and response-related data. While DMI's main focus is domestic, DMI's principles, products, and impacts will apply globally. The best way to stop diseases from spreading globally is to detect and contain them early, in the countries in which they originate. One way to support this effort is to have accurate and timely data generated by country health systems, as part of routine individual and public health service delivery. Many countries are pursuing this goal under the title of "digital transformation" or "digital health" and these efforts are being actively supported by global organizations and other donors.

While the application of digital tools to health service delivery has been undertaken for several years in lower- and middle-income countries, large-scale success and uses have been limited. Health systems are complex and constantly adapting. They are composed of chains of many linked services and digitally "fixing" one broken link in a chain of multiple broken links is not going to yield success. In recognition of this complexity, many countries are now taking an "enterprise approach" to health systems, looking at the health system more holistically, addressing key issues including digital literacy and data governance, and organizing and allocating resources more effectively across the entire system. This enterprise approach is also being supported by global stakeholders as part of the digital transformation paradigm.

The essence of this document then, is a collective roadmap shared by CDC and other global partners, to better align efforts and support countries in deploying enterprise approaches to realize the digital transformation or digital enablement of health services. This will not only benefit in-country health service delivery, reducing morbidity and mortality, but also provide disease experts globally with additional data sources to more effectively combat and control future outbreaks.

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LIST OF ABBREVIATIONS

AeHIN	Asian eHealth Information Network
AI	Artificial Intelligence
CDC	Centers for Disease Control and Prevention
CGH	Center for Global Health
CIO	Chief Information Officer
DHP	Digital Health Platform
DMI	Data Modernization Initiative
EA	Enterprise Architecture
EAC	East African Community
GDHS	Global Digital Health Strategy
HNSF	Health Normative Standards Framework for Interoperability in eHealth
ICT	Information Communication Technology
ITU	International Telecommunications Union
PAHO	Pan-American Health Organization
PEPFAR	President's Emergency Plan for AIDS Relief
SDG	Sustainable Development Goals
USAID	United States Agency for International Development
USG	United States Government
WHO	World Health Organization

DEFINITION OF TERMS

In the context of this strategy, these terms have been defined as follows:

Digital Component	Digital components are both software and hardware systems that are developed and deployed to support public-health programs, the delivery of health services, and other areas such as animal health, border health, and environment.
Digital Enablement	Digital enablement is the utilization of digital components to improve the efficiency of public health, health care services, and data-driven decision making.
Digitally Enabled Service	Digitally enabled services are those for which digital information communication technology (ICT) play a role in facilitating the provision and delivery of the service.
Digital Health	Digital health refers to "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."[1] Digital health supersedes concepts such as eHealth and mHealth.
Digital Transformation	Digital transformation is "the digitization of paper-based systems, as well as the accompanying change-management – sometimes referred to as 'digitalization' – of business practices or government or institutional policies, processes, capacities, and workflows to use digitized systems and data effectively. In addition to this digitization and digitalization, digital transformation accounts for the human behavioral and institutional cultural adaptations required to support the successful uptake and use of digital systems, and digital data and information, as part of a routine course of business."[2]
Enterprise Architecture	Enterprise architecture is "a blueprint of business processes, data, systems, and technologies used to help key stakeholders design increasingly complex systems to support the workflow and roles of people in a large enterprise, such as a health system."[1] This approach helps to address a problem holistically, reducing fragmentation and increasing efficiencies while reducing costs. This ensures the enterprise can sustainably support, integrate, and adopt existing and future interventions.
Enabling Environment	An enabling environment encompasses "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."[1]

Global Health Community

The global health community consists of a wide variety of actors at a local, regional, and global level. These include actors specifically focused on healthcare and public health, such as national, state, and local public health and health-care authorities, health professional institutions, academic institutions, and insurers. This extends to areas including animal health, border health, and environment. Actors outside of the health sector can also be participants in the global health community and include private sector service providers, telecommunications ministries, and education institutions. (Adapted from the *WHO/ITU National eHealth Strategy Toolkit.*)[3]

This is sometimes referred to as the global digital health community.

Digital Global Goods

"Digital public goods are open-source software, open data, open AI models, open standards and open content that adhere to privacy and other applicable best practices, do no harm and are of high relevance for attainment of the UN's 2030 Sustainable Development Goals (SDGs)."[4]

Interoperability

Interoperability is "the ability of different information systems, devices and applications (systems) to access, exchange, integrate and cooperatively use data in a coordinated manner, within and across organizational, regional, and national boundaries [as well as sectors], to provide timely and seamless portability of information and optimize the health of individuals and populations globally."[5]

Maturity Model

A maturity model "measures the 'as is' status of a process or set of processes and describes the critical components of a process believed to lead to improved outcomes. The model usually has a certain number of levels that describe the evolution of these processes."[6]

Reference Implementation

A reference implementation is the "implementation of a specification that serves as the standard, definitive form from which all other implementations are measured."[7]

Shared Digital Platform(s)

A shared digital platform is information infrastructure (infostructure) on which digital health and other sector applications are built to support consistent and efficient service delivery. The infostructure comprises an integrated set of common and reusable components that support a diverse set of digital applications. The components consist of software and shared information resources to support integration with new and existing systems, data definitions, and exchange standards for interoperability and to enable the use of point-of-service applications across program areas and use cases. (Adapted from the *Digital Implementation Investment Guide.*)[1]

Use Case

A use case describes the desired response of a system when it interacts with the requests of an actor. The actor may be a human, hardware, or another system. (Adapted from *Federal Agencies Digital Guidelines Initiative.)*[8]

An example of a global use case could be the collation of COVID19 data points from multiple countries. An example local use case could be the collection of HIV viral load information for adherence monitoring at country level. The repositories would reference the required data points and workflows.

1. INTRODUCTION

1.1 THE IMPORTANCE OF CREATING AN ENABLING ENVIRONMENT

A health threat anywhere is a health threat everywhere. Preventing, detecting, and responding to infectious disease threats globally has never been more important. Globalization has led to increased trade and travel, allowing new and emerging infectious diseases to spread exponentially, as highlighted by the COVID-19 pandemic.

The concept of **global health** embodies this increased interconnectivity as it is "an attempt to address health problems that transcend national boundaries, may be influenced by circumstances and experiences in other countries, and are best addressed by cooperative actions and solutions."[9] Within CDC, global health is addressed through multiple national centers including Center for Global Health (CGH), as well as other relevant programs and offices across the entire agency.

For instance, the CDC's One Health approach,[10] which is collaborative and multi-sectoral in nature, works towards achieving optimal health outcomes while recognizing the interconnection between people, animals, plants, and their shared environment, which has led to the spread of existing and new diseases. Within CDC, One Health leadership and coordination is provided through CDC One Health Office in the National Center for Emerging and Zoonotic Infectious Diseases (NCEZID).

DEFINITION: GLOBAL HEALTH

Global health is an attempt to address health problems that transcend national boundaries, may be influenced by circumstances and experiences in other countries, and are best addressed by cooperative actions and solutions.

Despite an increase in importance and reference, it should be noted that a standard and internationally accepted definition for global health is lacking.

THE LINK BETWEEN DIGITAL ENABLEMENT AND DIGITAL TRANSFORMATION

Digital enablement is the use of digital components to improve the efficiency of public health, health care services, science, research, and data-driven decision making.

Digital transformation is a broader concept that includes the associated workflow processes, governance structures, operational requirements, and capacity needed to achieve digital enablement. (Discussed more in Section 3.)

Together, CDC's multiple programs that focus on global health contribute to the safety and security of everyone's health. Therefore, strengthening public health systems across the globe must be a top priority for a prosperous, safe, and healthy global population. **Digital enablement** of healthcare services and other sources of relevant data advances health equity and is an essential part of this vision.

Digital health has shown its potential for transforming the collection, sharing, and use of data for key healthcare and public health capabilities. It underpins efforts towards health equity science to eliminate, rather than simply documenting, inequities by establishing systems to collect data and investigate the underlying contributors to health inequities. This in turn contributes to an increase in the amount of available, timely, quality data for patient care, population-level health management, disease surveillance, public health interventions, healthcare financing, and scientific research. By having timely, country-level, sub-regional, and regional data available, disease outbreaks are detected and responded to more rapidly, epidemic detection and response is enabled, and global health security is strengthened by preventing disease spread, both globally and to the United States.

DEFINITION: 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]
– Adopted from USAID's *A Vision for Action in Digital Health*

U.S. GOVERNMENT STATEMENT ON DIGITAL HEALTH

The U.S. government recognized the potential of digital health and the importance of developing and aligning with country digital health strategies in a statement made at the meeting of the World Health Organization (WHO) Executive Board in January 2018.

"To overcome challenges of fragmentation and duplication of digital health systems around the world, greater coordination is needed, including among public and private funders.

Recommendations include:

- First, that countries create and support the implementation of a digital health strategy reflecting priorities identified in the countries' national health strategies;
- Second, financiers align their efforts on digital health with national digital health strategies. Where country-focused digital health strategies do not yet exist, their development should be prioritized;
- Third, that countries strengthen a digital health-**enabling environment** including support for capacity building and governance with a focus on privacy, accessibility, use of data and data systems;
- Fourth, that investments align with a country's progression along the digital health continuum – starting with moving from paper to digital, culminating with a country's transition to independent management of digital health technologies; and
- Fifth, that digital health can be a powerful tool for public health surveillance. It is important to understand a host nation's infrastructure and capacity to implement effectively and manage these technologies, and to use the data that they produce. mHealth should be used appropriately depending on the context of an emergency, noting that in some situations, use of mobile technologies could put healthcare workers at increased risk, due to security issues.[2]

CREATING A PARADIGM SHIFT

Data underpins all core CDC activities, including its scientific research and evidence-based approaches to epidemiology and surveillance. In keeping up with the fast-paced evolution of technology, CDC will continue to evolve and adapt its methods for data science. However, a paradigm shift is needed that will allow the field of public health to modernize data use to support timely information sharing and decision making. This strategy advocates for a paradigm shift across global health that will create a world where:

- **Global, regional, and local (e.g., community-level) digital health stakeholders work in partnership** and collaboration to achieve and maintain ethical[i] digital enablement of public health, health services delivery, animal health, environmental activities, and other relevant data.

- **Data** are derived from and/or generated by health services delivery, public health, environmental and animal health data, and other sources (e.g., population movement), with the automated data abstraction from primary sources supplementing the current body of data being collected. This would allow surveillance activities to be automated and timely data to be used routinely by clinicians, public health, animal health, and border health officials, decision-makers, and researchers for disease monitoring, policy development, programmatic, public health response, and evaluation.

- **Emergency preparedness and response teams** are focused on building country and global resilience to health threats and have access to timely data, allowing them to quickly detect, respond to, and contain disease outbreaks.

- **Laboratory services** are interoperable with other health systems and sectors, and data across those systems are integrated, allowing for the secure exchange of data and ensuring timely access to laboratory data for public health activities, identification of causal pathogens and source attribution (such as response to outbreaks), and clinical decision making.

- **The public health and multisectoral workforce** has access, expertise, and capacity to understand, interpret, and act on timely data. The workforce is able to design, develop, implement, and evaluate digital health systems and lead the creation of an enabling environment for digital health implementation. Decision makers have access to workforce

[i] *See text box on page 26 regarding the ethics of designing and using digital technology.*

data, allowing an understanding of the workforce composition, workforce gaps and needs, and skills requirements.

- **Data integration** allows data from multiple sources (such as health clinics, laboratories, and community services) and areas such as animal and border health, to be combined and used for analysis and public health response. Integrated data is available to all sectors and at all levels of government to improve outcomes from patient level care to early identification of outbreaks or spillover events.

- **Data sharing** among global health stakeholders at all levels allows for near-term analysis of essential data from various sources for the identification of large-scale issues, disease outbreaks, spillover events, trends, and outliers in priority health programs. Data sharing is essential for global digital health to reach its full potential, making the establishment of data-sharing agreements and data sovereignty high-priority policy issues to be addressed by the global health community. Data and data sharing also contribute to predictive analysis of public health risk and can be used to inform resource allocation and response measures.

- Holistically designed **digitally enabled services** improve health equity by strengthening public health efforts through better use and access to relevant health and non-health data that can inform science, interventions, policies, and decision making.

AN OPPORTUNE MOMENT

Trends in Global Health

In recent years, there has been increased coordination across various global health partners, focused on aligned investments, shared best practices, and the integration of **digital components** into public health programs. The importance and urgency of coordination has been further accentuated by the devastating global effects of the COVID-19 pandemic. Heads of state and international agencies have acknowledged that addressing global health threats *cannot be done alone* and have called for building a more robust and integrated global health architecture that will better prepare regional, sub-national, and district-level public health partners to predict, prevent, detect, assess, and effectively respond to health threats.[11]

Publication of Digital Health Resources (Guides and Toolkits)

In addition to the pursuit of country, regional, and global health objectives, there is also a growing body of published resources that cover the full spectrum of planning and implementing digital interventions. These resources include a range of topics from investment approaches, strategy development, design and implementation of digital interventions, and monitoring and evaluation (M&E). Examples of these resources, which have also influenced the development of this strategy, can be found in the reference section.

Emergence of Strategic Planning for Digital Health

A 2016 survey by the World Health Organization (WHO) Global Observatory for eHealth indicated that 73 countries reported having eHealth[ii] strategies at various stages of implementation and maturity.[12] This showcases the growing number of country-specific digital health strategies, with global development organizations similarly developing their own digital-specific strategies. Both the U.S. Agency for International Development (USAID) [13] and WHO[14] have recently released global digital strategies, with USAID additionally publishing *A Vision for Action in Digital Health.*[2]

CDC has recently published several strategies that focus on public health data modernization.[15] These strategies contribute to and recognize the need for **digital transformation** of the public health mission. They are discussed in more detail in Section 4.

Pursuit of a Coordinated Approach and Global Unifying Health Objectives

The United Nations Sustainable Development Goals (SDG),[16] WHO Triple Billion Targets,[17] and the movement towards universal healthcare coverage (UHC)[18] create a political imperative for achieving digital enablement, as these shared global goals requires a holistic, coordinated approach across multiple sectors, including health.

Global health partners have come to understand that increased coordination improves implementation of country digital systems and improves the availability, timeliness, and quality of data for decision making. Partners, including CDC, have endorsed The Principles of Donor Alignment,[19] which encapsulates the need for collaboration, alignment with national strategies, and investment in **global goods.**

While donors endorse these principles, they are abstracted from implementation and can be difficult to put into practice. It is also challenging to evaluate whether a program has taken them into account. The strategic approach outlined in this document is a step towards addressing the gap between principles and implementation. By calling for an end to a fragmented approach through a set of proposed shared goals and objectives, and through active coordination and collaboration, CDC and its partners can align their work for greater impact.

[ii] *Digital health supersedes concepts such as eHealth and mHealth. The use of eHealth here and in other parts of the strategy have been used to ensure the integrity of referencing.*

THE URGENCY OF PANDEMIC PREVENTION

While COVID-19 accelerated the development and use of digital technology for the provision of certain health services such as telemedicine,[20] it also emphasized vulnerabilities in healthcare services and public health activities globally.[21,22] Digital health systems and processes had to be developed to accommodate COVID-19 reporting requirements and the exchange of critical health information. Access to timely, accurate, and relevant health data is key to responding to outbreaks and emerging disease threats, and a well-trained global workforce capable of interpreting and acting on data is key for timely response. The learnings from COVID-19 are still emerging, but initial commentary from world leaders[11] indicates that in order to predict and prevent future pandemics, the **global health community** needs to better align and coordinate to build a more robust health architecture in countries, regionally (such as regional bodies and CDC Regional Offices), and globally.

DEFINITION: GLOBAL HEALTH COMMUNITY

The global health community consists of a wide variety of actors at local, regional, and global levels. These include actors focused on healthcare and public health, such as national, state, and local public health and healthcare authorities, health professional institutions, academic institutions, and insurers. Actors outside of the health sector can also be participants and include animal health and environment ministries, border health, private-sector service providers, telecommunications ministries, and education institutions.[3]

1.2 DEVELOPING THE CDC GLOBAL DIGITAL HEALTH STRATEGY (GDHS)

THE VALUE OF DEVELOPING THE CDC GDHS

CDC builds capacity to better prevent, detect, and respond to existing and emerging health threats to reduce morbidity and mortality around the world. There are CDC headquarters and country-based programs operating in over 50 countries that bring significant subject-matter expertise, and the entire organization manages millions of dollars annually in global health funding. [23]

This Global Digital Health Strategy (GDHS) aligns with the CDC Global Health Strategy and allows CDC staff and partners to understand CDC digital health priorities and the role they will play in the development, support, and use of digital health services globally. In so doing, it will serve to address challenges in the digital health space – especially those related to the duplication of data; system silos; poor data governance, protection, and privacy; a lack of standards, **interoperability**, and supporting infrastructure; and workforce capacity.

Critically, this strategy will also support the alignment of internal initiatives and coordination of investments across CDC centers, regional offices, and country offices. Most notably it aligns with CDC's Global Health Equity Strategy's goal to implement standard health equity measures that will be integrated into CDC global data collection efforts and used to reach epidemic and accelerated disease control, and disease eradication and elimination among known and unknown marginalized populations. The goal leverages this strategy to strengthen data collection, develop and improve health equity indicators, and support workforce and system resilience with a health equity lens. This strategy will also serve to drive the internal development of the workforce skills and organizational capabilities necessary to implement the strategy, support countries, and inform relevant domestic policy. (See Section 4.3 for more information on synergies with DMI.)

Many global partners are aligning around the concept of **digital transformation**, which is the incorporation by countries of digital infrastructure and adoption of relevant technologies that allow, among other things, for the secure, robust, delivery of standardized data at scale across many points of care and sectors. CDC is a key player in utilizing data for informing public health action and, as such, has a role to play in supporting digital transformation in global health. This strategy strives to depict how CDC, in concert with other global partners and host governments, can enable and enhance the digital transformation process in countries and in regions.

HOW THIS STRATEGY WAS DEVELOPED

The strategy was developed through a consultative and collaborative process over the course of 11 months, with the following activities being completed as part of the development process:

- A desk review of strategic documentation both internal to CDC and produced by other donors and public health organizations
- Individual and group workshops and sessions with over 70 CDC staff from various levels and centers, institutes, and offices (a full list can be found in the appendix)

The strategy was drafted based on the wide range of inputs from these activities coupled with expert knowledge on digital health. The draft was then used to solicit feedback from internal and external partners for incorporation into the final strategy.

WHAT IS IN THE STRATEGY

The following sections articulate the CDC GDHS. Section 2 offers an overview of the purpose and goals, while Section 3 delves into the strategy's rationale, detailing how digital enablement contributes to maximum impact of health service delivery. Section 4 introduces the global unifying health goals, objectives, and CDC-specific strategic approaches for achieving the CDC GDHS, with associated risks found in Section 5. Finally, Section 6 provides guidance on next steps to realizing this strategy. Further detail on illustrative CDC-specific activities can be found in the appendix. These activities speak to both tactics and focus areas that would benefit the CDC significantly (for instance, three distinct activities related to cybersecurity in the context of cloud computing and hosting services).

2. MOTIVATION FOR THE CDC GDHS

This CDC strategy aims to improve the state of global digital health and accelerate the achievement of country-level digital enablement of health systems in support of public health, healthcare service delivery, health equity goals, science, disease detection and response, and research priorities, through a coordinated, global approach. It provides the first steps of a strategic road map for digital transformation that engages relevant CDC staff and programs, as well as other country-level and global public and private partners. Thus, this document represents not just an agency-wide CDC strategy, but rather a proposed collective strategy for the broader global digital health community, in which CDC plays a key role.

Other partners will be asked to contribute, and, as a data-driven agency and world-renowned leader in public-health science, CDC can provide leadership in its areas of strength – defining, accessing, sharing, and using health data for global health protection.

This strategy serves as a call by CDC and the global health community to rally around a set of proposed, shared goals and objectives, where the achievement of each goal depends on collective commitment and action.

2.1 PURPOSE AND GOALS OF THE CDC GDHS

With the growing trends of digital enablement and improved coordination, the purpose of the CDC GDHS is to articulate a dual-purpose approach (Figure 1) that looks at how digital health can accelerate the achievement of CDC's global and domestic missions as well as at how the organization can help to maximize the impact of digital health globally.

Figure 1: Mutually Supportive Purpose

Given this dual purpose, four pivotal strategic goals have been identified to guide this document. These goals should be viewed in both global, regional, and specific country contexts, and once achieved, will transform global health.

- **Goal 1:** Protect global health security by enabling timely access, protection, and use of high-quality, shared country data with global health community and practitioners in sectors such as environment and animal health.
- **Goal 2:** Implement data-driven public health and healthcare workflows, decision making, supervision, and programs that improve delivery of services, health outcomes, science, and research.
- **Goal 3:** Improve ability to collect, secure, and analyze quality data in service of strengthening health programs to improve effectiveness, including cost and access to services, via digital enablement.
- **Goal 4:** Provide secure information communication technology (ICT) infrastructure, accessible as appropriate to all users, sectors, and service providers.

These goals are applicable not only for CDC, but for the global digital health community at large. (See Sections 3 and 4 for further information including the impact these goals will have on global health and how they align with existing partner visions.)

HOW DIGITAL HEALTH CAN ACCELERATE THE ACHIEVEMENT OF CDC'S GLOBAL AND DOMESTIC MISSIONS

To protect the U.S. and the global community, there is a need to effectively detect, respond to, and prevent disease threats globally. Ultimately, this relies on robust country health systems, where countries can scale public health programs and service delivery as well as science and research programs more effectively and, in so doing, generate valuable individual- and population-level health data, augmented by service delivery, animal health, border health and environmental data that can support public health surveillance, response, mitigation, and program delivery activities.

Digital enablement is one of the most fundamental drivers of this transformation. Once data are available when and where they are needed, they can be used by country and global health systems as well as all relevant stakeholders (i.e., global, country, and domestic) to support better decision making across a wide spectrum of health services and sectors, including enhanced capabilities for preparing and responding to health threats that may affect the U.S. and other countries. This makes the realization of global and country-level digital enablement a critical success factor for the achievement of CDC's Global Health Strategy vision and mission.

VISION	MISSION
CDC aspires to create a world where people – in the United States and around the globe – live healthier, safer, and longer lives.	CDC's global health mission is to improve the health, safety, and security of Americans while reducing morbidity and mortality worldwide.

HOW CDC CAN HELP TO MAXIMIZE THE IMPACT OF DIGITAL HEALTH GLOBALLY

To achieve this comprehensive digital enablement, development must be done in coordination and partnership with others. It is only through global, regional, and country partners working collaboratively and collectively that digital transformation in a country can occur, and the desired health outcomes, such as more effective public health, reduced morbidity and mortality, improved multi-sectoral engagements, and more robust global health security, can be realized. This momentum towards digital enablement already exists among global partners.

A MOVE TOWARD COUNTRY-LEVEL DIGITAL ENABLEMENT BY GLOBAL PARTNERS

Global partners are strategically orienting their efforts in support of country-level digital enablement.

The USAID *Digital Strategy 2020-2024*[13] (page 3) states:

The U.S. Agency for International Development (USAID) Digital Strategy (2020-2024) will position the Agency to advance our mission – to end the need for foreign assistance – through digitally supported programming that fosters the Journey to Self-Reliance in our partner countries and maximizes the benefits, while managing the risks that digital technology introduces into the lives of the communities we serve.

The WHO *Global Strategy on Digital Health 2020-2025*[14] (page 7-8) states:

With the recognition that information and communications technologies present new opportunities and challenges for the achievement of all 17 Sustainable Development Goals, there is a growing consensus in the global health community that the strategic and innovative use of digital and cutting-edge information and communications technologies will be an essential enabling factor towards ensuring that 1 billion more people benefit from universal health coverage, that 1 billion more people are better protected from health emergencies, and that 1 billion more people enjoy better health and well-being (WHO's triple billion targets included in its Thirteenth General Programme of Work, 2019-2023).

The WHO[14] further states (page 8):

Digital transformation of health care can be disruptive; however, technologies such as the Internet of things, virtual care, remote monitoring, artificial intelligence, big data analytics, blockchain, smart wearables, platforms, tools enabling data exchange and storage and tools enabling remote data capture and the exchange of data and sharing of relevant information across the health ecosystem creating a continuum of care have proven potential to enhance health outcomes by improving medical diagnosis, data-based treatment decisions, digital therapeutics, clinical trials, self-management of care and person-centered care as well as creating more evidence-based knowledge, skills and competence for professionals to support health care.

ACHIEVING DIGITAL ENABLEMENT

Digital enablement is required throughout health service delivery and sectors, including environment and animal and border health, to achieve comprehensive health services and public health services for all.

As noted in numerous donor strategies (e.g., USAID, WHO), historically, some digital health systems have been developed in vertical, fragmented siloes. This has led to the proliferation of duplicate, non-interoperable systems, increased reporting requirements for frontline healthcare workers (due to information fragmentation), and reduced exchange of valuable health data. To fully achieve digital enablement and to meet the requirements of a range of stakeholders, from decision makers and sector-specific practitioners to frontline health workers and patients, digital health needs to be implemented cost-effectively, with interoperability across existing and new systems, at scale, across the health sectors.

There is an emerging recognition that health systems at country, region, and global levels that utilize **shared digital platforms** can systematize the scaling of digital enablement by leveraging common assets to meet various needs across health and non-health programs and sectors.7,8 Having such platforms can help ensure the availability of the right data at the right time to the right actors, improve patient care and public health programs, enable epidemic detection and response, and provide data to support scientific research and policy development. It can provide the foundation to investigate the underlying contributors to health inequities and bolsters health equity science. Achieving this requires holistic consideration of the health system, surrounding environment, incorporation of appropriate sectors, as well as alignment and support from all global health partners. This strategy focuses on advocacy, support, and adoption of shared digital platforms by the global health community as a whole. The value of this is further elaborated on in Section 3.

The following sections will further articulate the approach to achieving global, regional, and country-level digital enablement (Section 3), the specific objectives and strategic approaches to realizing it (Section 4), the risks and mitigation strategies for implementing this strategy (Section 5), and immediate next steps for CDC (Section 6).

DEFINITION: SHARED DIGITAL PLATFORM(S)

A shared digital platform is a suite of hardware and software modules that are utilized by two or more applications. It is built to support consistent and efficient service delivery through health and other vertical applications. A platform is comprised of an integrated set of software modules (called components) that support a diverse set of digital applications. These components consist of shared information resources that "support integration, data definitions and exchange standards for interoperability, and enable the use of point-of-service applications across program areas and use cases".[1]

This results in the platform being "shared" by design. The components can be generalized, replicated, and reused at various regional or country levels, specifically for health in support of consistent and efficient service delivery and extended across other sectors and services such as animal, environment, and border health as well as multiple verticals including finance, agriculture, and government services. The realization of a shared digital platform necessitates the integration of non-technical components, including effective governance structures and a capacitated workforce.

It should be noted that **there is no single shared digital platform** – the global ecosystem is made up of multiple digital platforms, implemented at sub-national, national, regional, and global levels. Each developed, managed, and governed according to the rules and capacity of the country or organization, and **each has its own characteristics**. However, there are global concerns that need to be accommodated across the individual systems as well as common functionalities, components, and use cases that can be shared.

This approach is referred to in the ICT industry as an **enterprise architecture (EA) approach.** See Section 3.3 and the appendix for further details.

Key Takeaway Points of CDC's Global Digital Health Strategy

The integration and scale of digital enablement needs to be done through a holistic approach by the global health community, one that includes these key concepts:

- Country-level morbidity and mortality are reduced by the delivery of relevant preventative, comprehensive, and targeted health services and public health activities, enabled by timely, data-driven decision making, utilizing data from various health and non-health sectors.
- Digitally enabled programs provide an opportunity to accelerate prevention and response.
- In turn, the digital health field needs a reliable and cost-effective approach to digitally enabling healthcare and public health, at scale, across the health system, as well as the ability to link with other sectors.
- There is an emerging recognition that the establishment and use of shared digital platforms at country levels, supported by robust governance structures and a capacitated workforce, would systematize the scaling of digital enablement at country, regional, and global levels.
- Accelerating this shift towards the implementation of shared digital platforms requires alignment on globally unifying goals and objectives and support from all partners.

CDC's most important role in contributing to this shift is to **lead the adoption and pursue the realization of shared platforms for digital enablement**, both **domestically and globally**, utilizing its areas of strength as a leading domestic and global public health agency, **including active coordination** with other partners and sectors for this holistic approach.

3. DIGITAL ENABLEMENT OF THE PUBLIC HEALTH SYSTEM

The digital enablement of a public health system is achieved when digital tools and services are used to improve efficacy, efficiency, and impact of health service provision and data-driven decision making. These tools and services complement and support non-digital health program processes and allow partners at all levels to better coordinate efforts and investments, resulting in reduced morbidity and mortality. Digital enablement dramatically improves the ability of the CDC to achieve its mission, with digitalized country health systems not only improving public health programs health services, science research and response, but also enabling secure and appropriate shared access to data across sectors.

The CDC GDHS promotes a coordinated and holistic approach, addressing organizational and technical needs to overcome persistent challenges that are barriers to achieving full digital enablement and to unlocking a future state of transformed global public health and service delivery (discussed more in Section 3.5). This approach also offers efficiencies (e.g., through interoperability) and cost effectiveness through shared services, applications, and infrastructure, all operating in a coordinated way to achieve common health goals.

3.1 MAXIMIZING THE IMPACT OF DIGITAL HEALTH GLOBALLY

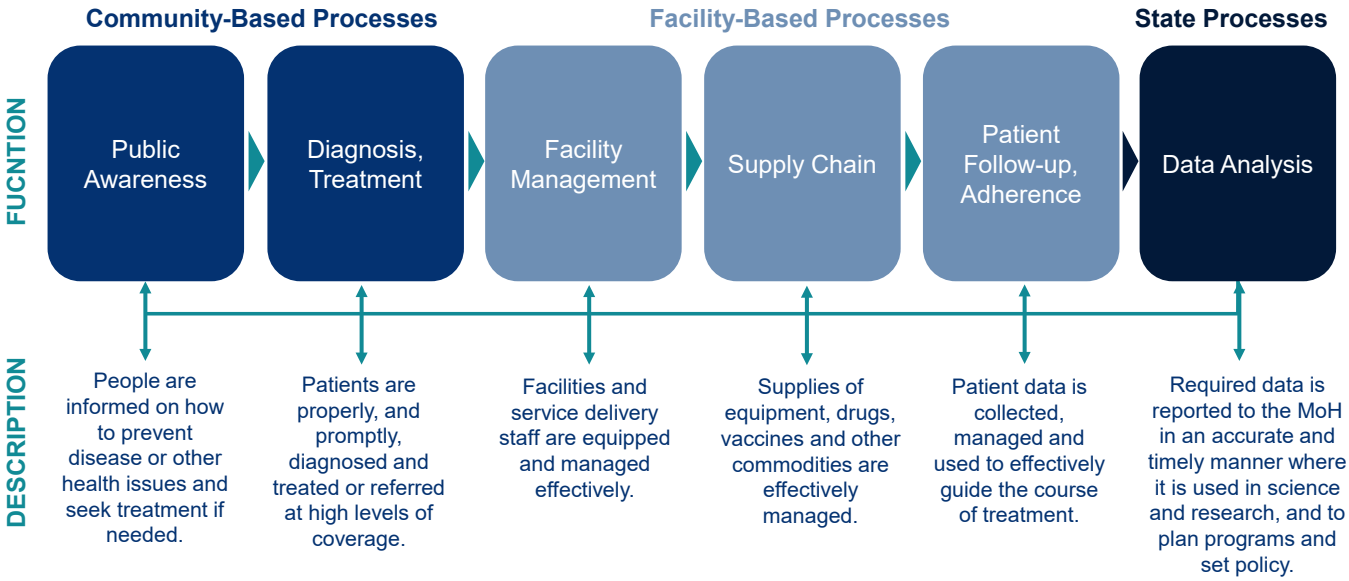
Health impact is maximized by a scaled, well-functioning, and integrated health system. Figure 2 (below) describes an idealized state of a health system, with key activities and associated digital health components necessary to complete public health activities and reduce morbidity and mortality in a population. In an ideal state:

- Populations and communities are informed about prevention and have access to preventative services.
- Individuals seek care when needed and receive prompt prevention and treatment services from a well-equipped facility in their community, with trained personnel who have access to appropriate supplies and are guided by patient-level information and service guidelines.
- Relevant data across sectors are collected, securely stored, and integrated with additional data sources, for decision making and use at all levels of the public health system, including population-level public health interventions, science, research, and global health activities.
- New and existing data sources are being identified and integrated across sectors as different public health events occur.
- Health system addresses all at-risk populations.

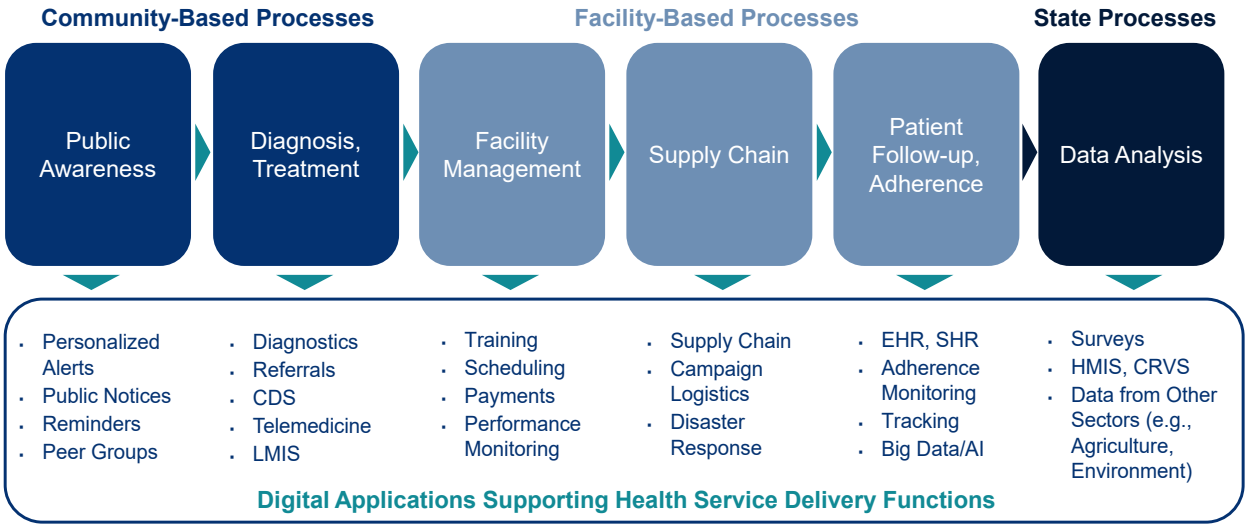
Full digital enablement of these activities, coupled with digital linkages to key public health and non-health data sources, introduces cross-cutting, mutually reinforcing benefits for all health service, disease, and public health domains.

By way of example, the following graphic (Figure 2) conveys an integrated relationship between each component of the health system in its idealized state. This first graphic depicts a typical health service delivery value chain as a patient seeks care and treatment through to the data that is collected, which will inform policy and program planning. This process is driven by a variety of applications that share services and data that are supported by a layer of interoperability and data exchange. Altogether, this interconnected system supports public health activities including surveillance and epidemiology, emergency preparedness and response, laboratory services, and workforce development. In addition, it extends to inclusion of and collaboration with cross-sector partners who influence the health of a community.

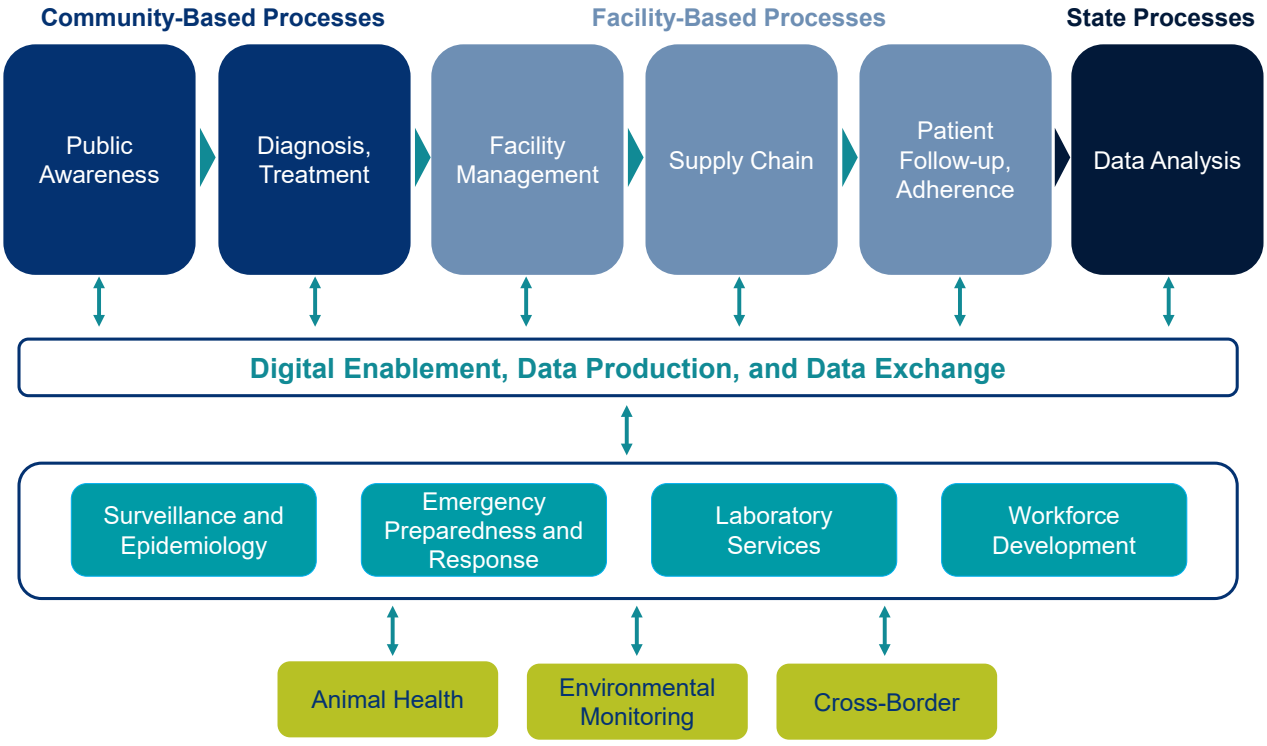
Figure 2: The Idealized State of a Health System



Important activities at every level of a public health or healthcare system are supported and scaled by digital applications, increasing effectiveness, timeliness, and reducing costs.



Interoperable applications allow for data to be shared securely and in a timely fashion. This includes the exchange of data from public health activities, such as case exposure, risk factors, and reference data, as well as non-health sector data sources such as animal health (both domestic and wildlife), border health, travel, environment, and agriculture data.



This allows increased shared access to valuable data for decision making to benefit those at the facility, country, regional and global level, as well as support the core activities of the CDC.

3.2 THE CURRENT STATE: EXISTING CHALLENGES WITH ACHIEVING DIGITAL ENABLEMENT

The development of data and application infrastructure without a unified approach across the global health community has resulted in a fragmented digital health landscape.

Health applications developed in isolation are often unable to interoperate with a connected health system and cannot share data with other components. Furthermore, the applications do not always leverage or contribute to shared, centralized health services or conform to accepted global standards in messaging and data storage. The resulting software is siloed and lacking in the robustness necessary to scale, and it often does not progress past the pilot stage during implementation.

Digital enablement depends on overcoming cultural, socio-economic, and implementation barriers as well as technical challenges. The human dynamics of the workforce and the populations they serve intersect with technical challenges to compound the complexity of achieving full digital enablement.

Common barriers to successful digital enablement include:

- **Data are collected and shared at different levels of aggregation**, from granular patient-level information to highly summarized district or national indicators, making integration, analysis, and visualization difficult. Additionally, **data sharing agreements are difficult to achieve across sectors and across borders.** (See text box on "access to data").

- **Cultural and socio-economic barriers inhibit health-seeking behavior** in disproportionately affected groups who already have limited access to core services such as effective public health interventions, primary and tertiary healthcare, and internet connectivity.

- Health services and programs are **not effective at supporting equitable care and surveillance**, including to remote locations, due to constraints in funding, access to appropriate infrastructure, limited capacity, and a focus on easier-to-reach cohorts, further perpetuating barriers to care.

- Programs are often designed and implemented to meet specific priority needs, including predefined population cohorts and disease profiles. Cohesive and integrated digital enablement can reduce the **focus on meeting specific funding requirements**, and support increasing efficiencies so that funding to all programs can be more effective in meeting programmatic objectives.

- **Workforce capacity and leadership** may be lacking at the country level. Effective leadership must be paired with the right technical capacity or bandwidth for digital

enablement efforts to succeed. This requires additional workforce capacity or bandwidth, in most cases.

- **Development and implementing partners are not supported or incentivized to coordinate software development** with others, including across sectors, or to share infrastructure and services. The perceived extra effort needed to create an interoperable application is eclipsed by the repeated redevelopment of very similar products, many of them not developed as enterprise applications.
- **Effective change management is not always prioritized.** Without sufficient preparation and support for the ultimate users of technology, which would allow users to understand how the system works and the required operational workflows, there is a poor uptake and use of digital systems.
- **Reluctance or distrust of privacy within cloud-based services** leads to local, closed solutions that are more costly, less secure, lack flexibility, and are difficult to manage.
- **Partners from across sectors are not engaged in the development process, and the importance of shared data from across sectors is not appreciated.**

These limitations result in inefficient health systems that are unable to access and share critical data needed from a myriad of sources to detect and manage epidemics. The lack of effective linkage, sharing, and analysis of these data inhibit health service delivery, public health activities, science, research, policy, and programmatic planning.

ACCESS TO DATA

Personal health data can be sensitive, especially for diseases that can lead to patients being stigmatized and discriminated against or that lead to economic hardships. This makes proper data privacy, policies, and governance practices essential for any digital health intervention.

These depends on strong country leadership and governance structures that support ongoing digital health needs and ensure that data sharing agreements between sectors, global health, regional bodies, and country governments are actionable, and that only relevant and appropriate data are shared and used for their intended purpose (e.g., global and cross-border disease detection, science and research, prevention and control, and outbreak response).

Governments need to have access to sub-national and private sector health data to ensure the health of their citizens and communities. Data should be shared with global bodies as appropriate (discussed more in Sections 3.4 and 3.5), and there must be clear internal guidance and legislation on ownership so that data are securely available while ensuring patient privacy and protection. Governments need to have the capacity and capabilities to develop, implement, enforce, and maintain their digital health governance, strategy, and programs across all sectors. They should also have the ability to store and exchange data securely and be able to trust that data shared globally will be similarly protected.

3.3 OVERCOMING SILOS THROUGH SHARED DIGITAL PLATFORMS

The use of interoperable, country- or regional-level **shared digital platforms**, which have effective governance structures, appropriate funding, and adequate change management, are required to overcome challenges. This can be achieved by mapping public health and health systems in their entirety, identifying relevant sectors for engagement, and deploying or integrating digitally enabled services with existing systems and infrastructure that maximize efficiencies throughout the provision of services, improve data flow and data use across points of care, and increase economies of scale and return on investment of digital systems. The implementation of digitally enabled services is achieved through planning and design processes that align technical standards, health workflows, and operational procedures across stakeholders.

In the ICT industry, this is referred to as an **Enterprise Architecture (EA) approach**.[24] (See text box below for more explanation.) This effort considers all dimensions of the health system, including digital, operational, and related sectors. With an EA approach, implementation is progressive, starting with priority **use cases** executed on evolving shared health platforms. As additional use cases are implemented, they make use of platform layers previously developed, resulting in accelerated scale. This type of approach can meet resistance as the initial investment cost will be high until the fundamental services are created. However, in the long term the costs will be significantly lower as future initiatives can leverage this investment and the efficiencies of the architecture.

LINKS WITH ENTERPRISE ARCHITECTURE APPROACH

Applications should adhere to a set of shared requirements around infrastructure, messaging and security standards, communication protocols, and health terminologies. Importantly, new systems should be designed according to an overarching technical strategy to ensure that existing components are leveraged and not redeveloped, that common standards are followed to improve interoperability and reduce complexity of development, and that open application programming interfaces (APIs), messaging standards, and communication channels are implemented. Modular patterns should be implemented to promote component reuse, and components should be well documented, with documentation being easily available. This is an enterprise architecture approach, described in the *Digital Health Platform Handbook: Building a Digital Information Infrastructure (Infostructure) for Health*[24] as:

"Enterprise architecture frameworks or methodologies are blueprints of information systems, commonly used to help ICT implementers design increasingly complex systems to support the workflow and roles of people in a large enterprise such as a health system. When designing a digital health platform (DHP), enterprise architecture is used to describe how the DHP components will interact with each other and specify how the DHP will interact with external applications and systems."

For more information on enterprise architecture and how it maps to a shared digital platform, see the appendix.

3.4 SHARED DIGITAL PLATFORMS ARE AN ENABLER OF PUBLIC HEALTH AND HEALTHCARE SERVICE DELIVERY

Achieving effective shared digital platforms requires a coordinated approach from all global health partners and sectors, where global, regional, and local use cases are accounted for as part of the design and implementation of digital health systems, and the data generated from these systems are used by a competent, capable workforce to inform local service delivery, global and regional health activities, science research and policy. Table 1 describes the four interdependent layers that need to be implemented, and the anticipated outcomes of successful implementation.

Table 1: Layers of Digital Enablement

LAYER	ANTICIPATED OUTCOME	REALIZED CAPABILITIES
1. GLOBAL AND REGIONAL MONITORING AND RESPONSE	There is global and regional monitoring of disease threats using reliable country data systems across sectors that support decision making at all levels and allow for early detection and effective response.	Globally focused programs: ▶ Can detect, prevent, and respond quickly to early threats to global health arising anywhere in the world ▶ Can provide technical support and intervene when needed for local health-threat management ▶ Can dynamically monitor their interventions and adjust accordingly to maximize impact
2. COUNTRY HEALTH PROGRAMS	Digital systems support public health workflows, allowing for data-driven decision making and resource allocation and supervision, resulting in improved health outcomes. New services and resources are deployed quickly. Services and target recipients benefit from rapid-cycle quality improvements through digital feedback loops.	Country programs: ▶ Are managed effectively ▶ Are coordinated efficiently ▶ Are scaled nationally ▶ Make use of multiple relevant data sources ▶ Have high coverage rates and make accurate data available quickly and globally

LAYER	ANTICIPATED OUTCOME	REALIZED CAPABILITIES
3. COUNTRY DIGITAL ENABLEMENT	Tools, applications, and common or shared services efficiently manage data, dataflows, and workflows across sectors. They can also adapt easily to future application needs. This enablement is achieved through the use of common services and secure exchange of timely data.	Digital tools: ▶ Are integrated into service delivery and public health programs ▶ Are scaled cost effectively ▶ Generate data as part of service delivery support ▶ Can move data quickly and securely ▶ Are developed and deployed quickly and cost effectively ▶ Are developed appropriately for their context, and countries progress along the continuum of a **maturity model** (see text box below) ▶ Incorporate critical sectors to ensure data sharing, coordination, and integration
4. COMMON INFRASTRUCTURE	There is effective last mile management of ICT infrastructure across sectors, including computing devices, in countries and regionally. There is availability of professionally managed data centers, secure infrastructure, cloud-based servers (to host applications, web services, and databases), middleware, compliance to standards, and network monitoring and management.	▶ Applications have high availability and performance ▶ Data are secure and recoverable in the event of disaster ▶ Communication networks have high reliability and accessibility ▶ All users and sectors (including rural areas and the last mile) have access to networks and are able to take advantage of services delivered digitally

All four of the layers are required[iii] for reaching and sustaining application use at scale on a shared platform, and achievement of the outcomes relies on enablement of and across each layer. It is in every partner's interest to approach digital enablement from this perspective so that use cases across different diseases, public health threats, and programmatic areas can be accommodated, and technical services and health data can be securely shared across different initiatives.

The most challenging part of fully realizing digital enablement is the seamless transition and interfacing between layers, organizations, and sectors. It requires a coordinated approach across the global health community, investment in digital and non-digital activities, and agreement on key enablers such as data standards and ethical considerations (see text box below). These will be addressed directly in subsequent sections of this strategy document.

MATURITY MODELS

Maturity models are used to understand the existing landscape and can assist with contextualizing the decisions and requirements for achieving digital enablement. These models speak to the continuous improvements required, while accounting for the evolution of country/regional digital maturity and advancements in digital technology. Outcomes related to achieving digital enablement are defined according to a country's progress along the maturity continuum.

This strategy does not prescribe any specific maturity model framework, as each country remains the sovereign of their digital health strategy and implementation.

[iii] *Refer to the appendix for the critical success factors of each layer.*

A SHORT NOTE ON THE ETHICS OF DIGITAL TECHNOLOGY

Although digital enablement can create and discover new opportunities for the field of healthcare, technology itself is not "objective." Humans are responsible for the design, development, and use of the technology, which can (if unchecked) cause codified social and structural bias and result in systemic exclusion and disproportionate harm to already vulnerable populations.

This is particularly true for artificial intelligence (AI) where biases are often embedded during data cleaning and coding. Biases can be further exacerbated by challenges with human interpretation of predictions and explanation of decisions generated by the AI model (especially when the model uses complex algorithms).

Without proper risk mitigation and incorporation of safeguards in digital health interventions, the use of digital technology can be harmful.

The following resources discuss these ethics in more detail:

- The United Nations Sustainable Development Group's *Data Privacy, Ethics and Protection: Guidance Note on Big Data for Achievement of the 2030 Agenda* https://unsdg.un.org/resources/data-privacy-ethics-and-protection-guidance-note-big-data-achievement-2030-agenda
- USAID's *Managing ML Projects in International Development: A Practical Guide* https://www.usaid.gov/digital-development/managing-machine-learning-projects

3.5 THE FUTURE STATE

When countries routinely develop and maintain their own shared digital platforms,[iv] resources can be more efficiently allocated, and public health officials, practitioners, and decision-makers can make informed decisions across all areas of service delivery, sectors, and public health in ways that improve demand and risk forecasting, support tracking of individual patients, and help to identify and respond to disease outbreaks and other public health threats.

[iv] *This includes utilizing a set of requirements around infrastructure, messaging and security standards, communication protocols, and health terminologies.*

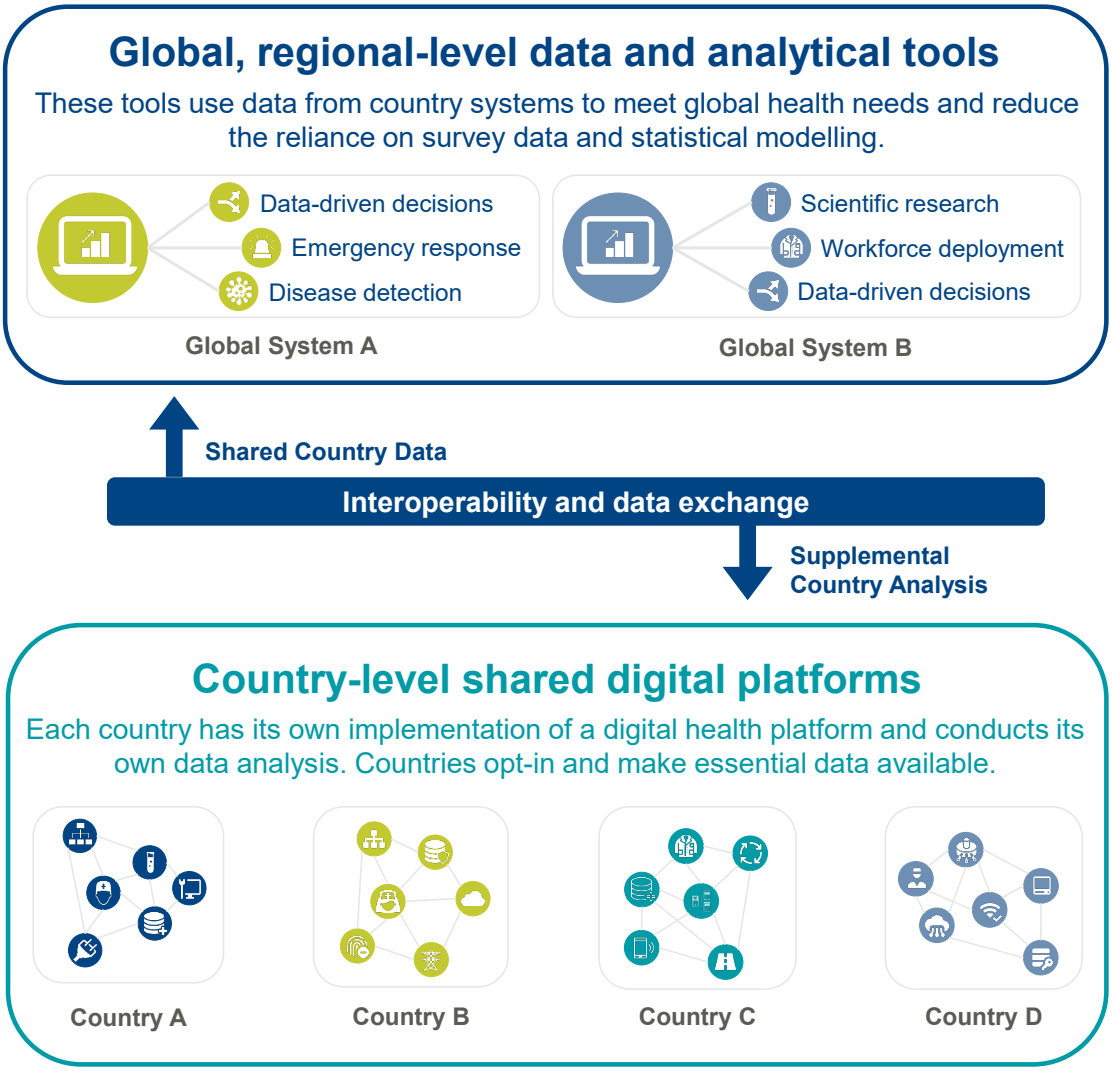
Figure 3 shows this “future state” where shared digital platforms are embraced across the global digital field. In a virtuous circle, service-delivery data feeds public-health needs, thus allowing public health to better support service delivery.

In this future state:

- Country and local-level (e.g., community) public health and healthcare delivery processes, digitally enabled and scaled, generate health-related data that are used locally to inform care provision, science, research and public health planning and decisions and that are of vital interest to the country, region, and global partners. Countries conduct their own data analysis as part of routine decision making, with these systems owned and governed by country governments and sectors, and data are stored at the country level.
- Global and regional-level tools are designed to securely access shared country data. They display data via dashboards and use visualization and analytical tools for timely analysis and predictive analytics across country borders. Any analysis conducted using data sources or techniques unavailable at the country level should be synthesized and shared with countries.
- Thus, public health efforts are a result of responses to observed data across sectors instead of statistically modelled or limited survey data sampling.

This future state will evolve and advance as a country's digital capabilities advance. As new platforms introduce new capabilities and newly accessible data provide insights previously unobtainable, new services can be quickly and efficiently launched, thus introducing further capabilities and additional data in a cycle that evolves indefinitely into the future.

Figure 3: A Future State



This future state will materialize differently across geographies, and countries with infrastructure and capacity challenges may be several years away from this reality. This strategy is intended to help CDC and its global partners in assisting countries and regional bodies[v] of varying digital capability to take manageable steps towards the long-term goal of attaining full digital enablement of data sharing and coordination of services and public health activities, while simultaneously providing value to CDC and other agencies charged with protecting global health.

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[v] *Examples of regional bodies include the Economic Community of West African States (ECOWAS), the West African Health Organization (WAHO), the East African Community (EAC), the Southern African Development Community (SADC), and the Mekong Basin Disease Surveillance Foundation (MBDS).*

4. STRATEGIC APPROACH

4.1 GLOBAL UNIFYING GOALS AND OBJECTIVES

This strategy has been developed based on a global vision of full digital enablement, and accomplishing this vision requires a holistic view of the health system, with shared goals and objectives across the digital health community. There are many methodologies, such as enterprise architecture, as mentioned earlier, that support such a holistic approach.

With this approach in mind, various partners (e.g., global agencies, donors, and digital implementers) and sectors (including animal health, border health, and environment) should work in collaboration to digitally enable and strengthen all aspects of the public health system, through the use of shared digital platforms, collaborative global governance, and system- and sector-wide workforce development. This collaboration can enable interoperability across various health, public health, and multisectoral information systems and promote foundational infrastructure updates, such as migration to the cloud, which will result in seamless reporting to public health authorities.

Table 2 describes the global goals that correspond to the different layers that make up a shared digital platform (described in Table 1) as well as a set of associated global unifying objectives that are required to realize each goal. Each of the objectives fall into three categories, representing core components needed to fully realize holistic digital enablement:

- Digitally enabled services and digital components
- Operations and skilled workforce
- Governance and leadership

The pursuit of these proposed goals and objectives will move the digital health field towards the realization and use of shared digital platforms across low- and middle-income countries and globally.

The goals articulated in this strategy cannot be realized through a focus on technology alone. Digital enablement must consider non-digital factors that create an enabling environment through governance mechanisms, policy and legal frameworks, operational management, and a workforce to support it all. Examples of frameworks that incorporate these components include the Informatics-savvy Organization framework[25] and the ITU/WHO *National eHealth Strategy Toolkit*[3] building blocks.

Table 2: Global Unifying Goals and Objectives

GLOBAL GOALS	GLOBAL UNIFYING OBJECTIVES		
	DIGITALLY ENABLED SERVICES AND COMPONENTS	**OPERATIONS & SKILLED WORKFORCE**	**GOVERNANCE & LEADERSHIP**
GLOBAL AND REGIONAL MONITORING AND RESPONSE: Protect global health security by enabling timely access, protection, and use of high-quality, shared country data with global health community and practitioners in sectors such as environment and animal health.	Shared data and analyses from country-driven systems are being used at the global and regional level in support of global health goals.	Decision-making is data-driven and based upon the best available science and technology.	Countries have established data governance policies and mechanisms to make relevant data available to all partners.
COUNTRY HEALTH PROGRAMS: Implement data-driven public health and healthcare workflows, decision making, supervision, and programs that improve delivery of services, health outcomes, science, and research.	Common digital components are being deployed in support of service delivery and public health programs.	The workforce is trained and able to keep up with current demand to use digital tools and data to improve service delivery and other health activities.	Country governments are supporting technology and policy regarding use of digital technology.
COUNTRY DIGITAL ENABLEMENT: Improve ability to collect, secure, and analyze quality data in service of strengthening health programs to improve effectiveness, including cost and access to services, via digital enablement.	Countries are developing or using existing digital global goods in support of service delivery and public health programs.	Countries are capacitated and able to implement, use, and maintain digital components.	Country strategy and implementation plans have support across partners and sectors, and country government digital core services are cross-sector.
COMMON INFRASTRUCTURE: Provide secure ICT infrastructure, accessible as appropriate to all users and service providers.	Hardware infrastructure is robust, secure, and accessible.	A critical mass of the workforce across sectors has access to cellular or internet network connectivity and functional devices.	Scope of hardware platforms and connectivity is cross-sector.

4.2 ALIGNMENT WITHIN THE GLOBAL HEALTH COMMUNITY

The strategies published by other prominent global health partners, including other agencies and organizations based within the United States, are already well aligned with these unifying objectives. For instance, **WHO** calls out the use of adaptable digital technologies, with the objectives that countries utilize existing global digital goods: "*The global strategy promotes the appropriate use of digital technologies as digital public goods which are adaptable to different countries and contexts to help address key health system challenges to support equity in access to digital resources so that no one is left behind.*"[14] The strategy further recommends that national digital health systems be interoperable, "*[Digital health systems]… should be set up in such a way that the information technology health infrastructures are both interoperable among each other and, allowing for differences in national legislation and policies, capable of sharing health data with infrastructures of other countries."*[14]

Similarly, **USAID** acknowledges the role of country data to achieve global health goals: "*The full potential of digital technologies, data analytics, and the use of data can bolster preparedness for, and response to, pandemics, and accelerate efforts to reach global health goals*."[2] They further call out the need for a coordinated investment approach: "*To enable a systems-level approach to digitalizing country-level health sectors, digital investments in individual diseases and health-promotion areas must coordinate and, wherever possible, align to national digital-health strategies grounded in national health institutions and plans.*" [2]

Additionally, USAID's *A Vision for Action in Digital Health*[2] highlights the following as their four strategic priorities, all of which align closely with this strategy:

1. *"Investments in country-level capacity in digital health – including in leadership and governance, and institutional and workforce capacity…*
2. *National digital health strategies [to] align funders' investments to country identified health priorities and plans…*
3. *National digital health architecture [to] provide a blueprint, including through the use of standards, to identify country-specific technology requirements, that can prioritize interoperability between national digital-health systems, and streamline future investments…*
4. *Global goods [to] meet the diverging needs of various geographic or thematic contexts."*

The **Pan American Health Organization (PAHO)** promotes digital enablement of public health systems and has developed *8 Principles for Digital Transformation of Public Health*[26] as part of the Information Systems for Health (IS4H) initiative. The principles cover many of the same themes as the CDC Global Digital Health Strategy, including public health architecture, interoperability, universal connectivity, equity in health service access, and information security. Health information

system strengthening is also a major objective of PAHOs, with an aim "*to improve and strengthen health information for decision-making and program planning.*"[26]

The **World Bank's** Digital Development Partnership supports all three objectives related to country common infrastructure, "*To deliver universal digital access, we must invest in infrastructure and pursue reforms that bring greater competition to telecommunications markets, promote public-private partnerships, and yield effective regulation.*"[27]

Domestically, there are many organizations with aligned initiatives and strategies. The National Institute of Health National Center for Advancing Translational Sciences (NCATS) strategic plan includes objectives around interoperability and the development of digital platforms.[28] The interoperability roadmap[29] of the Office of the National Coordinator for Health Information Technology (ONC) covers components relating to data standards and semantics, patient identification and matching, security, authentication, and infrastructure. The Food and Drug Administration Sentinel System strategy[30] includes many of the same themes, and the U.S. Department of Health and Human Services has a global strategy[31] with goals and objectives that are highly aligned with the CDC GDHS.

Indeed, the collective view of objectives in digital development published by these domestic and global organizations present a full complement of strategies in support of the global unifying objectives articulated in this strategic document. This view of partner strategies reinforces the value of a shared vision and set of objectives as shown above. It also illustrates a unified momentum that has developed organically but now requires more purposeful coordination to accelerate and maximize achievement of the overall vision.

Multiple countries and regional bodies are already implementing and calling for this approach:

- There is an emerging trend of adoption of an enterprise architecture approach[vi] in the **Asian eHealth Information Network (AeHIN)** member healthcare organizations, with 5 of 18 organizations actively pursuing enterprise architecture to address issues such as interoperability, lack of technical infrastructure, and poor alignment of business and ICT strategies.[32]

- The **East African Community (EAC)** is another regional body pursuing an approach aligned with this strategy, through the development of an EAC Regional Digital Agenda and a supporting Centre of Excellence for the implementation of a comprehensive, cross-sector

[vi] *See further detail on enterprise architecture in the appendix.*

eGovernment interface that would provide digital services including health, agriculture, supply chain, and financial services to its citizens.[33] Additionally, individual countries within the EAC region are also undertaking strategies for shared digital health platforms:

- The **Kenyan Ministry of Health** is taking a similar approach, detailed in its eHealth Strategy.[34] The Kenya Health Enterprise Architecture (KHEA) model provides a standard approach to design, implementation, and use of digital health solutions. This includes a technology layer that supports sharing of infrastructure to reduce costs, increased interoperability across the health sector and data, and application-related services and standards, allowing actors to share and reuse common assets.[34]

- The **Ministry of Health in Uganda** has also undertaken several key initiatives to improve health data access and use through the development of a standards-based interoperable digital health architecture.[35]

- The **South African National Department of Health** has published the *Health Normative Standards Framework for Interoperability in eHealth* (HNSF),[36] which is a core component of the enterprise architecture of the national healthcare system. The *National Digital Health Strategy for South Africa 2019-2024* [37] proposes the establishment of an integrated information architecture as one of the nine strategic interventions to be achieved by 2024. An open standards and open architecture approach will be adopted, expanding the HNSF and extending the health enterprise architecture.

4.3 CDC ESTABLISHED STRENGTHS AND OPTIMAL ROLE IN DIGITAL HEALTH

Based on CDC's strong track record of scientific leadership and public health technical expertise, CDC is uniquely positioned to contribute to the realization of these goals and objectives of digital enablement across global health systems. Through its divisions and centers focused on epidemiology, laboratory, informatics, surveillance, workforce capacity building, emergency preparedness and response, and specific programmatic and disease areas, CDC is able to deepen knowledge and scientific advancement in pursuit of global health objectives. With this technical expertise, CDC aims to integrate standard health equity measures seamlessly into global data collection efforts used to reach epidemic and accelerated disease control, and disease eradication and elimination among known and unknown marginalized populations. This comprehensive view enables CDC to articulate priority use cases at global, regional, and local levels and collaborate with countries to collate and define health-system requirements to meet the needs of those use cases.

Furthermore, CDC is a trusted partner in global health, with strong diplomatic relations and partnerships with national and international health agencies, such as ministries of health, WHO, and Africa CDC. These connections can be utilized to advocate for country and regional shared digital platforms, promote the adoption and use of standards, and build local capacity. CDC has also recently rolled out its cloud-hosting strategy and the Data Modernization Initiative (DMI), which are both key enablers in pursuit of this strategy. This, coupled with the growing ownership and trend

towards the development of digital health strategies by ministries of health and the advancement of digital technology such as cloud computing and artificial intelligence (AI), makes for an opportune moment to embrace and pursue digital enablement.

In this role, CDC can provide cross-disease, cross-sector (e.g., animal and border health, environment) and cross-domain (e.g., lab, analytics, informatics, surveillance) technical assistance and expertise to help ensure that digital policies, standards, guidelines, systems, data requirements, data analytics, and workforce capacity meet the needs of country public health core capabilities. Where appropriate, CDC will support the collaborative identification and the acquisition and appropriate use of global common digital components or infrastructure. This will reduce the development of disease-specific, stand-alone, and non-interoperable systems, which can be more costly and unsustainable over the long term. This type of approach enables the CDC to holistically meet the needs of each disease area or use case, as well as integrate existing or legacy systems, while addressing common barriers to digital enablement.

To make this a reality, CDC will work through strategic partnerships to implement and demonstrate the value of the approach articulated in this strategy and to influence others to achieve digital enablement. It will also build internal and external capacity around digital enablement, especially in countries that have little existing capacity.

THE DATA MODERNIZATION INITIATIVE (DMI)

This strategic approach has also been contextualized within the CDC's Data Modernization Initiative (DMI).[15] The DMI is focused on unlocking the full potential of data for disease detection and elimination. It is a comprehensive strategy to modernize data, technology, and workforce capabilities – together and at once. This initiative supports public health surveillance, research and, ultimately, decision making. The goal of DMI is to move from siloed and weak public health data systems to connected, resilient, adaptable, and sustainable systems that can prevent and quickly respond to emerging problems.[21]

The DMI focuses on three priority areas of investment, namely:

- **Coordinate people and systems** so that the United States has trusted data to promote evidence-based behaviors, interventions, and solutions.
- **Accelerate data for action** so that the United States can rapidly identify and effectively mitigate emerging threats.
- **Support strategic innovation** to seek partner-driven solutions and strengthen advanced analytics such as predictions and forecasting.

Detailed activities and outcomes for each of these priority areas can be found on the DMI logic framework in the appendix.

While the focus of the DMI is on the domestic United States, the principles of the initiative are equally applicable to a global health context, and its logic model is universal. The domestic challenges the initiative addresses (reacting to instead of predicting epidemics, the focus on collecting data without the ability to rapidly utilize it for timely insights, the existence of siloed and outdated systems that restrict data sharing and impact the ability to move quickly, and the ineffective use of existing resources and common investments) are pervasive and exist across countries and sectors and at the regional and global levels.[vii] The approach to achieving and scaling the opportunities that will address these issues domestically to realize widespread and rapid access to data for decision making can also be applied globally. This includes extensive coordination as well as the development and use of policies, standards, and interoperable systems for efficient, secure data access and exchange across healthcare and public health, in addition to investing in building a highly skilled public workforce that can respond to changing needs.

The DMI acknowledges that modernization is a journey, not a destination, and that addressing the underlying issues of data integration is a critical continuous effort that requires evolution as technology and needs change.

There is a clear opportunity to utilize investments, assets, and artifacts generated during existing DMI efforts and translate them for use in a global setting, as well as opportunities to leverage learnings from GDHS implementation for use domestically. Immediate next steps can be found in Section 6.3.

[vii] *For a summary of these challenges and their corresponding opportunities areas see the CDC infographic: "Timely. Accurate. Accessible – The New World of Public Health Data" available at https://www.cdc.gov/surveillance/pdfs/New-World-of-Public-Health-Data.pdf.*

THE CDC DATA MODERNIZATION INITATIVE (DMI)

The DMI is part of a national effort to create integrated, real-time public health and surveillance data to protect the U.S. from health threats. The initiative aims to bring together data from U.S. states, tribal, local, and territorial jurisdictions as well as private and public sector partners to create interoperable, real-time public health data and surveillance systems that will protect the American public.

The long-term outcomes of the DMI are:

- CDC can rapidly identify and effectively mitigate emerging threats.
- Trusted data promotes evidence-based behaviors, interventions, and solutions to protect health.
- Every American has equal opportunity to attain the highest level of health possible.
- All people have the right information at the right time to make sound decisions.
- Our country is better prepared for, and protected from, all types of public health threats.

For more on the DMI see: https://www.cdc.gov/surveillance/surveillance-data-strategies/dmi-investments.html.

4.4 CDC-SPECIFIC STRATEGIC APPROACHES

The following digital health goals and strategies are CDC-specific and have been developed based on CDC priorities and its optimal role in digital health. They take advantage of CDC's expertise and unique position as a global health leader to contribute to the collaborative achievement of globally shared goals and objectives. Many of these strategies are already being implemented as part of CDC global work and are well defined by the DMI. Existing strategies will be maintained and additional strategies adopted, with internal approaches for CDC discussed in Section 6.

The strategies below and corresponding activities (discussed in detail in the appendix) are best considered in the context of specific implementations (e.g., a national digital health platform implementation). The strategic approaches focus on the contribution that the CDC is best able to make in order to achieve the objectives.

GOAL 1: GLOBAL AND REGIONAL MONITORING AND RESPONSE **Protect global health security by enabling timely access, protection, and use of high-quality, shared country data with global health community and practitioners in sectors such as environment and animal health.**		
	OBJECTIVES	**STRATEGIC APPROACHES**
Digitally Enabled Services	**Objective 1.1:** *Shared data and analyses from country-driven systems are being used at the global and regional level in support of global health goals.*	1.1.1 Work with global, regional, and domestic partners to identify common existing and potential new global digital health use cases.[viii] Catalog the data relevant to each use case and normalize the findings into a common core data and systems architecture. 1.1.2 Contribute to the development of a CDC global repository consisting of use cases, core metadata, systems architectures, and standardized requirements for disease surveillance and epidemiology. 1.1.3 Implement a CDC global data warehouse securely storing data described by the global use case repository. The warehouse should expose open data interfaces and public datasets where possible (and supported by data-sharing agreements) and utilize standard data structures and flexible architecture. It will store

[viii] *The strategies reference use cases that should be identified and detailed. An example of a global use case could be the collation of COVID19 data points from multiple countries. An example local use case could be the collection of HIV viral load information for adherence monitoring at country level. The repositories would reference the required data points and workflows.*

GOAL 1: GLOBAL AND REGIONAL MONITORING AND RESPONSE **Protect global health security by enabling timely access, protection, and use of high-quality, shared country data with global health community and practitioners in sectors such as environment and animal health.**		
		aggregate data as well as identified and de-identified individual data depending on the use case and security considerations. 1.1.4 Develop population linkage strategies and techniques to enable analytical modelling and statistical analysis across disparate data sets. Unlock new epidemiological insights for global health security. 1.1.5 Identify data generated or consumed by CDC that would be useful to other partners but are not yet currently available. Identify how those data could be more readily shared, ensuring privacy, security, and confidentiality.
Operations and Skilled Workforce	**Objective 1.2:** *Decision-making is data-driven and based upon the best available science and technology.*	1.2.1 Develop new and contribute to existing materials and provide training for health informatics and data science capacity building (internally and globally). Ensure training and capacity building resources are institutionalized in country (e.g., ministries of health, agriculture, environment, national public health institutes, academic centers) and readily available to public health workforce.
		1.2.2 Elevate health informatics as a core skill necessary for relevant CDC staff.
		1.2.3 Establish cross-disease, -sector, and -domain (lab, analytics, informatics, surveillance) public health teams to help ensure that digital policies, standards, guidelines, systems (existing or new), data requirements, and data analytics meet the needs of the public health systems and emergency response activities. 1.2.4 Engage staff and resources with existing critical disease surveillance systems to advance integration and interoperability across platforms and sectors.
Governance and Leadership	**Objective 1.3:** *Countries have established data governance policies and mechanisms to make relevant data*	1.3.1 Support active coordination of digital health efforts and investments and advocate for adoption of shared goals and objectives. 1.3.2 Participate in communities of practice in order to socialize the advantages of and share best practices or lessons learned from sharing country data for global utilization.

GOAL 1: GLOBAL AND REGIONAL MONITORING AND RESPONSE **Protect global health security by enabling timely access, protection, and use of high-quality, shared country data with global health community and practitioners in sectors such as environment and animal health.**		
	available to all partners.	1.3.3 Develop a cost analysis showing the long-term cost benefits of investing in country-owned systems. 1.3.4 Support the development of policy, guidelines, and practice by using data-driven technical expertise. 1.3.5 Drive the development and implementation of policy and standards, including those for privacy and security of data for cross-border data sharing.

GOAL 2: COUNTRY HEALTH PROGRAMS Implement data-driven public health and healthcare workflows, decision making, supervision, and programs that improve delivery of services, health outcomes, science, and research.		
	OBJECTIVES	**STRATEGIC APPROACHES**
Digitally Enabled Services	**Objective 2.1:** *Common digital components are being deployed in support of service delivery and public health programs.*	2.1.1 Document local use cases driven by CDC core activities and identify the data associated with each. Identify common use cases within and across the pillars, and with other partners. 2.1.2 Identify data relevant to CDC's mission and cross reference the data with what are currently available in any given country to produce a gap analysis. 2.1.3 Collaboratively identify common digital components and tools that can be applied to identified use cases. 2.1.4 Ensure that appropriate data privacy and security technology and services are incorporated across all digital health platforms, with attention to unique country-specific privacy laws and data governance policies where necessary. 2.1.5 Use machine learning and data science techniques (such as data triangulation, descriptive, diagnostic, predictive and prescriptive analytics, and forecasting) to understand and answer key programmatic questions. 2.1.6 Use data for resource allocation (e.g., workforce deployment, supply allocation, or investments) across new or established systems. 2.1.7 Share data across health programs where possible and where enabled by common digital tools.
Operations and Skilled Workforce	**Objective 2.2:** *The workforce is trained and able to keep up with current demand to use digital tools and data to improve service delivery and other health activities.*	2.2.1 Identify existing assets related to workforce development and produce a skills and coverage gap analysis.
		2.2.2 Catalyze in-country and regional public-private partnerships that support workforce development (pre-service and in-service).
		2.2.3 Provide mentoring and technical assistance to countries and programs where needed, in support of their use of data for decision-making.

GOAL 2: COUNTRY HEALTH PROGRAMS Implement data-driven public health and healthcare workflows, decision making, supervision, and programs that improve delivery of services, health outcomes, science, and research.		
Governance and Leadership	**Objective 2.3:** *Country governments are supporting technology and policy regarding use of digital technology.*	2.3.1 Work with ministries to enable better health outcomes for overall population health by leveraging digital technology. Promote the value of data collection, analytics, and visualization and determine gaps that need to be filled. 2.3.2 Work with countries to address broader enterprise data management and digital platform maturity issues in order to advance sustainable solutions.

GOAL 3: COUNTRY DIGITAL ENABLEMENT Improve ability to collect, secure, and analyze quality data in service of strengthening health programs to improve effectiveness, including cost and access to services, via digital enablement.		
	OBJECTIVES	**STRATEGIC APPROACHES**
Digitally Enabled Services	**Objective 3.1:** *Countries are developing or using existing digital global goods in support of service delivery and public health programs.*	3.1.1 Use global and local use cases to inform system design and requirements. 3.1.2 Support identification and implementation of global goods and interoperability standards to improve service delivery use cases. 3.1.3 Help partners implement cloud-based shared services, including workflow engines and identity management systems. 3.1.4 Help drive development of cloud-based data privacy and security standards.
Operations and Skilled Workforce	**Objective 3.2:** *Countries are capacitated and able to implement, use, and maintain digital components.*	3.2.1 Provide mentoring and technical assistance where required to help countries make decisions about system requirements and standards. 3.2.2 Identify workforce requirements for deploying digital assets and integration of existing systems. 3.2.3 Build capacity in interoperability standards, open data architecture, and mechanisms for health information exchange. 3.2.4 Support competency in, and knowledge and usage of, national data privacy and security standards to allow for identification and remediation of cyber security risk.
Governance and Leadership	**Objective 3.3:** *Country strategy and implementation plans have support across partners and sectors, and country government digital core services are cross-sector.*	3.3.1 Lead or participate with other partners in aligning specific country projects to a shared implementation roadmap. 3.3.2 Work with other partners to ensure software platforms are aligned in support of identified common use cases. 3.3.3 Engage with other partners in promoting reference implementations of CDC programs supporting country public health programs or activities. 3.3.4 Support the development of materials quantifying return on investment (ROI) of an enterprise approach.

GOAL 4: COMMON INFRASTRUCTURE Provide secure ICT infrastructure, accessible as appropriate to all users and service providers.		
	OBJECTIVES	**STRATEGIC APPROACHES**
Digitally Enabled Services	***Objective 4.1:*** *Hardware infrastructure is robust, secure, and accessible.*	4.1.1 Support the provisioning of reliable electrical power to currently under-served areas to enable use of digital tools. 4.1.2 Facilitate partnerships to ensure hardware infrastructure and/or cloud services conform to national ICT regulatory requirements. 4.1.3 Support cloud-based deployment of services and software, ensuring business continuity and supporting necessary change management.
Operations and Skilled Workforce	***Objective 4.2:*** *A critical mass of the workforce across sectors has access to cellular or internet network connectivity and functional devices.*	4.2.1 Partner with multilateral donors and development organizations that fund infrastructure where CDC cannot. 4.2.2 Partner with the private sector and other partners (e.g., mobile network operators) to develop and deploy business models to increase network accessibility. 4.2.3 Support training of service delivery personnel in the deployment, use, and maintenance of digital tools, including implementation of protocols necessary to ensure data privacy and security. Support effective and efficient personnel management.
Governance and Leadership	***Objective 4.3:*** *Scope of hardware platforms and connectivity is cross-sector.*	4.3.1 Support the incorporation of digital health within government digital services. 4.3.2 Support in-country partnerships across sectors and ministerial divisions. 4.3.3 Work with other partners to ensure hardware and network resources are available to provide sufficient infrastructure to support secure service delivery at scale. 4.3.4 Implement policies that enable the secure movement and sharing of data across sectoral information systems, such as geospatial, environment, agriculture, security, animal health, and refugee data. 4.3.5 Support the generation of policies that inform the adoption of cloud-based services and data sharing.

5. STRATEGIC RISKS AND MITIGATIONS

Increased collaboration between global, regional, and country bodies is imperative to the achievement of the strategic goals. Although this introduces complexity and risk in the short term as it relies on greater coordination and introduces external dependencies, it promises significant optimization and streamlining in the medium to long term. This strategy aims to mitigate risks by providing guidance both on interactions with internal and external partners as well as on taking a collaborative approach from the start. The following table describes several potential risks and possible mitigation strategies.

POTENTIAL RISK	POTENTIAL MITIGATION STRATEGY
Data collected and shared by countries will not be of sufficient quality for public health decision-making needs.	Work with countries and other partners to establish and/or iteratively improve data quality standards. Improve data quality by implementing data quality assurance activities within programs to ensure these standards are adhered to.
Countries have concerns around data sovereignty and privacy and are reluctant to share data with international partners.	Collaborate with country governments in the development and iteration of data sharing agreements, ensuring that country data that does not need to be shared is safe-guarded, and that shared data is shared securely. Promote the benefits of open data (e.g., data.cdc.gov), and ensure that best-practice security mechanisms that safeguard privacy and confidentiality are implemented and maintained, and, in the absence of secure data exchange, reduce risk by sharing only aggregate-level and/or deidentified data.
Countries have policies in place restricting the use of public cloud-based infrastructure and services	Document and share examples of successful implementation of cloud services by other countries, the legislation adopted by these countries to allow for cloud services, and advantages provided in terms of security and cost. Strengthen in-country capacity for securing and managing cloud-based resources.

Partners may choose not to collaborate.	Engage with partners from the very start. If resistance persists, identify the root causes of the partners' reluctance to collaborate and work with them to identify solutions. Show the value proposition for participation and engage in emerging efforts aimed at helping demonstrate the business case for scalable country-owned systems.
The collaborative approach will take a long time to deploy before yielding real benefits.	Work with country and regional partners on immediate opportunities to implement a scaled digital infrastructure and digitally enable services in an iterative but accelerated manner. Demonstrate the benefits of the implementation and build momentum by identifying and documenting quick wins.
Countries may not have appropriate infrastructure necessary to participate in the digital ecosystem (e.g., power and connectivity)	Ensure that infrastructure requirements are clearly stated and continually highlighted as dependencies. Advocate for supportive infrastructure investment among partners in the global health community. Implement the strategic approaches detailed in this strategy to ensure that hardware infrastructure is robust, secure, accessible, and sustainable.
Country-level operational data flow may be blocked due to inter- and intra-ministerial divisions and inefficiencies or challenges in obtaining data from sub-national levels.	Advocate for an open data policy in countries and work to ensure that potential conflicts, political divisions, and local data governance issues have been investigated and possible delays built into delivery timelines. Work to unblock data flows and mediate conflict where possible. Share learnings from other countries and help to implement the strategic approaches detailed in this strategy.

6. PREPARING CDC'S ROLE IN DIGITAL ENABLEMENT

Realizing this strategy will require focus and effort internally within the CDC and externally with other stakeholders and partners. Beyond the initial conception of this strategy internally, the vision articulated must be further shared and socialized across CDC organizational units, which must partake in actional planning and undertake the change management required to make it a reality. Externally, the strategy will require coordination with others in the global digital health community through focus on specific on-the-ground implementations, starting with identifying high priority needs based on country experience and implementations in a select number of exemplar countries or regions. This section highlights the various dimensions involved and provides some immediate next steps to support operationalization.

6.1 INTERNAL EFFORTS AND CHANGE IN SUPPORT OF THE STRATEGY

Successful implementation of this strategy will require CDC to continue existing efforts and undertake new internal activities as well as reforms. CDC will promote digital enablement and the expansion of the DMI principles across its global health activities in the following areas:

STAFFING AND SUPPORT SKILLS

Supplement staffing and training on the implications of embracing the development, integration, and use of shared digital platforms across CDC, especially in regional and country offices. An assessment of CDC headquarters, country, and regional office staff positions and job descriptions that are relevant to digital enablement would help to guide where skills need to be most supported. For instance, a focus on cloud infrastructure and services, data science, cybersecurity, or data protection and privacy.

COMMUNICATION

Publish and share cleared digital strategy, its value, and implications across the various global and domestic CDC divisions and offices, and amongst CDC global partners to begin working towards its implementation.

KNOWLEDGE SHARING

Create venues for sharing learnings and knowledge across different divisions, programs and regional as well as country offices, showcasing success stories and real-world challenges experienced in implementing the strategy; consider how to share these lessons externally with other partners.

RESOURCE PLANNING

Build out a resource plan and governance structure for the successful implementation of the strategy.

UPDATE RECIPIENT REQUIREMENTS

Assess and update requirements to include scope and sufficient budget for long-term availability of human resources trained and skilled in supporting a unified approach to digital enablement. Include requirements for grantees to demonstrate alignment with this strategy.

STRATEGIC PARTNERING

Achieving this approach will require strategic and tactical coordination both internally, across multiple CDC centers, divisions, and country offices, as well as externally, with partners. Part of CDC's role in this strategy is to encourage collaboration and coordination among other partners to take on the activities that complement and complete the CDC-specific approaches so that the unifying objectives are met. To support this strategy CDC can also define how it works with regional communities, country governments, civil society and non-governmental bodies, research and academic institutions, international donors, multi-lateral organizations, and the private sector.

INTERNAL ADOPTION

Adopt and support policies, global goods, and common implementation models as they are established. Guidelines such as the principles for donor alignment will be institutionalized, further improving coordination between CDC, governments, other donors, and global public health institutions.

MONITORING AND EVALUATION

Strategize a cohesive monitoring and evaluation (M&E) framework for global digital health. M&E are built into all CDC programs and interventions. Tools and guides for program performance and evaluation, for economic evaluation, and for M&E of digital health, as well as other interventions have been developed and matured by CDC and other organizations over many years and have been applied in a robust manner.

However, one of the biggest challenges to digital enablement and the adoption of digital health is the lack of evidence on their impact, effectiveness, and return on investment. An overarching M&E governance framework for global digital health is needed to align M&E across programs and partners so that a large body of evidence can be produced. The governance framework will ensure that program-specific activities are structured around the objectives defined in this strategy, which are common across all partners. In addition, it will define the metrics used to measure effectiveness and performance and will govern how these metrics are collected, collated, and shared across programs and partners. It will leverage and adapt other existing frameworks, such as CDC's *Framework for Program Evaluation in Public Health,*[38] with a specific focus on digital. It is important to note that the complexities associated with realizing digital enablement and the specific contexts in which implementations take place will require an approach to M&E that accommodates flexibility and an emergent nature to outputs and outcomes that differ from what was originally planned.

6.2 IMPLEMENTATION AND PARTNERSHIPS

IMPLEMENTATION FOCUS

For this strategy to be effective, it must be pursued in the context of specific in-country or regional work, on an implementation-by-implementation basis. The opportunity exists to start by selecting a limited number of **exemplar countries, programs, or regions to implement** the strategic approaches articulated in this document, working with partners in the global digital health community from the start.[ix]

A focus on concrete implementations will provide the momentum to expand this approach to other countries and regions by demonstrating quick wins and generating learnings that can be applied elsewhere. This approach will also support the development of artifacts (and global goods) that can be reused and utilized across future implementations.

PARTNERSHIP MODELS

The specific partners involved in each implementation will vary depending on the geography and context and can include governments and regional political bodies, domestic and international public health organizations, private foundations, multi-laterals, bi-laterals, and pooled investment vehicles.[x]

6.3 IMMEDIATE NEXT STEPS

This section provides a collection of immediate next steps that would position the newly established program office to pursue both programmatic (e.g., the creation of the cross-chief information officer (CIO) governance and M&E framework) and fundraising activities internally and with external stakeholders.

- **Internal socialization across CDC:** Conduct a socialization process internally to share this cleared strategy more broadly and kick-start the development of an operational plan for the CDC GDHS. This can include webinars, division meetings, large convenings, and a formal launch.

[ix] Focusing on exemplar countries or regions will be a way of utilizing resources to build early momentum for this strategy. Nonetheless, other countries and regions should be invited and supported to learn from activities being conducted in the exemplar countries.

[x] For further information on how CDC partners with organizations see: https://www.cdc.gov/partners/index.html.

- **Governance**: Successful implementation and resource planning will take a whole of Agency approach. Governance will require cross-CIO leadership engagement and shared decision making to ensure priorities, plans, and resourcing align to meet objectives and needs of programs, countries, and regions. Governance will ensure that the leadership and equities across the CIOs, regional offices, and programs are included to inform frameworks, processes and planning to successfully implement this strategy.

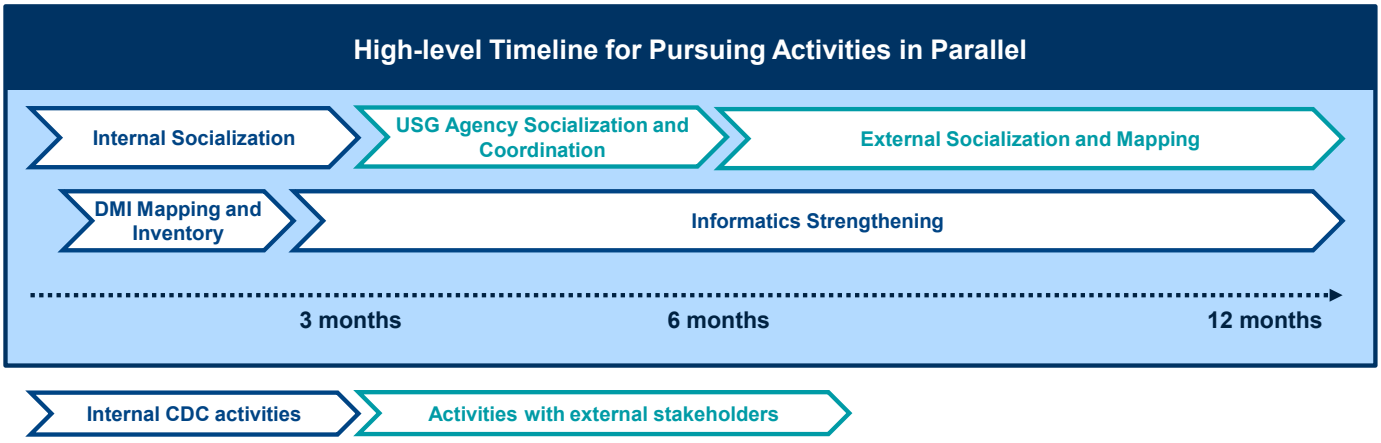
- **DMI mapping and inventory:** Conduct in-depth mapping of strategic approaches articulated in this document to the DMI and vice versa to ensure conscious coordination with the initiative. Simultaneously, conduct an inventory of DMI products, artifacts, and strategies that can be leveraged and extended globally.

- **Informatics strengthening and upskilling:** Identify areas for CDC to move forward with strengthening overall informatics capabilities, e.g., the need for improved understanding of cyber security risk (e.g., holding a convening and creating a strategic approach to addressing this topic) and supporting lifelong learning.

- **U.S. government (USG) agency socialization and coordination:** Hold USG specific discussions to realize a broader USG approach to digital health, working in an inter-agency manner to achieve the proposed collective vision articulated in this strategy.

- **External socialization and mapping:** Conduct socialization with partners and hold convenings that clarify and map partner strategies to the objectives and identify opportunities for collaboration in the near, mid, and long term.

Figure 4: High-level Timeline for Pursuing Activities in Parallel



6.4 CONCLUSION

To lower global morbidity and mortality, a new approach to developing digital systems is needed. Partners must work in collaboration to digitally enable health services through the use of shared digital platforms, the building of effective governance structures, and strengthening of system-wide workforce development. This strategy advocates for a paradigm shift that encompasses both digital and non-digital foundations across the global health community. It is a call to rally around a set of shared goals and objectives – where the achievement of each goal depends on collective commitment and action. It is through this shift that the field of public health can modernize data use to support timely information sharing and decision making and meet health goals.

CDC's most important role in contributing to this shift is to adopt and pursue the realization of shared platforms for digital enablement, utilizing its areas of strength as a leading global public health agency, including active coordination and advocacy with the global health community for this approach.

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