Digital health and universal health coverage: opportunities and policy considerations for Pacific Island health authorities

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Asia Pacific Observatory
on Health Systems and Policies

POLICY BRIEF

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Authorship and acknowledgements

Acronyms and abbreviations

APO	Asia Pacific Observatory on Health Systems and Policies
CRVS	civil registration and vital statistics
DHI	digital health intervention
DHIS2	District Health Information System, version 2
e-health	electronic health
HIS	health information system
ICT	information and communications technology
LMICs	low- and middle-income countries
NHIS	National Health Information System
PHIN	Pacific Health Information Network
PICTs	Pacific Island countries and territories
SDG	Sustainable Development Goal
SMS	short message service (i.e. text message)
UHC	universal health coverage
WHO	World Health Organization

Glossary of key terms

Digital health – the field of knowledge and practice associated with the development and use of digital technologies to improve health. Digital health expands the concept of e-health to include consumers of digital health information and services, using a wider range of smart devices and connected equipment. It also encompasses other uses of digital technologies for health such as artificial intelligence, big data and robotics.

E-health – the use of information and communications technology to support health and health-related fields, including health-care services, health surveillance, health literature, health education, and knowledge and research. E-health and digital health are typically used interchangeably.

Electronic medical records/electronic health records – a repository of clinical and other information used in patient care, which is captured in a structured, computer-readable form that supports interoperability and clinical decision making. Specifically, electronic medical records refer to individual patient files, and electronic health records refer to aggregated service data (e.g. number of occasions of service per day) and other health system-related records (e.g. stock levels).

Health information system – a system that integrates the collection, processing, reporting and use of information to improve health service effectiveness and efficiency through better management at all levels of health services.

Information and communications technology – refers to all communication technologies that enable users to access, retrieve, store, transmit and manipulate data and information in a digital form. Includes the Internet, wireless networks, mobile (cell) phones, computers, software, videoconferencing, social networking, and other media applications and services.

Interoperability – the ability of different information technology systems and software applications to communicate, exchange data and use the information that has been exchanged. In health care, data exchange schema and standards should permit data to be shared across clinical, laboratory, hospital and pharmacy systems, and with the patient, regardless of the application or application vendor. Interoperability means that health information systems work together within and across organizational

boundaries, which improves the effective delivery of health care for individuals and communities.

Telehealth – the delivery of health-care services using information and communications technology when the patient and provider are separated by distance.

Pacific Island countries and territories – a group of 22 island countries and semi-autonomous territories located in the South and North Pacific Ocean: American Samoa, the Commonwealth of the Northern Mariana Islands, the Cook Islands, the Federated States of Micronesia, Fiji, French Polynesia, Guam, Kiribati, the Republic of the Marshall Islands, Nauru, New Caledonia, Niue, Palau, Papua New Guinea, Pitcairn Island, Samoa, Solomon Islands, the Kingdom of Tonga, Tokelau, Tuvalu, Vanuatu, and Wallis and Futuna.

Primary care – a term used to describe the first contact a person has with the health system when they have a health problem or issue that is not an emergency. It is the part of the health system that people use most. Primary health care may, for example, be provided by a general practitioner, physiotherapist or pharmacist, or by a community health service or facility.

Primary health care – a term used to describe a whole-of-society approach to health that aims at ensuring the highest possible level of health and well-being and their equitable distribution by focusing on people's needs and as early as possible along the continuum of health promotion and disease prevention to treatment, rehabilitation and palliative care, and as close as possible to people's everyday environment.

Universal health coverage – a concept that means all people have access to the health services they need, when and where they need them, without financial hardship.

Policy brief

Background

The provision of adequate health services is critical to achieving the Sustainable Development Goals (SDGs), attaining universal health coverage (UHC) and realizing the Pacific's own "Healthy Islands" vision. Despite this, progress in health service delivery in many Pacific Island countries and territories (PICTs) has been slow.

Recent advancements in information and communications technology (ICT) and the associated emergence of digital health tools are anticipated to change the face of health care in resource-constrained settings, including how primary and public health services are delivered.

This policy brief and associated working paper aim to identify digital health interventions (DHIs) that are evidence based and contextually appropriate for PICTs. These are presented so that decision-makers in PICTs can consider their appropriateness for adoption, and select interventions that may support action to address priority health system challenges; details are provided in the Working Paper. Strategic policy advice to guide digital health development is also provided.

This policy brief complements the World Health Organization (WHO) *Global strategy on digital health, 2020–2025* (1) and the *Regional action agenda on harnessing e-health for improved health service delivery in the Western Pacific* (2) (both endorsed by Member States), and supplements these documents by presenting a suite of actions contextualized for Pacific Island users.

Use of digital health globally and in the Pacific

Across low- and middle-income countries (LMICs), various DHIs have been implemented in response to specific health-care delivery challenges. These initiatives leverage a combination of ubiquitous technologies (such as mobile devices) and progressively sophisticated and purpose-designed systems to support a range of health functions, including patient data collection and transfer, diagnostics, remote clinical monitoring, supply chain management, and business and human resources administration.

The use of digital health in PICTs is increasing. Examples of its application include (but are not limited to) supporting health worker-to-health worker communication for clinical decisions in Solomon Islands; use of satellite communication networks to transfer data between remote health facilities in Tuvalu; and two-way mobile near real-time health data exchange in Papua New Guinea. Despite these encouraging examples, many well-intentioned DHIs in PICTs have failed, often due to a misalignment between system design and contextual realities; differing priorities of end-users, system designers and funders; an assumption that a "one-size-fits-all" approach is appropriate across highly diverse contexts and premature roll-out of digital health tools.

Development efforts in the Pacific have been hampered by a lack of the administrative, ICT and broader systemwide architecture required to support the sustainable and scalable use of digital health. Many PICTs are still considered to be at a "foundational, or early, stage" of digital health maturity. To move beyond this stage, the focus of digital health development must shift towards integration to improve health system processes and health outcomes (3).

Given this situation, this policy brief and associated working paper aim to cast light on three questions:

  i. What are the health system challenges for Pacific decision-makers that digital health may support?
  ii. What policy and implementation issues should be considered to maximize the likelihood that adopted DHIs are sustainable and scalable?
  iii. Where should health resources be directed to best capitalize on opportunities that digital health offers?

Important health system challenges in the PICTs and priority digital health responses

To identify the important health system challenges faced by Pacific decision-makers, and to understand what context-relevant DHIs should be prioritized in response, we conducted:

- a thematic analysis of 5 years (2015–2020) of senior-level Pacific health meeting reports
- a comprehensive literature review
- consultations with Pacific policy leaders and digital health development experts.

Four themes emerged. These themes and corresponding priority digital health responses are presented in **Table 1**.

Table 1.   Important UHC-related challenges identified by Pacific leaders and priority digital health responses

Important UHC-related challenges identified by Pacific leaders		Health system challenges*	Priority digital health responses
	Building systems for the collection and timely exchange of health data (for clinical management and health system planning)	Lack of quality/reliable data Communication roadblocks Lack of access to information or data Lack of unique identifier Insufficient continuity of care Loss to follow up Poor planning and coordination High cost of manual processes	Digital health information systems Digital tracking/ unique identifiers Shared electronic health and medical records Digital linkage of health data with CRVS systems

Table 1. Important UHC-related challenges identified by Pacific leaders and priority digital health responses (contd)

Important UHC-related challenges identified by Pacific leaders	Health system challenges*	Priority digital health responses
Addressing access barriers to health services, particularly for communities in rural and remote areas, and ensuring quality care is available when and where it is needed	Geographical inaccessibility Inadequate access to transportation Insufficient supply of services Insufficient supply of qualified health workers Insufficient continuity of care Insufficient supply of commodities Delayed provision of care High cost of manual processes	Telehealth Shared electronic health and medical records Digital stock and commodity management systems
Improving mechanisms for communication with and between facilities, health staff and the functions of the health system Providing adequate staff supervision and clinical decision-making support to health workers in rural and remote areas	Inadequate supportive supervision Lack of or inappropriate referrals Poor planning and coordination High cost of manual processes Poor accountability between the levels of the health sector Inadequate understanding of beneficiary populations	Digitally enabled health worker-to-health worker communication Clinical decision-making support
Addressing health workforce training needs and essential skills deficits	Insufficient health worker competence Low health worker motivation High cost of manual processes	e-learning platforms

CRVS = civil registration and vital statistics; UHC = universal health coverage
* As per the taxonomy used in the World Health Organization Classification of digital health intervention v1.0. (4)

Policy and implementation issues that need to be considered by PICTs

First and foremost, it must be stressed that DHIs complement and enhance health system functions. They do not replace fundamental health system components such as the health workforce, supply chains, financing or governance (5–7). In PICTs, where achievement of health service delivery goals is highly resource sensitive, digital health must add demonstrable benefit to justify the expenditure of resources that could otherwise be allocated to facilities, equipment, staff, medicines and other commodities (8).

While digital health is claimed to support resource-efficient, patient-oriented care, evidence for this is limited, particularly in settings where transaction costs are high. Given this, decision-makers in PICTs should appreciate that the costs and benefits of DHIs are a function of local need and context, how an intervention evolves over time, the intervention's impact in the presence (or absence) of viable alternatives, and the extent to which users interact with the intervention. As such, a diverse set of costs and benefits, including those falling outside the health sector, should be assessed when considering the value proposition that digital health offers.

Digital health interventions complement and enhance health system functions through accelerated access to and exchange of information. They do not replace fundamental health system components such as health workforce, supply chains, reporting, financing or governance.

A further factor to consider is that, while health authorities may drive digital health programmes, stakeholders from multiple government and nongovernment sectors (including the corporate telecommunications sector) have a part to play in seeing plans come to fruition.

Recommendations

Because health systems, health system challenges, stage of digital development and opportunities for adoption of digital health differ across the PICTs, each country or territory will need to assess and determine their own priorities and opportunities, and devise tailored digital health development strategies in response.

Our review of the literature on the use of digital health to support health-care delivery in LMICs found that investment in the systemwide architecture (policies and regulations, standards, infrastructure, people, tools and procedures) required for digital health pays dividends in terms of its sustained and scalable adoption. Investment in these fundamentals should therefore be central to all development efforts.

Recommendations for all PICTs

For the successful implementation of digital health, ministries of health in PICTs should:

- **develop a national digital health strategy** that identifies timelines and priorities for advancing the infrastructure, policies, workforce skills and broader systems needed to support implementation of digital health;
- **assess the need for and capacity to deliver digital tools** that support action to overcome priority issues in primary health care delivery and achieving UHC;
- **take steps to build the human and institutional capacity and physical infrastructure** required to support digital health – establish mechanisms for digital health governance, create new staff positions for managing and implementing digital initiatives, support skills development in ICT, and put in place mechanisms to support adoption of new technology;
- **develop mechanisms to engage stakeholders** from other ministries and the private sector, and work with them to address the systemwide challenges to sustainable and scalable adoption of digital health;
- **develop administrative instruments** (i.e. the legislation, policies and procedures) to ensure that digitized health data are secure and used appropriately;
- **monitor and evaluate** the implementation of digital health and its impact on health system function and share findings within and across countries.

Recommended actions for PICTs new to digital health

In addition to the overarching recommendations above, priorities for PICTs new to digital health are as follows:

- **to build domestic political support** for digital health by collecting and presenting evidence, including evidence of the likely impact of digital health on health-care access, quality, equity and budgets;
- **to secure the financial and technical support** required for implementing a national digital health strategy;
- **to assess the coverage of essential services** (e.g. electricity, Internet and mobile phone coverage), determine what DHIs are feasible, and ensure that the findings of this assessment are reflected in the national digital health strategy;
- t**o establish country-led governance structures** to drive and guide the prudent use of digital health to support UHC and primary health care delivery.

In terms of digital interventions, priorities for PICTs at this stage of digital health maturity are as follows:

- **to establish (or, if in place, improve) an electronic health information management system** that supports the ongoing collection, secure transfer and storage, and analysis of digitized health data across the health system;
- **to establish (or, if in place, improve) processes for digitizing newly collected health data**; where capacity is available, this may be extended to the retrospective digitization of medical and health records;
- **to plan for the introduction of a unique patient/provider/ facility identification system** (e.g. unique patient ID number);
- **to seek opportunities to introduce facility-level electronic medical records.**

Recommended actions for PICTs with foundational digital health infrastructure and systems in place

PICTs that have foundational digital health infrastructure and systems in place should:

- **focus on establishing a workforce that is able to integrate digital health** as a routine part of health service delivery, including targeted skills development; creation of roles within the public service for digital health ICT engineers, data managers and analysts; and support for the workforce at both national and subnational levels to adopt new technologies and to ensure that project-based interventions can be scaled and implemented systemwide;
- **conduct a gap analysis of the legal and administrative instruments** (i.e. laws, standards, policies and procedures) required for data security, storage and use, and take action to address the identified gaps;
- **expand the use of digital health tools** in accordance with the local need and opportunity (e.g. by expanding the range of digital tools used or the number of sites/people using them);
- **develop a plan to enhance the national digital health architecture**, including selecting and adopting standards that support interoperability and information exchange, to help more efficient and reliable information-sharing and use within and between ministries of health and other ministries.

In terms of digital interventions, PICTs at this stage of digital health maturity should focus their efforts on high-impact DHIs such as:

- establishing unique identification systems
- developing electronic medical records systems
- digitizing stock and supply chain management
- delivering telehealth-supported services (including health worker-to-health worker communication and decision-making support and, where feasible, direct service delivery to patients)
- expanding e-learning opportunities.

Recommended actions for development partners

Priorities for development partners are as follows:

- to work with international agencies, donors, philanthropic organizations and the corporate sector to improve coordination of investment in digital health;
- to support prudent decision-making by providing context-specific evidence on the benefits, opportunities and risks associated with adoption of digital health;
- to assist PICTs in developing a business case for digital health and, where appropriate, source or provide financial assistance;
- to provide guidance on the development of national digital health strategies and action plans and, where needed, support efforts to develop national capacity;
- to produce adaptable tools (e.g. protype templates) to guide PICTs' development of the system architecture required for digital health;
- to support leaders in PICTs to set agendas and establish governance for digital health development;
- to monitor, synthesize and share trends in digital health innovation with decision-makers in PICTs, and collect and share examples of good practice;
- to support digital health monitoring and evaluation, and the translation of findings into action;
- to ensure that digital health innovations are in step with other Pacific region health and social development initiatives.

Role of telecommunication companies

Engaging telecommunication providers as partners in delivering digital health programmes is critical, given their role in ensuring that the necessary ICT infrastructure is in place. Where appropriate, public–private partnerships for digital health should be considered.

Looking to the future

As PICTs' digital health maturity and experience grows, development of innovative digital health applications to address a wider range of challenges to UHC and primary health care will increasingly generate unique knowledge that should be shared, within and outside the region, to support better digital health practice globally.

Working paper
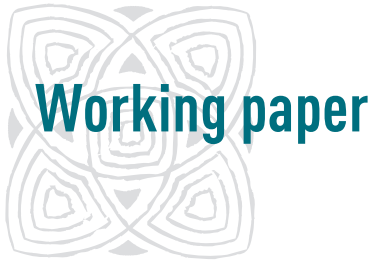
Introduction

The World Health Organization (WHO) defines universal health coverage (UHC) as ".... all individuals and communities receive the health services they need without suffering financial hardship. It includes the full spectrum of essential, quality health services, from health promotion to prevention, treatment, rehabilitation, and palliative care across the life course" (9). Moving towards UHC demands strengthening health systems in all countries. The WHO Health Systems Framework describes six building blocks of robust health systems that can achieve UHC. These are leadership and governance; health workforce; access to essential medicines (including medical products, vaccines and technologies); service delivery; financing; and health information systems (5).

The delivery of sufficient health services is recognized as being critical to attaining UHC (9) and achieving the United Nations Sustainable Development Goals (SDGs) (10, 11), and is fundamental to realizing the Pacific's own "Healthy Islands" vision (3, 12, 13). Despite this, progress towards achieving UHC in many Pacific Island countries and territories (PICTs) has been slow, hindered by (among other factors) weak health systems and workforce shortages; geographical barriers and economic challenges; poor infrastructure; geopolitical and environmental crises; and weak governance (14, 15).

One hopeful area of development to help address some of these challenges is the application of information and communications technology (ICT), especially if offered in a sustainable way and at scale (2, 16). The potential contribution of ICT in efforts to make health care more efficient, accessible and effective has led to the growth of new digital applications, some of which are being implemented in low- and middle-income countries (LMICs) (17–19).

The application of ICT in the health sector is referred to as "digital health". Digital health is an umbrella term that encompasses e-health, together with emergent areas such as machine learning and remote sensing (1, 20). A useful definition describes digital health as "the field of knowledge and practice associated with the development and use of digital technologies to improve health. … Digital health expands the concept of eHealth to … [encompass] other uses of digital technologies for health" (1).

Put simply, digital health interventions encompass those that collect and deliver health data and information from and to health professionals and health consumers through the Internet and telecommunications; use of ICT to improve public health service delivery; or use of ICT to support health system management.

Given the potential of digital health when devised as part of a systemwide approach, the question must be asked: **what further action could be taken to enable the prudent adoption of digital health in PICTs?**

Because achieving health service delivery goals in PICTs is so resource sensitive, technological interventions must add demonstrable benefit to justify the expenditure of resources that could otherwise be allocated to facilities, equipment, staff, medicines and other commodities (8). Furthermore, although the literature is laden with claims that digital health interventions (DHIs) have resulted in improved efficiency and better service, there is also evidence of waste, frustration and failures. These failures are said to be due – in part – to a misalignment between system design and contextual realities; differing priorities of end-users, system engineers and funders; an assumption that a "one-size-fits-all" approach is appropriate across highly diverse contexts and premature roll-out of digital health tools (8, 21–24). Resource wastage due to poorly conceived, designed or executed interventions is an outcome that PICTs cannot afford.

This paper adds to the body of work designed to support the adoption of digital health in LMICs and to the existing literature relating specifically to PICTs (*see* "How this document should be used" below).

Objectives

This working paper and the associated policy brief aim to provide policy-makers in PICTs with insights and guidance on where and how DHIs may support their efforts towards UHC. There is no one-size-fits-all approach to digital health development; the local context (resources, ICT infrastructure, workforce capacity, financial situation, etc.) is critical to any digital development plans in individual PICTs. Given the early stage of digital health maturity across the PICTs, the Working Paper focuses on the policy considerations needed to establish the foundations for prudent, sustainable and scalable use of digital health to address UHC challenges.

The Working Paper comprises three parts:

- **Part 1 (context and digital health maturity in the Pacific)** provides a baseline measure of readiness for digital health adoption across the PICTs, and a contextual reality check on which the Policy Brief is based.
- **Part 2 (selected digital health interventions for UHC in PICTs)** discusses selected high-impact DHIs in response to priority UHC challenges identified by policy-makers in PICTs.
- **Part 3 (policy responses to support adoption of digital health in the Pacific)** provides advice on the policy responses that should be considered to support digital health adoption and avoid mistakes experienced in other LMIC settings.

Who should use this document

This document is primarily for decision-makers responsible for managing health systems and the delivery of UHC in PICTs. This includes ministers, secretaries, undersecretaries, senior bureaucrats of ministries of health, and their national and international collaborators (including ministries responsible for infrastructure, telecommunication, finance and social development, and development partners). It is also relevant to teams charged with managing health information and implementing DHIs in PICTs.

The Policy Brief and Working Paper will be of interest to those seeking to understand how digital health contributes to UHC and the other health aims of the SDGs. This will include staff of technical assistance, philanthropic, corporate, aid and donor organizations, and students of global health, public health and international development studies.

How this document should be used

This document should be used as a companion to the existing body of literature providing technical guidance for the adoption of digital health in resource-constrained settings. Specifically, readers are directed to the following seminal resources: the WHO *Global strategy on digital health, 2020–2025* (1), the *Regional action agenda on harnessing e-health for improved health service delivery in the Western Pacific* (2) the *WHO guidelines: recommendations on digital interventions for health system strengthening* (20), the *National eHealth strategy toolkit* (25), and the *Digital health implementation guide for the Pacific* (26).

At the Pacific regional level, this document supports the UHC ambitions outlined in the Healthy Islands vision (3, 13, 27). Further, the document will provide policy guidance and options to support the implementation of the Pacific Health Information Network's (PHIN's) regional digital health strategy (28).

Part 1. Context and digital health maturity in the Pacific

The Pacific context

The Pacific islands are located over one third of the earth's surface and are home to 11.4 million people (Fig. 1.1) (29, 30), 8.2 million of whom reside in Papua New Guinea. The remaining population is dispersed across the thousands of islands that constitute the other 21 PICTs (30). Eight PICTs have populations of less than 25 000 and three less than 10 000, while Niue and Tokelau each have populations of approximately 1200 (30). All Pacific Island countries are considered to be LMICs, with three (Fiji, Samoa and Tonga) classified by the United Nations within the "high" human development stratum and four (Kiribati, Papua New Guinea, Solomon Islands and Vanuatu) in the "medium" stratum (31).

Fig. 1.1   Map of the Pacific islands and region
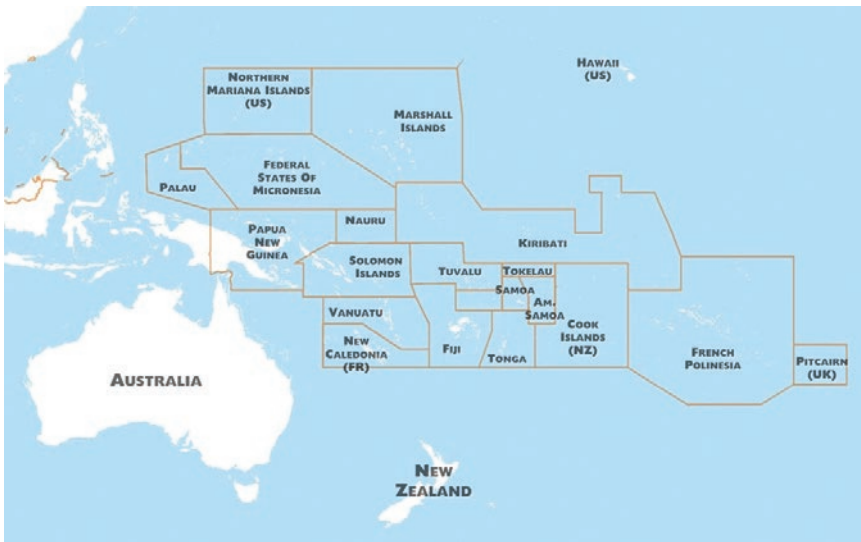
Source: Risk of COVID-19 importation to the Pacific islands through global air travel (32)

The PICTs are not a homogeneous group but rather a bloc of 15 self-governed countries and seven territories of other countries. The PICTs are ethnically, politically, geographically and culturally diverse, and operate different health models.

While diverse, the PICTs share many challenges that affect both the health status of their populations and their capacity to deliver UHC. In addition to the universal lack of financial and human resources, these challenges include the reality that a large proportion of the population of PICTs lives in small and isolated rural villages reliant on mainly subsistence economies.

The PICTs are not a homogeneous group but rather a block of 15 self-governed countries and seven territories that are ethnically, politically, geographically and culturally diverse. The PICTs, however, share many challenges that impact the overall health status of their populations and their capacity to deliver UHC.

Even with an increasing level of urbanization, national capitals and larger towns are often bordered by clusters of villages with generally poor housing conditions. Urban dwellers share many problems with their rural counterparts, including limited income, poor sanitation and endemic diseases (8).

Despite marked improvements in recent years, maternal and perinatal health in PICTs is below global standards, and maternal, infant and child mortality rates remain unacceptably high (33, 34). PICTs also face a rise in the burden of noncommunicable diseases. Obesity, accompanied by a rapid rise in type 2 diabetes, is now estimated to affect 50% of the Pacific Islands' population (35). This phenomenon places additional demand on already overstretched health systems.

The lack of human and financial resources for health in many PICTs means that standards of health-care provision are inevitably compromised. Primary health care is normally provided through community-based clinics offering variable levels of service. There is substantial reliance on paramedical workers (i.e. community health workers or staff with limited training) in rural and remote areas. Patients in many PICTs have long, arduous and often expensive journeys to reach a rural health facility. At the next level, provincial and regional facilities offer limited hospital-based care, such as basic surgery and maternity services, and deliver

facility-based and outreach programmes, such as immunizations and environmental health programmes. Most PICTs have a national hospital where patients in need of higher level or specialist care may be referred. Hospitals are often dependent on visiting specialists and are commonly staffed by foreign doctors (who may not know the local language or customs), and they often have limited medical equipment. Some health facilities (particularly those at the periphery of health systems) lack reliable access to essential utilities, including clean water and electricity (8).

Implementing and keeping digital systems functioning in many PICTs has been a challenge due to the lack of financial resources, infrastructure, human resources for support services and user ICT abilities (8, 36). Internet connections, while improving, are unpredictable and expensive in some areas, and electricity supply can be intermittent outside of urban centres. Funding for digital health must compete for scant resources with essential patient care (medications, consumables, clean water, electricity and basic equipment).

Digital health maturity in the Pacific

In many PICTs, adoption of digital technology is a relatively new phenomenon. The recent work of WHO in collaboration with Liaw et al. (36) to assess the level of readiness and ability of PICTs to adopt digital health has produced digital health maturity profiles for 17 of the 22 PICTs.

This work examines five dimensions of digital health considered to be essential for digital health success:[1]

i.   availability of and access to ICT infrastructure;

ii.   use of essential digital tools (such as unique patient identification systems and electronic health and medical records systems);

iii. availability of standards for health information-sharing;

iv.   enablers of digital health adoption;

v.   quality improvement and evaluation activities.

Aggregate component "scores" were calculated and organized into five strata ranging from "basic" (where the foundations for digital health

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1   Refer to the paper by Liaw et al. (36) for details about the components of the assessment tool used.

were either non-existent or very weak) through to "innovative" (where sustained and integrated use of DHIs for health service delivery is evident).

A summary of the digital health maturity assessments for PICTs is presented in Table 2. The table highlights the early stages of digital health development and limited readiness for digital health across the region. It also indicates where investments in digital health could be focused.

The evaluations found that, across the PICTs assessed, limited progress has been made in establishing the foundations for digital health, with examples of progress tending to be associated with externally funded projects. The evaluations found that most gains have been made in the areas of ICT infrastructure (mainly owing to investment in new communication infrastructure and growth in mobile phone usage) and improved compliance with standardized civil registration and vital statistics (CRVS) coding (36). In terms of health information management, most PICTs are in a "stage of transition", moving from paper-based to electronic systems.

Table 2. Number of assessed PICTs falling into each level of the Informatics Capability Maturity Model (levels 1–5), by assessment category (for 17 PICTs)

Level of digital health maturity/ descriptors*		ICT infrastructure	Essential digital tools	Information standards	Enablers of digital health adoption	Quality improvement and evaluation
Level 1: Basic	Digital systems are ad hoc, unstable and chaotic, and focused on avoiding "downtime". Processes are unproven, disjointed and uncoordinated. Knowledge is not shared, and performance is unpredictable.	8 (47%)	14 (82%)	12 (71%)	11 (65%)	12 (71%)

Table 2. Number of assessed PICTs falling into each level of the Informatics Capability Maturity Model (levels 1–5), by assessment category (for 17 PICTs) (contd)

Level of digital health maturity/ descriptors*		ICT infrastructure	Essential digital tools	Information standards	Enablers of digital health adoption	Quality improvement and evaluation
Level 2: Controlled	Digital systems are coordinated, and processes are becoming predictable but are still inconsistent. Knowledge is siloed. Systems are reactive and problem driven.	8 (47%)	3 (18%)	5 (29%)	6 (35%)	5 (29%)
Level 3: Standardized	Digital systems are centralized and processes consistent. Organization-level collaboration is evident, and knowledge is shared. The system has predictable performance. Systems are request driven.	1 (<1%)	0	0	0	0
Level 4: Optimized	Digital systems are integrated and support cross-organization knowledge-sharing and collaboration. Systems are proactive, accountable and service driven.	0	0	0	0	0
Level 5: Innovative	Digital systems are dynamic and catalysts for innovation, supporting industry-level knowledge-sharing and collaboration. Systems are value driven.	0	0	0	0	0

ICT = information and communications technology
* Adapted from the level descriptions provided in Liaw et al. (36)

While a growing number of PICTs have developed a national digital health strategy, many of these are yet to be costed, fully resourced or endorsed. The digital health ambitions of PICTs are largely reliant on external funding and technical assistance, which – while generally forthcoming – have, until recently, been delivered in a piecemeal way that has challenged efforts to take a holistic and integrated approach to digital health development. This issue was captured by a health policy officer interviewed during research for this paper who commented, "we developed a [digital health] strategy; however, it remains in draft and – [as such] – we are not really guided by it. [Rather,] we are opportunistic in our approach to supporting the use of ICT in health."

Cost–effectiveness of digital health

While there are claims that digital health can support the provision of resource-efficient, patient-oriented care, particularly in settings where transaction costs are high, evidence for this is currently limited (37). For instance, a recent synopsis of 35 economic analyses of DHIs by Puleo et al. (2021) found weak and inconclusive evidence for cost savings. The authors noted that evidence is insufficient to arrive at a definitive conclusion about the value proposition that digital health offers (38). Murray and colleagues (2016) concur, noting that the available economic analyses are ubiquitous, reductionist and, given that studies were undertaken in different health-care delivery contexts, challenging to compare and generalize (39). The review we conducted for this paper found that cost–benefit analyses of DHIs tended to be methodologically heterogeneous, intervention-specific and limited to initiatives implemented in developed countries. We found no evaluations examining the cost–effectiveness or cost–utility of health systems in LMICs or small island developing states.

Gomes, Murray and Raftery (2022) (40) and others (39, 41, 42) suggest that the economic evaluation of DHIs raises distinct methodological challenges that are not well understood or addressed; therefore, the true costs and benefits of investment in digital technology in health are still unclear. They note that most published economic evaluations of DHIs have adopted methodologies for evaluating health-care technologies, which do not reflect the distinct nature of DHIs. They argue that DHIs are typically complex interventions, composed of multiple interacting components, and hence establishing their cost–effectiveness will require a much broader

assessment of costs and effects, including non-health benefits and costs falling outside the health-care sector (40, 42).

Given the limited evidence, decision-makers in PICTs should take a pragmatic and precautionary approach to determine the value proposition that digital health offers, and whether evidence for the budget impact of digital health should drive decisions about its adoption. Decision-makers should appreciate that what may be perceived (and reported) as an unreasonable cost in settings where alternative health-care delivery options are available may not translate to PICTs, where alternatives are likely to be limited. The costs and benefits of DHIs are a function of local need and context, how an intervention evolves over time, and the extent to which users interact with the interventions. As such, a more diverse set of costs and benefits should be considered.

PICTs can make an important contribution to knowledge by improving the methodological rigour and reporting of studies examining the cost–effectiveness and cost–utility of DHIs in LMICs. Further, PICTs may consider framing economic evaluation in terms of the long-term cost–effectiveness of these technologies for health-care delivery and – indirectly – for a broader range of social and economic outcomes (37, 43).
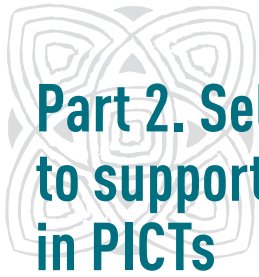
Part 2. Selected digital health tools to support the achievement of UHC in PICTs

To shed light on the priority UHC-related challenges of Pacific leaders, we undertook a thematic analysis of the discussions, resolutions and recommendations from five years (2015–2020) of Pacific health meetings among senior-level persons, conducted a literature review and consulted with senior Pacific leaders.

Four themes emerged:

i.   a need to build systems for the collection and timely exchange of health data (for clinical management and health system planning);

ii. an urgent need to address access barriers to health services, particularly for communities in rural and remote areas, and to ensure that quality care is available when and where it is needed;

iii. a need to improve mechanisms for communication with and between facilities, health staff and the functions of the health system, and to provide adequate staff supervision and clinical decision-making support to health workers in rural and remote areas;

iv. a need to address health workforce training requirements and essential skills deficits.

An account of this research and its findings is available in a separate publication (44).

Together with our review of the priority UHC-related challenges identified by Pacific leaders, we also consulted the literature to further understand how DHIs have been used to address such challenges across LMICs globally. Summary findings from this umbrella review are included as **Annex A**. Evidence gathered through this work has informed our understanding

of the digital health tools outlined below. These findings are summarized in **Table 3**.

We note that the interventions discussed may be aspirational for some PICTs and that the discussion is not a list of all DHIs that may be adopted to support UHC. PICTs will need to assess their level of digital health maturity, specific requirements, and capacity to develop, implement and maintain digital interventions. Readers interested in other DHIs are referred to the *WHO guidelines: recommendations on digital interventions for health system strengthening* (2019) (20) and the WHO *Classification of digital health interventions v1.0* (2018) (4).

Table 3.   Important UHC-related challenges identified by Pacific leaders and priority digital health responses

	Important UHC-related challenges identified by Pacific leaders	Health system challenges*	Priority digital health responses
	Building systems for the collection and timely exchange of health data (for clinical management and health system planning)	Lack of quality/reliable data Communication roadblocks Lack of access to information or data Lack of unique identifier Insufficient continuity of care Loss to follow up Poor planning and coordination High cost of manual processes	Digital health information systems Digital tracking/ unique identifiers Shared electronic health and medical records Digital linkage of health data with CRVS systems
	Addressing access barriers to health services, particularly for communities in rural and remote areas, and ensuring that quality care is available when and where it is needed	Geographical inaccessibility Inadequate access to transportation Insufficient supply of services Insufficient supply of qualified health workers Insufficient continuity of care Insufficient supply of commodities Delayed provision of care High cost of manual processes	Telehealth Shared electronic health and medical records Digital stock and commodity management systems

Table 2.   Number of assessed PICTs falling into each level of the Informatics Capability Maturity Model (levels 1–5), by assessment category (for 17 PICTs) (contd)

Important UHC-related challenges identified by Pacific leaders	Health system challenges*	Priority digital health responses
Improving mechanisms for communication within and between facilities, health staff and the functions of the health system Providing adequate staff supervision and clinical decision-making support to health workers in rural and remote areas	Inadequate supportive supervision Lack of or inappropriate referrals Poor planning and coordination High cost of manual processes Poor accountability between the levels of the health sector Inadequate understanding of beneficiary populations	Digitally enabled health worker-to-health worker communication Clinical decision-making support
Addressing health workforce training needs and essential skills deficits	Insufficient health worker competence Low health worker motivation High cost of manual processes	e-learning platforms

CRVS = civil registration and vital statistics; UHC = universal health coverage
* As per the taxonomy used in the World Health Organization Classification of digital health interventions v1.0. (4)

Digital health tools that support the collection and timely exchange of data and information across the health sector

Digital health information systems

To date, PICTs have rightfully focused their attention on digitizing health information and using proprietary or open-source health information system (HIS) platforms to collect, store, transfer, analyse and visualize health data to guide public health interventions. This work is ongoing

across the Pacific, with increasing levels of provincial- and even facility-level participation in direct data exchange. Perhaps the most well-developed example of a digital HIS in the Pacific comes from Papua New Guinea, which has been implementing an electronic national HIS (the e-NHIS). The e-NHIS has integrated mobile technologies and geographical information system datasets at household-, village- and health-facility levels across the country since 2015 (45). The system is reported to have increased the "timeliness, completeness, quality, accessibility, flexibility, acceptability and utility of national health data" (45).

PICTs yet to implement digital HIS solutions have various proprietary and open-source options available to them. PICTs must each consider what system best meets their specific and ongoing needs and adds the greatest value. The experience gained is invaluable and should be shared.

Other PICTs, including Solomon Islands, Tonga and Vanuatu, have adopted the open-source and WHO-supported HIS platform District Health Information Software (version 2; DHIS2). DHIS2 supports routine digital reporting from facilities to the central level across multiple programmes, including standard periodic reporting on service delivery, and reporting from specific programmes, such as reproductive and maternal health programmes (46–48). Using the DHIS2 platform, these countries are migrating previously programme-specific and "vertically managed" information systems (such as laboratory, radiology, pharmacy and disease-specific information systems) to a common platform. Health authorities are working to equip their subnational counterparts (including provincial health and council officers) to carry out direct data collection and quality monitoring. As seen with the e-NHIS in Papua New Guinea, the adoption of DHIS2 in other PICTs is helping to address data security, quality and usefulness issues, and reportedly improves data stewardship (48).

PICTs yet to implement digital HIS solutions have various proprietary and open-source options available to them, each with different costs and benefits. PICTs can also use the experience gained in Papua New Guinea to assess the suitability of mobile technologies and geographical information systems for their HIS platforms. PICTs must each consider what system best meets their specific and ongoing needs and adds the greatest value. Among other factors, health authorities will need to consider the ICT and human resources infrastructure needed to support a digital HIS, the upfront and ongoing costs associated with different options, and the level

and nature of technical support that will be required and available. PICTs transitioning to a digital HIS should seek opportunities to learn from the experiences of others in the region, assessing both contextual similarities and their own specific needs.

Digital tracking and electronic medical records

Paper-based systems to record occasions of service are commonplace across the PICTs, with service logbooks often used in rural health facilities. These systems introduce an immense clerical burden on health workers and reduce their ability to efficiently keep track of patients' health, treatment and follow-up needs, which are all essential to maintaining the quality and continuity of patient care.

Digital tracking includes digital forms of paper-based registers and case management logs within specific target populations, as well as electronic medical records linked to uniquely identified individuals (4,20) (usually through a unique patient identification number or a biometric marker such as a fingerprint). Digital tracking aims to reduce lapses in the continuity of care by giving health workers access to a comprehensive history of a patient's past services, treatment plans and diagnostic test results. Digital tracking may be linked to a national HIS to allow access to patients' information from multiple sites and by multiple providers, or it can be linked with demand-side interventions, such as targeted digital communication, to increase patients' engagement with preventive health-care services.

An important initial step in being able to digitally track users of a health system (and link users to the services they receive or need) is to assign unique identifiers. This may be a common number used across all government services (e.g. a national ID), a health-specific number used by all health services (e.g. a health ID), or – if warranted and feasible – a unique biomarker, such as a fingerprint. Ideally, unique identifiers would be assigned to users (i.e. patients), providers (i.e. identified health workers) and facilities. They would then be used to link relevant data within a health information management system across time and place. While achieving the comprehensive roll-out of unique identifiers is important for digital data linkage and tracking, it is extremely complex. It therefore needs to be considered within the context of the logistics required, and of broader health and government systems and infrastructure. Interoperability standards and data-sharing protocols (*see* Part 3 below

on recommendations) should be built into ICT infrastructure to support the frictionless sharing of data and information within and across systems.

New work (supported by the Asian Development Bank) in Tonga to enhance national ICT infrastructure and systems to support the digital collection of health data is being watched with interest across the region. The project plan suggests that implementers will take a systems approach, with investments in software and hardware infrastructure, policy and legislation, and tools that will support integrated data exchange, including digital tracking (49, 50). The project aims to implement a patient-level electronic medical record system that supports the well-established DHIS2-based electronic public health information system known as Fanafana Ola (47). De-identified patient-level data will be aggregated and sent to the Fanafana Ola system to enhance routine reporting of public health data and indicators. The project will form part of Tonga's broader e-governance ambitions (50).

While digital tracking is not an immediate priority for all PICTs, functionality for it is built into modern HIS platforms. DHIS2, for instance, can collect and record patient-level data and serve as an electronic health record system, given the right supports. A range of technical, medicolegal and operational issues would need to be considered as part of the implementation of digital tracking.

Digital linkage of health data with civil registration and vital statistics

A well-functioning civil registration system provides the most reliable source of population data on vital events (i.e. vital statistics), namely births and deaths. It has multiple uses, including for planning, evaluating and distributing resources, and for policy development in the health and other sectors. Civil registration also provides the documentary evidence needed for recognition of an individual's legal identity, including their nationality, and their rights to social protection and inheritance (51). While responsibility for CRVS systems sits outside the jurisdiction of the health authorities, the health system has an integral role in facilitating civil registration.

The forms issued by the health system following a birth (i.e. certificate of live birth, notification of birth) or death (i.e. medical certificate of cause of death, notification of death) are required as evidence for the civil registration process in most PICTs. The World Bank and WHO have

developed a global enhancement plan for CRVS systems intending to achieve "universal civil registration of births, deaths and other vital events, including reporting the cause of death, and access to legal proof of registration for all individuals by 2030" (51). A vital component of this plan is to establish or strengthen the linkage between CRVS systems and health systems, including strategies to link with digital health information systems.

PICTs considering the digital integration of their HIS with CRVS systems should ensure that legislative processes are in place. These should explicitly state the roles, responsibilities and accountability of the Ministry of Health and the authority responsible for CRVS, to enable and protect the sharing of data and to appropriately protect the privacy of citizens.

Fiji provides an example of how linking a digital HIS with the CRVS system can improve the timeliness and completeness of birth registration. The digital HIS (PATIS Plus) in the major hospitals across Fiji has been linked to the national civil registration system. When the details from a certificate of live birth are entered into PATIS Plus, this information is automatically sent to the civil registry, which is under the jurisdiction of the Fiji Ministry of Justice. While a parent or caregiver is still required to present to a civil registration office to complete the registration process, the automatic sharing of digital information from the HIS makes the civil registry aware that the birth has occurred and, if registration has not been completed within a certain period, enables the civil registry to contact the parents or caregiver directly to encourage and facilitate timely birth registration. Some limitations remain, however, in the linkage between the digital HIS and the CRVS system in Fiji, such as the fact that approximately 10% of births happen in facilities without a digital link to PATIS Plus (52).

PICTs considering the digital integration of their HIS with CRVS systems should ensure that legislative processes are in place. These should explicitly state the roles, responsibilities and accountability of the Ministry of Health and the authority responsible for CRVS, to enable and protect the sharing of data and to appropriately protect the privacy of citizens. It is also essential that the appropriate ICT infrastructure and human resource capacity are in place so that birth and death data collection and entry into the digital HIS are accurate, timely and complete, and that mechanisms for data-sharing with the civil registry are reliable.

Digital tools to support other systems required for achievement of UHC

In addition to the data collection, transfer, storage and analysis described above, digital tools offer benefits to other systems required to achieve UHC. These benefits include (but are not limited to) support for service-specific information exchange in laboratory and pharmacy information systems, and in specific programmes, such as tuberculosis, malaria or early warning disease surveillance programmes; support for auxiliary services such as financial and human resources management; and support for maintaining registers (such as national cancer registers or immunization registers).

A tendency to view digital health interventions as independent of each other and not as related elements of a country's digital architecture risks limiting their potential impact.

Further, digital tools have a role to play in supporting the collection of data from non-health agencies that are integral to health service planning. For example, national census data, which enumerate population numbers and distribution, age and sex structures, living conditions and other socioeconomic information, are vital to person-centred health service planning. Multiple proprietary and open-source digital health options to support these functions are available for PICTs to consider and – if feasible – adopt. These range from the quite simple and widely available (e.g. Excel database tools) through to highly sophisticated and tailored applications that draw on, for example, mathematical modelling, image processing and remote sensing (52–55).

A tendency to view DHIs as independent of each other and not as related elements of a country's digital architecture risks limiting their potential impact. For example, opportunities exist within a digital HIS to capture and code health facilities and workers by location. These location data may be linked with other datasets and systems: for example, government payroll systems to support service mapping, national Census-derived demographic data to inform planning, and human resources management systems to support the routine and equitable roll-out of staff development activities. Further, integration across digital tools may support efficiencies by streamlining processes. For example, using mobile tablets to collect and feed data directly into the e-NHIS in Papua New Guinea has made the time-consuming and error-prone process of manual paper-based tallying and reporting redundant, freeing up health workers' time, and improving

the timeliness and quality of data collected. Similar efficiencies may be achieved across multiple programmes through clever use of technology.

Integration across information systems requires interoperability to be built into their design. This is most efficiently achieved at the planning stage and through adoption of interoperability standards (*see* Part 3 on policy considerations below).

Digital health tools that support access to quality health services, particularly for hard-to-reach communities

Health worker-to-patient telehealth

Despite improvements in addressing health workforce deficiencies in many PICTs, through schemes such as the Cuban medical assistance programme (53), achieving equitable access to health care and adequate distribution of skilled staff remain significant hurdles (20). While many PICTs are developing role delineation policies and determining the "packages of care" that ought to be available to the public at different levels of the health system, providing the resources (including appropriate staff) to meet these needs is an ongoing challenge.

Telehealth refers to the "use of telecommunication techniques for the purpose of providing telemedicine, medical education, and health education over a distance" (54), and encompasses the preventive, diagnostic and treatment aspects of service provision. It is increasingly being used across LMICs to support the delivery of care to underserved communities,

Telehealth should be viewed as an opportunity to extend the reach and efficiency of the health sector and not as a replacement for provision of primary health care. Mechanisms that support patient access to health facilities and services will still be required for comprehensive person-centred care.

including those in rural and remote areas (55–57). Uses of telehealth vary, and may include "remote consultations, remote monitoring of vital signs or diagnostic data, and the transmission of medical files such as images for review" (20). Telehealth may be as simple as a phone-based consultation, or as complex as video-based examination and diagnosis.

The use of telehealth in PICTs is limited, with only a few examples identified among private providers. While perhaps not feasible (or an immediate priority) for most PICTs, emerging technologies are shifting the landscape. This has prompted consideration of how ubiquitous technology (such as mobile phones and other Internet-connected personal devices) could be used to connect patients with health workers for the delivery of care such as basic consultations, referrals and e-prescription services for chronic disease management.

If PICTs are contemplating implementing more sophisticated telehealth, they will need to consider issues related to digital network availability and connectivity, access to devices, data privacy and obtaining informed consent, data security, the collection and integration of telehealth records with established patient files, and any potential medicolegal implications, among other issues.

Finally, telehealth should be viewed as an opportunity to extend the reach and efficiency of the health sector and not as a replacement for provision of primary health care. Mechanisms that support patient access to health facilities and services (such as laboratory and public health services) will still be required for comprehensive person-centred care.

Digital health stock and commodity management systems

Systems able to support the procurement, tracking and distribution of medical supplies (including essential medicines, vaccines, bandages, needles and syringes, and laboratory consumables) through a health system are critical to strengthening the quality of care that a health system can provide, thereby helping to achieve a core pillar of UHC. Many PICTs have experienced long-standing health system challenges of insufficient supply of stock at points of care; lack of systems to predict, monitor and manage commodity requirements; and lack of transparency in stock and commodity transactions.

To address these challenges, many PICTs have implemented proprietary and open-source digital stock management tools, such as mSupply, which is used in 13 of the 22 PICTs (58), to support the monitoring and distribution of medical equipment and supplies. Solomon Islands provides an example of how digital stock management can lead to improved health system functioning. In Solomon Islands, mSupply is used to digitally link the national medical stores warehouse with those at the National Referral Hospital in Honiara and 44 other health facilities across the country.

Using mSupply, managers in Solomon Islands are better able to monitor inventories and stock levels, forecast demand, and manage transport of sensitive items, such as those that require a cold chain to be maintained (59). Anecdotally, the system has led to greater efficiency, fewer stock-outs and improved financial accountability. Solomon Islands also provides a case study in the fragility of supply chain systems, with a marked reduction in the use of mSupply (and thus visibility and transparency) at primary health care facilities due to the disrupting effect of the COVID-19 pandemic.

Rapid advances in ICT, including the increasing coverage of 2G, 3G and 4G networks, and ubiquitous access to mobile devices, create opportunities to expand the use of digital supply chain management systems across island states and – in doing so – capitalize on the efficiencies that

Rapid advances in ICT and access to mobile devices create opportunities to expand the use of digital supply chain management systems and – in doing so – capitalize on the efficiencies that digital approaches offer.

digital approaches offer. To ensure usability across all digital networks, systems should be developed to operate in 2G environments. Applications for digital supply chain management need to be tailored to national needs and capacities. In some settings, the process may be as simple as health facilities using established communication tools (such as phone, email or text messages) to order supplies from relevant medical stores. In other settings, networked digital systems may allow users at multiple sites to forecast, order, track and manage supplies from warehouses to end-users.

Barriers to implementing digital supply chain management in PICTs include access to electricity and ICT infrastructure; network connectivity and reliability; the usability of devices; and the quality of support provided to workers to use new digital tools. Software, however, is not a panacea for addressing challenges in the management of stock and commodity supply; rather, it is one tool that may aid broader health system strengthening efforts. If PICTs are considering adopting or expanding digital supply chain management solutions, authorities should ensure that these solutions are implementable within existing ICT infrastructure constraints, able to adapt to meet changing needs, and interoperable with other established information systems (such as laboratory or programme-specific information systems).

Digital health tools that support communication between health-care providers and facilities

Health worker-to-health worker telehealth

With large portions of the Pacific population living in rural and remote areas (up to 80% in some PICTs), access to health facilities and trained health workers, including to specialist care, remains a challenge to achieving UHC in many settings. This compromises both the demand for and use of health-care services and the quality of the services provided and is a significant obstacle to improving health outcomes across many PICTs.

Digitally supported health worker-to-health worker communication links less experienced staff with more experienced staff, allowing for clinical supervision and peer decision-making support. Establishing communication channels may also allow remote monitoring of patients' health status, organization of referrals, orientation to new policy and procedures, and provision of training.

Digital technology, most notably technology that supports connection and two-way communication between health workers, has emerged as a valuable tool that helps bridge barriers in communication and aids the delivery of health worker peer support, advice and supervision. Across the PICTs, relatively low-cost and simple technology, including high-frequency radio and telephones, have been used to good effect for many years to link health facilities. With advances in technology and increasing investment in applications such as integrated HIS, opportunities abound to further enable health worker-to-health worker telehealth. For example, the Papua New Guinea e-NHIS allows free, two-way, tablet-based communication between frontline workers across the health system, which enhances staff engagement and leads to improved support and clinical practice (60). Similarly, the Tuvaluan Government's recent investment in satellite ground stations infrastructure at health facilities on outlying islands is allowing two-way communication between the facilities and the national hospital in Funafuti (the only hospital in Tuvalu), resulting in more frequent and diverse engagements with previously isolated staff (60).

Digitally enabled communication between health workers may use readily available technology such as telephones, short message services (SMS) or video- and teleconferencing tools such as WhatsApp and Zoom (if

connectivity allows). If able and required, more sophisticated tailor-made and sophisticated platform-based telehealth services can be utilized. Digitally supported health worker-to-health worker communication links less skilled or less experienced staff with more experienced staff, allowing for clinical supervision and peer decision-making support. Establishing communication channels may also allow remote monitoring of patients' health status, organization of referrals, orientation to new policy and procedures, and provision of training.

Digital health tools that support staff training and skills development

E-Learning

Broadly defined as the "management and provision of education and training content in digital form" (20), electronic learning (e-learning) has emerged as an approach to improve health workers' access to professional development opportunities and resources.

PICTs have a long history of e-learning through remotely delivered higher education and – in the health sector – the Pacific Open Learning Health Net (POLHN). POLHN is an initiative of WHO that aims to improve health professionals' quality and standards of practice by offering free online and blended courses through 54 "learning labs" across the Pacific islands (61, 62).

The expansion in mobile network coverage and increasing access to Internet-connected personal devices across the PICTs raises the possibility of expanding e-learning opportunities for health workers, including for those located in rural and remote areas. Training content may be exchanged in a multimedia format, either in real time or as pre-prepared content. In remote areas where lack of ICT

DHIs are not a panacea for health system weaknesses. Without leadership, well-trained staff, and accountability and transparency, the potential benefit of DHIs will not be realized. Health systems are complex and ever-changing; the design and delivery of DHIs should therefore consider – and aim to address – the root causes of system weaknesses.

infrastructure and geographical barriers inhibit connection, use of pre-loaded devices or a satellite connection are options worth considering. Access to fundamental infrastructure, including electricity, the Internet

and Internet-enabled devices, and the usability of devices, will all need to be considered, as will capacity for producing and maintaining training material and support for health workers using digital tools for learning.

Further, delivery of large-scale DHIs is a multisectoral endeavour, far beyond the capacity of most PICTs' health authorities alone. As such, partnerships are likely to be needed. Building or bolstering new digital tools and systems while strengthening capacity will require pragmatic approaches to secure technical support through donors and/or public–private arrangements. This is to say that where demonstrated expertise in the delivery of complex ICT solutions is accessible, PICTs should not always wait until domestic capacity is available before moving ahead with solutions that save lives. These issues are discussed further in Part 3 of this paper.

DHIs are not a panacea for health system weaknesses. Without leadership, well-trained staff, and accountability and transparency, the potential benefit of DHIs will not be realized. Health systems are complex and ever-changing; the design and delivery of DHIs should therefore consider – and aim to address – the root causes of system weaknesses.

Part 3. Policy considerations to support the adoption of digital health

While there are examples in the scientific literature of DHIs resulting in improved efficiency and access to health care, and better service delivery and service management, there is also evidence of waste, frustration and failures (8, 22–24).

This section of the Working Paper draws on evidence from the literature and interviews with stakeholders to outline key policy considerations required for the successful adoption of digital health.

We frame policy considerations as those that support:

- an enabling environment for digital health
- the technical and organizational requirements for digital health
- technical and financial partnerships (Fig. 3.1).

Fig. 3.1. Framework for conceptualizing policy to support adoption of digital health interventions

Policies to support …			Digital health interventions	Universal health coverage
an enabling environment for digital health	**the technical and organizational requirements for digital health**	**technical and financial partnerships**		
• Vision and leadership • A link to national priorities • A digital health strategy and governance arrangements	• Digital health policies and legislation • Workforce requirements • Information and communications technology infrastructure • Common standards for interoperability	• Technical and financial partnerships • Regional collaborations for resource-sharing and joint development	• The foundations for development and implementation of digital health interventions that support … • (see Part 2 above for examples)	• … efforts at universal health coverage and delivery of the health-related Sustainable Development Goals

Policy to support an enabling environment for digital health

An enabling environment has been described as a set of interrelated conditions – such as legal, bureaucratic, fiscal, informational, political and cultural factors – that affect the capacity of stakeholders to sustainably and effectively engage in development processes. For digital health, an enabling environment includes policies, programmes, standards and governance arrangements that engender trust between regulators, implementers, service providers and users, and build and maintain a competent digital health workforce able to implement an agreed national digital health strategy. Policies must be in place to support a stable digital health architecture that enables data exchange and supports interoperability between the different components and systems of a health enterprise.

Vision and leadership

While a ministry of health is likely responsible for creating the right conditions for digital health, they are not the only ones with a role to play in the Pacific context. The donor, development, nongovernment, business and civil society sectors are resources that may be drawn on to support efforts at digital health development.

To gain and maintain momentum, digital health initiatives require advocates from within the health sector, as well as skilled managers able to communicate a strong vision to guide the reforms required for successful adoption. This requires commitment and leadership at multiple levels of government (but notably at the executive level), backed by robust planning and decision-making structures. Ministries of health are, of course, pivotal to the establishment of digital health, but they will need support from government agencies involved in information technology, telecommunications and finance. To ensure effective cross-sectoral cooperation, it is necessary to build a national consensus on the goals that digital health is intended to achieve, and what infrastructure, systems and policy and governance instruments (including financing and human resources) are required for successful implementation (25). Digital health should sit within a broader whole-of-government vision (or strategy) for using digital technology to improve the effectiveness and efficiency of service provision.

The early establishment of transparent, accountable, efficient and responsive governance mechanisms for digital health is important for bringing credibility and coordination, and securing the "buy-in" of crucial stakeholders from the government, corporate and donor sectors. A culture of collaboration – in which political leaders instil open channels of communication, share goals and trust, and ensure ethical behaviour, mutual respect and collective responsibility – is necessary for the success of digital health initiatives (26). Such structures should contribute to oversight and steering, project management, procurement of technical assistance, stakeholder engagement and communication management (25).

While a government (or more specifically, a ministry of health) is likely responsible for creating the right conditions for digital health, they are not the only ones with a role to play. The donor, development, nongovernment, business and civil society sectors are resources that may be drawn on to support efforts at digital health development. This is particularly relevant in PICTs where community-based organizations (notably church organizations) play an important role in delivering health care. PICTs will each have a different mix of stakeholders, and setting-specific factors such as local know-how, local leadership and local infrastructure that will impact operating environments in quite different ways.

Political will, commitment of resources and the decision-making process of policy-makers, as well as the way plans and decisions are communicated to stakeholders (including the public and health workers), will impact the level of buy-in that is achieved and, subsequently, the likelihood of digital health being successfully adopted.

A link to national priorities

Across the literature, authors emphasize the importance of designing DHIs to align with government priorities and national strategy, and within budgetary constraints.

Employing needs-based approaches when integrating new ICTs for health system improvement is not a new concept (63–65). Developing

Without close alignment between government priorities, national strategy and budget, and without sufficient buy-in from leaders, the mobilization of resources and coordination required for digital health is likely to be very difficult, impacting the cost–effectiveness, speed, scalability and sustainability of adoption, and potentially increasing the opportunity costs that are incurred.

strategies in response to needs and identified priorities can help ensure that DHIs meet their intended purpose, that there is buy-in among those responsible for the success of DHIs, and that what is designed is usable, scalable and sustainable within contextual constraints. For this reason, an early policy question that decision-makers in PICTs must consider relates to which population health needs the proposed DHIs are intended to address.

Interestingly, our review of digital health use found that the focus of most DHIs used in LMICs overlaps with the UHC priorities of Pacific decision-makers (*see* Part 2 above for examples). These priorities include the use of digital health to support health service delivery in rural areas, support health workers through e-learning initiatives, digitally link health workers with patients and with each other, and enhance the collection and use of health data. Telehealth, for example, has been used to supplement service delivery in remote settings that suffer workforce shortages, and technology-enabled health worker-to-health worker communication is being used for supervision and mentoring, and to support real-time peer consultation for clinical decision-making (66–68).

The greater the proprietorship that government authorities have over the design and implementation of digital health interventions, the more likely it is that the interventions will achieve scale and sustainability.

The need to improve the quality, analysis, interpretation and use of health data is a common challenge that many countries have focused on addressing through adoption of technology. Most PICTs are in the process of transitioning from paper-based to electronic (and semi-automated) HIS, with the aim of delivering higher quality and more timely data, and improving the use of health information. Globally, researchers have noted that improving access to information tends to stimulate end-user demand for more and better-quality data which, in turn, drives system improvement (16).

Ownership and accountability by local authorities have emerged as important factors influencing the outcome of digital health innovations. A project may be owned by government or external stakeholders, or through partnership arrangements. Importantly, the greater the proprietorship that government authorities (at both national and local levels) have over the design and implementation of DHIs, the more likely it is that the interventions will achieve scale and sustainability (69, 70). This has been clearly demonstrated in Solomon Islands where stewardship of

digitizing health information is being driven by national authorities in collaboration with their provincial counterparts and with the support of WHO's internal and contracted technical assistance.

A digital health strategy and governance arrangements

Digital health has been recognized as an enabler of sustainable health system development and a set of tools that countries can draw on to help address the challenges in delivering accessible, equitable and quality health care. To realize its potential, digital health should be designed to support a visionary health sector development strategy. By doing so, efforts to establish DHIs will inevitably benefit from broader, systemwide investments in leadership, infrastructure enhancement, and development of organizational and human resources.

Historical reviews show that without a strategic digital health plan supported by strong leadership and governance, investments in technology risk being ill-coordinated or disjointed. This can lead to development of multiple stand-alone ICT "solutions" that, although well intended, result in information fragmentation and, consequently, losses in efficiency and effectiveness (1). A comprehensive digital health

Digital health should be designed to support a visionary health sector development strategy. By doing so, efforts to establish digital health interventions will inevitably benefit from broader, systemwide investments in leadership, infrastructure enhancement, and development of organizational and human resources.

strategy lays the foundation for considered and pragmatic digital health adoption. This includes action to build and align investments in infrastructure, workforce, policy and legislation, governance and standards, and to guide strategic technical and financial partnerships. A successful digital health strategy should be simple and should not include detailed plans; it should rather set an agenda for digital health around which all may rally and within which all may work.

In most PICTs, the governance of digital health will be managed by a committee (or task force). To build credibility, this committee should be made up of representatives from across relevant sectors who have both a stake in the digitization of government services (specifically health services) and the authority and capacity to action change. As one Pacific leader said, *"Having a digital health strategy is all good and well, but without a mechanism to coordinate and plan the actions required to see*

the strategy become reality, we will never get past step one."

Where relevant, representatives from the development and corporate communication sectors may be engaged to provide their unique perspectives and insights to the work of national digital health governance committees. The nature of extra-government stakeholder engagement with national digital health governance arrangements will be setting specific. Regardless of the process, the arrangements should be explicit and documented.

Digital health governance committees should have a mandate to perform (among other tasks) the following functions:

- monitor health sector needs and challenges, and identify opportunities for DHIs;
- champion (advocate for) digital health considerations in health service delivery and system reform;
- oversee the implementation of a national digital health strategy in line with broader national digital governance plans;
- manage digital health development projects, including the human and financial resources of the project, and identify and manage threats to success;
- work across government and with donor and corporate partners to create a supportive ICT, financial and operational environment for digital health;
- monitor progress and, when required, review strategic directions;
- communicate with stakeholders up and down the line of command.

Policy to support the technical and organizational requirements for digital health

In addition to the components outlined above, there are important technical and organizational considerations required for the successful implementation of DHIs. Among these, the following are key.

Digital health policies and legislation

The approach taken to develop the policies, legislation and normative support required for digital health will depend on individual PICTs' national health priorities, adequacy of existing legal instruments, stage of digital health maturity, and availability of policy and legal expertise. Hence, PICTs should each consider their own unique digital health situation and aspirations, as well as the associated risks, opportunity costs and other influential factors when determining which policy and legislative instruments they require for prudent digital health adoption.

However, there are some core policy and legislative instruments that need to be in place to support the development and implementation of a digital health environment. These include the following:

- national legislation, policy and regulatory components that govern how citizens' information is stored, secured, accessed and shared (25). These include legislation regarding privacy and protection of personal information, consumer protection, cybersecurity and use of personal identifiers;
- digital health-specific policies that govern the use of health data, and guide how the systemwide architecture required for digital health will be organized and maintained, and what ICT and data coding standard will be used. Further, digital health-specific policies should consider medicolegal jurisdiction, liability and safety;
- broader public policies that support the development of an enabling environment for digital health, including health sector reforms to improve and promote the use of health information, government-wide policy that supports e-governance and initiatives that stimulate innovation;
- systems for monitoring and evaluating digital health performance to inform continuing quality improvement.

In addition to the development of these instruments, staff required to use digital health tools will need to be oriented to the policy and legislation to which their practice should conform, and systems for monitoring compliance will need to be developed.

Table 7 of the *Digital health implementation guide for the Pacific* (26) provides an extended list of potential policies that decision-makers should consider.

Health information, including personal health records, is highly sensitive and must be treated as such to engender trust among citizens. Ensuring that regulations, policies and systems are in place to protect health information must be paramount in PICTs' digital health development plans.

Health information, including personal health records, are highly sensitive and must be treated as such to engender trust among citizens. Ensuring that regulations, policies and systems are in place to protect health information must be paramount in PICTs' digital health development plans. Appropriate measures should be taken against unauthorized or unlawful processing of health data, and accidental loss, malicious or inadvertent alteration, theft or destruction of data.

Authorities designing and implementing a digital health policy and legislation in PICTs should aim, wherever possible, to establish an ecosystem that supports ICT interoperability and smooth exchange of data within and between relevant departments of government as the norm. This will require health ICT infrastructure to be designed based on commonly agreed objectives and standards.

Workforce requirements

Securing the right mix of trained staff who can effectively implement a digital health strategy and address technical and administrative issues is vital but often challenging (16), particularly in small Pacific Island developing states where education and mentoring opportunities are lacking. Input will be needed from software engineers (with skills in designing, implementing and maintaining technical platforms) and data managers (able to set up, administer, manage and maintain databases, and transform data into information), and health ICT support staff (able to address technical problems such as device failure, ICT conflicts and usability). The capacity to support staff who are new to digital technology

to adopt and integrate its use into routine practice, and to troubleshoot, will also be required.

Engagement of out-of-country experts and service providers is an option considered by many LMICs, as they offer solutions to some of the technology and human resource constraints faced; however, if not carefully planned, such an option runs the risk of making national DHIs reliant on external bodies. For long-term sustainability, it is prudent – where feasible – to build

Where in-country ICT capacity is not available, mechanisms for the procurement and judicious stewardship of extranational support services, which ensure that national interests remain the priority, are needed. Long-term service support contracts that incorporate capacity-building activities are found across many sectors in PICTs and may be considered when designing tenders for digital health initiatives.

in-country capacity of human resources for health ICT management. This will require allocating a budget to establish new ICT-focused civil service roles. Where in-country ICT capacity is not available, mechanisms for the procurement and judicious stewardship of extranational support services, which ensure that national interests remain the priority, are needed. Long-term service support contracts that incorporate capacity-building activities are found across many sectors in PICTs and may be considered when designing tenders for DHIs.

The workforce skills required for implementing digital health will evolve as higher levels of digital health maturity are achieved. Workforce capacity needs can be considered as falling into five broad areas, which are summarized in Table 4. PICTs planning to implement digital health solutions must consider the training and development of human resources required to adopt those solutions.

Table 4. Fundamental human resource skills and roles required for implementation of digital health

Area	Skills	Example job titles
Policy and programme development	An understanding of the purpose and function of digital health, and the capacity to determine and guide the development of legal instruments to support digital health implementation	Digital health policy manager/officer
Health information management and governance	An ability to work with stakeholders to co-design, establish and maintain the architecture in which health information is captured, transferred and stored; and the skills to ensure that appropriate information governance processes are in place to maintain system function, data confidentiality and security	Health information manager/officer Information governance manager/officer
Health informatics and data analysis	An ability to transform data into meaningful information and communicate this information in ways that support evidence-based decision-making	Data analyst
ICT skills	An ability to develop, manage and support implementation of hardware and software used to exchange digitized health information	ICT manager/officers
Implementation and change management	Skills to train and support end-users in adopting digital health and integrating digital processes into everyday practice	Field officer Technical support officer

Infrastructure for information and communications technology

International evidence shows that countries are best placed to make progress in digital health when the essential infrastructure required for health information exchange is in place (25). Infrastructure, in this context, spans both physical hardware and software, and includes the services that support their implementation and use across the health sector.

The National eHealth Strategy Toolkit (25) provides a catalogue of ICT infrastructure components required for digital health. These are summarized in Table 5.

Table 5.   Examples of ICT infrastructure components required for digital health

ICT component	Description
Essential utilities	Necessary utilities required to power ICT
Internet connectivity	The high-level data networking and connectivity infrastructure required to support digital data exchange
Computing hardware	Physical computing devices that host software and applications used in collecting, recording and exchanging information
Storage infrastructure	The physical or cloud-based facilities where data will be stored
Electronic information systems	Repositories and associated services that support the storage of and access to health data and information across geographical boundaries
Identification and authentication services and protocols	Services that enable the secure transmission of data and information between authenticated users
Data analysis and visualization software	Tools to analyse raw data and transform it into meaningful information useful to decision-makers in clinical and health system management

ICT = information and communications technology
Source: Adapted from National eHealth Strategy Toolkit (25)

To ensure interoperability and the ability to upgrade ICT infrastructure, ICT for digital health must be designed based on agreed standards for technology and agreed communication protocols (71). Staff of ministries of communication and infrastructure are typically knowledgeable regarding the capacity of existing national communications infrastructure and should

be consulted when designing digital health systems. For health-specific advice, expert consultants' knowledge may be required.

To safeguard the long-term utility of investment in ICT infrastructure, procurement decisions should be made with scalability in mind. This may incur a greater initial cost (for the purchase of more advanced and flexible ICT infrastructure); however, if well planned, such investments should pay dividends in terms of lower maintenance costs, less frequent upgrades and reduced downtime resulting from failing infrastructure.

To ensure interoperability and the ability to upgrade ICT infrastructure, ICT for digital health must be designed based on agreed standards for technology and agreed communication protocols.

Despite requiring reliable and accessible Internet connectivity, the emergence of cloud-based computing technologies provides an attractive option for PICTs seeking to establish the infrastructure required for digital health. Cloud-based services, including commercially available cloud storage solutions and web-hosted software, are typically more affordable, require less maintenance, are easier to upgrade and scale, and are more secure than local disk storage (26). Further, they reduce the need for purchasing, maintaining and upgrading expensive hardware (such as servers) that are not readily available in many PICTs and are expensive to maintain in a tropical climate. In PICTs, where Internet coverage is patchy, it is important that digital health tools can function offline and "synchronize" with data storage systems once reconnected.

PICTs can choose from a variety of software options. Broadly speaking, options are either open-source or proprietary. Open-source software is usually available with no upfront costs; however, it will require hardware, storage and networking infrastructure, and will probably be dependent on on-demand international consultants to build and modify software applications and troubleshoot problems. Anecdotally, countries implementing some open-source digital solutions have experienced long delays in system functionality while awaiting consultants' input to address problems. Proprietary software, on the other hand, will usually incur significant upfront and/or perpetual licensing costs, but comes with packages of technical support provided by the vendor. As with open-source options, proprietary software may incur delays or additional expense if extranational support is required. The choice is not either/or; examples of "hybrid" models that work well are in place in some PICTs. Choices about the mix of software to be adopted need to be made with a

full understanding of the pros and cons of various options, considering both the immediate need and long-term sustainability. However, if PICTs consider data integral to the quality of care and achieving UHC, then adequate investment in data systems will be needed to generate the insights required to meet authorities' needs.

While use of ICT in health offers opportunities for UHC, there are also risks. Opportunities to access digital services are – to a large degree – dependent on the availability of (and access to) the infrastructure required for data transfer. With significant portions of the Pacific population living in rural and remote locations distant from such infrastructure, moving to platforms that use (or rely on) ICT for the delivery of services may inadvertently disadvantage some groups and – if not managed – lead to greater health inequities. This is an issue both within individual PICTs and across the Pacific region where opportunities for digitization of health services differ greatly.

Common standards for interoperability

Interoperability involves the capacity to share data across digital information systems and platforms. At a more inclusive level, interoperability allows HIS to access and share data without needing to maintain duplicate siloed systems. Systems needing to share data may be those of different programmes or divisions of a ministry of health (e.g. sharing between the laboratory information management system and an NHIS), or different ministries (e.g. sharing between a ministry of health-held database containing information about human incidents of zoonotic disease and ministry of agriculture-held database about the incidence and location of animal diseases).

The exchange of data across an enterprise requires both "syntactic" and "semantic" interoperability standards. Syntactic standards refer to the structure, representation and format of the data, whereas semantic standards refer to the ability of ICT to receive, compute and make sense of data received from different technology or data collection systems. The new HL7 (Health Level 7) Fast Healthcare Interoperability Resources (FHIR) tools are the most widely used syntactic standards to transfer health data, while the SNOMED-CT (Systematized Nomenclature of Medicine – Clinical Terms) and ICD (International Classification of Diseases) are commonly used semantic standards related to patients' illnesses, symptoms, diagnoses and treatment.

Systems with well-developed syntactic and semantic standards are essential if interoperability between the ICT elements and HIS are to be achieved. Well-established and internationally recognized standards are available (69, 72, 73) for PICTs to draw on; however, ultimately, the choice of standards to be adopted is a national decision, which will be influenced by existing practice, licences, reporting needs and ICT capacity.

Policy to support technical and financial partnerships

Technical and financial partnerships

Many of the digital health studies conducted in LMICs have identified challenges concerned with cost, infrastructure requirements, technical capacities and lack of a supportive policy environment that necessitated external partnerships for DHIs (16). These studies suggest that effective partnership between the public, donors and development agencies (and sometimes the corporate and non-profit sectors) are distinctive features of effective DHIs in LMICs, helping to catalyse the process of developing, implementing or expanding digital health projects. This is particularly relevant in the PICTs, where opportunities to independently secure the financial and human resources required for DHIs are often limited.

"While our country may need external assistance to establish digital health programmes now, we are aware that in time we will be independently able to operate. It is important that we carefully think through the partnership arrangements we have so that the digital health system we develop is affordable within our means in the long term."

[Pacific leader]

In Tonga, a major investment to develop the foundations for digital governance is being implemented through a partnership with the World Bank. Funding is being used to develop a national digital governance strategy; establish a national data centre; design a data system, user interface dashboards and tools; develop the legal and regulatory frameworks required for digital governance; and procure ICT infrastructure and establish the systemwide architecture required to support the use and integration of digital tools (49). The project has engaged several technical partners – both development agencies and corporate organizations – to support implementation of the project's plan (49).

In another example, a long-term collaboration between the Papua New Guinea Remote Sensing Center, the Asian Development Bank and the Papua New Guinea government has resulted in the development of a HIS that links health facilities with central authorities through mobile tablet-based two-way exchange of data. Data exchange is used by health authorities to populate the national HIS and by staff at participating facilities to view dashboards that provide real-time surveillance information, treatment advice and alerts (45).

Shuvo et al. (2015) note that experience from LMICs suggest that "it is important to consider the role and implications of partnerships prior to engagement" to ensure that technical and/or financial arrangements that may create opportunities for developing digital initiatives do not result in debt or long-term dependence on external assistance (16). There has been criticism that, in some instances in the past, digital health support has been externally driven, with assistance sourced from providers with a limited track record in DHIs or limited understanding of the context in PICTs. This situation must be avoided in future. Creative approaches to identifying, screening and securing long-term involvement of technical assistance partners with real and demonstrated ICT and digital health expertise, together with the skills required to engage with and navigate complex political environments, should be explored. One approach may be long-term service agreements to support the scoping, design and implementation of DHIs. Such models may benefit from high levels of financial and administrative integrity if they are delivered through tender processes of an international institution.

Regional collaborations for resource sharing and joint development

PICTs share many common challenges that impact their populations' health (*8)* and impede efforts at health sector development (*see* Part 1 for a summary). Given this, and to achieve economies of scale, regional approaches to providing development assistance have often been adopted. While regional approaches have a role to play in driving a common agenda forward and, in doing so, providing motivation and direction, they are best when aligned with well-developed country plans and supported by targeted technical assistance that aims to develop self-reliant and self-sustaining systems (8). In the area of digital health, the Pacific Health Information Network (PHIN) has been established to fulfil this role.

"There is an important role for regional approaches to the provision of digital health development assistance in the Pacific. This assistance is most impactful when aligned with well-established country plans, strong digital health governance arrangements, and access to resources."

[Regional development agency staff member]

The PHIN, through the implementation of a strategy endorsed by Pacific health leaders (*28*), seeks to strengthen the foundations for and use of digital tools to support health-care delivery. To be effective, regional bodies need to have both the technical expertise and resources to drive what are complex pieces of work involving multiple stakeholders from across sectors. The current approach to regional digital health governance may be strengthened if the PHIN were equipped to undertake a programme of strategic digital health development work, and not be reliant on the voluntary contribution of its members. Expertise from across the region could be engaged to guide and support the PHIN's work.

Areas where regional approaches may be warranted include:

i.   establishing a regional agenda for digital health development and support for developing strategies specific to PICTs;

ii. procuring and coordinating targeted technical assistance;

iii. brokering regional partnerships that support digital health development (e.g. for cloud storage or with regional telecommunication providers);

iv. providing advice for developing national legislation, policy and standards on which sustainable DHIs can be built;

v.   providing relevant skills training;

vi. monitoring and reviewing programmes;

vii. documenting and sharing examples of good practice;

viii. ensuring that DHIs intersect with and support other regional health initiatives (e.g. the Healthy Islands monitoring framework).

Individual PICTs are unique, and any generic material produced at a regional level will need to be contextualized to ensure that it aligns with national needs, approaches and existing systems.

Conclusion

It must be stressed that DHIs complement and enhance health system functions through accelerated access to and exchange of information; they do not replace fundamental health system components such as health workforce, supply chains, health reporting, financing or governance (5–7). Acknowledging this is particularly important in the context of PICTs, where work to build core system capabilities is ongoing. Nevertheless, where adopted appropriately, digital health offers many opportunities to improve the efficiency and effectiveness of established health enterprises. In doing so, digital health can improve access to, and equity and quality of health care, which are central to national health development objectives and UHC priorities.

Annex B provides a summary of the policy considerations to support adoption of digital health.

Part 4. Recommendations

Health systems, health system challenges, stage of digital development and opportunities for adopting digital health differ between (and within) the PICTs, although some characteristics are common to all of them. As such, each country and territory will need to assess and determine their own priorities and opportunities, and devise tailored digital health strategies in response.

To guide activities for developing digital health programmes, decision-makers in PICTs can draw on WHO's *Global strategy on digital health, 2020–2025* (1) and the *Regional action agenda on harnessing e-health for improved health service delivery in the Western Pacific* (2). Collectively, these documents provide a suite of actions that Member States have endorsed and notionally committed to.

Our recommendations below align with these endorsed instruments and provide the Pacific context and suggested priorities where relevant. By customizing these recommendations, PICTs will be aligning their actions with well-established and considered global and regional guidance and, by doing this, will be working in concert with the global digital health development agenda.

Recommendations for all PICTs

Common across the above-mentioned guides is the notion that, for successful implementation of digital health, ministries of health in PICTs should do the following:

- **Develop a national digital health strategy that identifies timelines and priorities for advancing the infrastructure,**

policies, workforce skills and broader systems needed to support digital health implementation.

For PICTs, the digital health strategy should align with the national health sector development strategy and broader social development goals of each country or territory. Where relevant, and to plan the ongoing support required for digital health development, there is value in explicitly linking PICTs' digital health ambitions and plans with country cooperation strategies.

- **Assess the need for and capacity to deliver digital tools that support action to overcome priority issues in primary health care delivery and achieving UHC.**

  In PICTs, digital tools may leverage ubiquitous technology (such as smartphones and commercial phone applications, such as Zoom or WhatsApp, for interpersonal or group communication) or be tailored to meet specific needs. Regardless, a clear need for and capacity to deliver these tools is paramount for success.

- **Take steps to build the human and institutional capacity and physical infrastructure required to support digital health – establish mechanisms for governance of digital health, create new staff positions for managing and implementing digital health initiatives, support skills development in ICT, and put in place mechanisms to support the adoption of new technology.**

- **Develop mechanisms to engage stakeholders from other ministries and the private sector, and work with them to address the systemwide challenges to sustainable and scalable adoption of digital health.**

  Health authorities in PICTs are encouraged to engage their counterparts from the ministries of communication and infrastructure who, typically, have experience across sectors in advancing ICT. Health authorities can leverage the knowledge and relationships of others to advance digital health development.

- **Develop administrative instruments (i.e. the legislation, policies and procedures) to ensure that digitized health data are secure and used appropriately.**

  While ensuring that these administrative instruments are in place will entail significant effort for most PICTs, they are critical for successful adoption of digital health. Development partners

can provide technical assistance to support the development of such instruments.

- **Monitor and evaluate the implementation of digital health and its impact on health system functioning, and share the findings within and across countries.**

  Evidence of effective and efficient use of digital technology is sparse in the context of small island developing states. PICTs implementing digital health therefore have unique insights to contribute through monitoring, evaluating and sharing experiences. PICTs can share experiences through communities of practice, such as the PHIN, or more formally at regional forums or in peer-reviewed publications.

Recommended actions for PICTs new to digital health

In addition to the overarching recommendations above, the following priorities are recommended for PICTs new to digital health:

- **Build domestic political support** for digital health by collecting and presenting evidence, including evidence of the likely impact of digital health on health-care access, quality, equity and budgets.

- **Secure the financial and technical support** required for implementing a national digital health strategy.

- **Assess the coverage of essential services** (e.g. electricity, Internet and mobile phone coverage), determine what DHIs are feasible, and ensure that the findings of this assessment are reflected in the national digital health strategy.

- **Establish country-led governance structures** to drive and guide the prudent use of digital health to support UHC and primary health care delivery.

In terms of digital interventions, priorities for PICTs at this stage of digital health maturity are:

- **to establish (or, if in place, improve) an electronic health information management system** that supports the ongoing collection, secure transfer and storage, and analysis of digitized health data across the health system;

- **to establish (or, if in place, improve) processes for digitizing newly collected health data**; where capacity is available, this may be extended to the retrospective digitization of medical and health records;

- **to plan for the introduction of a unique patient/provider/ facility identification system** (e.g. unique patient ID number);

- **to seek opportunities to introduce facility-level electronic medical records.**

Recommended actions for PICTs with foundational digital health infrastructure and systems in place

PICTs that have foundational digital health infrastructure and systems in place should do the following:

- **Focus on establishing a workforce able to integrate digital health as a routine part of health service delivery.**

  This will include targeted skills development; creation of roles within the public service for ICT engineers in digital health, and data managers and analysts; and support for the workforce at both national and subnational levels to adopt new technologies and to ensure that project-based interventions can be scaled up and implemented systemwide.

- **Conduct a gap analysis of the legal and administrative instruments (i.e. laws, standards, policies and procedures) required for data security, storage and use, and take action to address the identified gaps.**

- **Expand the use of digital health tools in accordance with local need and opportunity.**

  This may involve expanding the range of digital tools used or the number of sites/people using them. The decision on which digital health tools to develop will be specific to each setting. However, high-impact DHIs that should be considered include establishing unique identification systems, developing electronic medical and health records systems, digitizing stock and supply chain management, delivering telehealth-supported services (including health worker-to-health worker communication and decision-

making support and, where feasible, direct service delivery to patients), and expanding e-learning opportunities.

- **Develop a plan to enhance the national digital health architecture, including selecting and adopting standards that support interoperability and information exchange.**

  Well-developed interoperability standards are essential to support more efficient and reliable information-sharing and use within and between ministries of health and other ministries.

Recommended actions for development partners

Development assistance from donors, development banks and philanthropic organizations provides an important means of realizing the potential of digital health and offsets potentially prohibitive economic costs. Beyond financial support, donors have a role to play in providing advocacy and guidance to enhance country ownership and leadership of new DHIs, which increases the likelihood of achieving sustainability and scalability, and ensuring alignment between and across the agendas of regional health, social and infrastructure development.

Regardless of their stage of digital health maturity, all PICTs and their development partners should identify ways to create environments that support the use of ICT to deliver equitable and integrated person-centred health care. Financial, organizational and human resource investments to support the adoption of digital health must be both adequate and sustained to avoid the pitfalls experienced by others, and to translate plans for better use of technology in health into improved outcomes for UHC.

Priorities for development partners

- Work with international partners, donors, philanthropic organizations and the corporate sector to improve coordination of digital health investment.
- Support prudent decision-making by providing context-specific evidence on the benefits, opportunities and risks associated with adoption of digital health.
- Assist PICTs in developing a business case for digital health and, where appropriate, source or provide financial assistance.

- Provide guidance on the development of national digital health strategies and action plans and, where needed, support efforts to develop national capacity.
- Produce adaptable tools (e.g. protype templates) to guide PICTs' development of the system architecture required for digital health.
- Support leaders in PICTs to set agendas and establish governance for development of digital health.
- Monitor, synthesize and share trends in digital health innovation with decision-makers in PICTs, and collect and share examples of good practice.
- Support digital health monitoring and evaluation, and the translation of findings into action.
- Ensure that digital health innovations are in step with other health and social development initiatives in the Pacific region.

Role of telecommunication companies

Inevitably, planners undertaking digital health development in the Pacific will need to work with the public and private telecommunication sectors. Telecommunication companies have a role to play in ensuring that the ICT infrastructure on which digital health relies is in place, both in urban and rural areas. Where appropriate, telecommunication providers may be engaged in planning for digital health futures, including assisting to provide digital health services to rural and remote communities. Public–private partnerships for digital health should be considered. Health authorities may learn from the experience of others (notably, infrastructure ministries) when engaging with private enterprise to deliver health initiatives.

Looking to the future

As PICTs' maturity and experience with digital health grows, so will opportunities to foster innovative digital health applications to address a wider range of challenges to UHC and primary health care. This may include – for example – the use of remote sensing technology for population mapping or machine learning to enhance data analysis capabilities. Increasingly, PICTs will generate unique knowledge that should be shared within and outside the region to support better digital health practices globally.

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Annexes

Annex A: Summary of review of digital health use in low- and middle-income countries, globally, 2010–2021

Digital health intervention	Description*	Dimension of UHC most impacted^	Summary
Telehealth	Delivery of health-care services where patients and providers are separated by distance. Telemedicine may be as simple as phone-based consultation to as complex as video-enabled remote examination and diagnosis.	2, 4	Across the literature reviewed, telehealth interventions are widely recognized to improve access to care (55–57). Disciplines where utility has been demonstrated include mental health (74–76), maternal and child health (77–79), contraceptive use (80) diabetic retinopathy screening (81), HIV/AIDS (82–84), noncommunicable diseases (85) (e.g. stroke (86) cancer (87)), dentistry (88), surgery (89), paediatrics (90, 91), neurology (92), audiology (93), polio eradication and immunization (94).

Digital health intervention	Description*	Dimension of UHC most impacted^	Summary
Targeted client (i.e. patient) communication	Electronic transmission of customized health information, or notification to individuals or target audiences whereby messages meet the specific needs and preferences of an individual. Messages may be delivered by SMS, social media or other electronic means, and content may include appointment reminders, promotion of visiting providers of health services (e.g. upcoming immunization clinics), and delivery of pathology results. Communication is usually unidirectional but may prompt bidirectional interactions.	3, 4	Review articles demonstrate the myriad uses of targeted client communication in primary care (68, 56), often for patient education and awareness (68, 95, 96), behaviour change communication (17, 97, 98), patient follow up (95, 99), reminders (96, 100), appointments (101), medication adherence (84, 102), contraceptive use (80, 103), data collection (97, 104), and care stakeholder interactions (105, 106). Targeted client communication is often sent by community health workers (107), and SMS interventions are the most-used modality (108).
			Targeted client communication has been used to improve outcomes for chronic diseases (109) and noncommunicable diseases (85) (e.g. cardiovascular disease and diabetes) (110), communicable diseases (e.g. HIV/AIDS and tuberculosis) (83, 84, 111), polio eradication and immunization programmes (94, 112), maternal and child health (78, 79, 101, 112–116) (e.g. antenatal and postnatal health (117), nutrition in pregnancy (118), perinatal health (99, 119, 120), sexual and reproductive health in young people (97), mental health (74, 75) and hearing loss (93), as well as the social determinants of health, including gender relations (121) and social health inequalities (122).

Annex A: Summary of review of digital health use in low- and middle-income countries, globally, 2010–2021 (contd)

Digital health intervention	Description*	Dimension of UHC most impacted^	Summary
Digitally enabled communication between health providers and with health authorities	Communication between and transmission of information among health providers, supervisors and health system managers to improve the timeliness and quality of care that is delivered. In its most practical sense, ICT-enabled health-care provider communication can support collaborative health worker-to-health worker clinical decision-making.	3, 4	Digital communication between health providers is an important stakeholder interaction (18, 105, 106), and facilitates effective health service delivery (19, 104) and health workforce improvement (66–68, 123). Application has been demonstrated in the fields of maternal health (101, 113, 114, 117) and management of noncommunicable diseases (17, 86).
Referral coordination	Digital approaches to support communication and coordination mechanisms that facilitate referrals (both within the health sector and to other health-related sectors) and patients' continuity of care	2, 3, 4	Digitally coordinating referrals has shown promise in practice, as part of a tiered health system (19, 100, 124). It is particularly important in screening programmes to ensure that identified cases receive the appropriate case management (125).
Supply chain management	Digital approaches to monitoring and reporting stock levels, consumption and distribution of medical commodities. This can include the use of communication systems and data dashboards to manage and report supply levels of medical commodities.	1, 2, 3, 4	Digital health systems have been demonstrated to improve supply chain management (17, 94,103). Demonstrated applications include pharmacy information systems (100) and managing supplies for community health workers (107).

Digital health intervention	Description*	Dimension of UHC most impacted^	Summary
Laboratory and diagnostic imaging management	Digital approaches to managing and exchanging laboratory and diagnostic orders and results, including the automated linkage of results to individual patients' medical records	1, 2, 3, 4	Management of laboratory and diagnostic imaging can be improved by digital systems (17, 100) with, for example, improved test turnaround time (79). Specific modalities where utility has been demonstrated include ultrasound (126) and point-of-care diagnostics (104). Disease areas in which improvements have been seen include noncommunicable diseases (17, 86), and maternal and child health (79).
Health-care provider training (e-learning)	The management and provision of education and training in electronic form for health professionals. Through the Pacific Open Learning Health Net, PICTs are familiar with e-learning initiatives. The proliferation of Internet-connected mobile devices opens opportunities for more flexible access to e-learning opportunities, including access within clinical settings and at home.	3, 5	Health-care provider training is a key component of health systems strengthening, and can be delivered using digital means (67, 104, 127). These are used for staff training, support, motivation, monitoring, evaluation and compliance with guidelines (95). Provider training has been used to ensure that care workers' knowledge is up to date regarding common conditions, such as diabetes (128) and stroke (129). Approaches also incorporate simulations (130) and portable technologies (131). Aside from health-care providers, digital training interventions have also been directed at students (132) and at care workers beyond the formal health system (e.g. school staff for improving child health) (90). Notably, reviews highlight the importance of engaging end-users in programme development (133).

Digital health intervention	Description*	Dimension of UHC most impacted^	Summary
Health-care provider decision-making support	Digitized decision-making support tools include job aids (such as protocols, manuals, treatment guidelines, clinical decision-making algorithms) that assist health-care providers in making diagnoses and treatment decisions.	3, 5	Online decision support systems are recognized as an important component of digital health service delivery (100, 104, 124), particularly for frontline and community health workers (19, 107, 116, 133, 123), as well as for enabling telehealth systems (66, 74). They have been used for noncommunicable diseases (17), mental health (74), HIV/AIDS (82, 134), paediatric care (e.g. common childhood infections) (116) and child behavioural health (90).
Electronic medical and health records	Digitized records used to capture, store, access and share health information on individual patients or groupings of patients is central to digital health and health information exchange and should be a priority. PICTs are in the process of transitioning from paper-based health records (e.g. clinic treatment logbooks) to electronic HIS platforms.	1, 3, 4	Electronic medical and health records are widely recognized as a core component of digital health service delivery systems in several reviews (17, 68, 79, 82, 94, 100, 104, 107, 116, 117, 127, 134–140).

Digital health intervention	Description*	Dimension of UHC most impacted^	Summary
Unique identification and registration	Core to a functional HIS is the ability to electronically link records relating to individual patients, health-care providers and facilities. To achieve this, each patient, provider and facility requires a unique identifier that is linked in an HIS. With such capability, patients' records can be tracked across time and place, and the continuity of care enhanced.	1, 4	Client identification and registration is a key tool for patient identification and tracking (137, 141), and for improving case monitoring and surveillance (18, 123, 127) to improve adherence and follow up. Utility has been demonstrated in noncommunicable diseases (17), diabetic retinopathy screening (125), monitoring antiretroviral therapy for HIV (141), and in maternal and child health care (117).
Health data collection, management and use	Digital approaches to data collection, management, analysis and storage include stand-alone components (e.g. mobile device-based data collection tools, EWARS in a box), complex systems and health information systems (e.g. DHIS2), and data services to support other interventions, such as data visualization.	1	Digital systems are well recognized to improve data collection, management and use (95, 127) including in primary care (123, 142). Data collection by frontline health workers is demonstrably improved (18, 19) and this extends to data from various health and care activities, including for nutrition and diet (143), antiretroviral treatment (141), HIV prevention (82) sexual and reproductive health in young people (97), cancer management (87), and noncommunicable diseases (17). Several factors are recognized to influence data processes, including governance, information production and health information system resources (144).

Digital health intervention	Description*	Dimension of UHC most impacted^	Summary
Health information exchange and interoperability	The capability of two or more systems to communicate and exchange data through specified data formats and communication protocols. This may involve exchange within a ministry (e.g. between the malaria and the HIV programmes) or across government agencies (e.g. between a national meteorology agency and an environmental health unit).	1	Health information exchange offers the potential for digitally integrating health systems (145) and requires that sociopolitical, financial, infrastructural, organizational and technical alignment be established to facilitate optimal function (146).
Electronic civil registration and vital statistics	Digital approaches to support the registration of births and deaths, issue birth and death certificates, and compile and disseminate vital statistics, including cause-of-death information	1	Civil registration and vital statistics systems are essential for monitoring births and deaths and are demonstrably improved by the use of digital systems (17, 104, 117).

DHIS2 = District Health Information System, version 2; EWARS = Early Warning, Alert and Response System; HIS = health information system; ICT = information and communications technology
* Descriptions taken or adapted from (*4*).
^ 1 – Support for the collection and timely exchange of data and information across the health sector; 2 – Support to access health services; 3 – Support for the quality delivery of care; 4 – Support for communication between health-care providers and facilities; 5 – Support for staff training and skills development.

Annex B: Summary of policy considerations to support adoption of digital health

Policies to support an enabling environment for digital health		
1	Ensure that there is **senior-level government buy-in** for digital health, **vision** for what can be achieved, and **leaders** willing to drive action to realize it.	To gain and maintain momentum, digital health interventions (DHIs) require advocates from within the health sector, and skilled managers able to develop and communicate a strong vision to guide the reforms required for successful adoption.
2	Ensure that effective **digital health governance structures** are in place to plan and guide the implementation of a national digital health agenda.	The early establishment of governance mechanisms is important to bring credibility and coordination, and to secure the buy-in of crucial stakeholders from the government, corporate and donor sectors. A culture of collaboration through which political leaders instil open channels of communication and share goals and trust is necessary for the success of DHIs.
3	Develop a **digital health strategy** that aligns with/supports the broader national health development goals.	Designing DHIs based on government priorities and aligned with national strategy, and within budgetary constraints, is of paramount importance. A comprehensive digital health strategy lays the framework for considered and pragmatic digital health adoption.

	Policies to support the technical and organizational requirements for digital health	
4	Ensure that the suite of **policies and legislation** required for digital health is in place.	Policy and legislation provide the framework for action and mandates for change. Legislative instruments related to health data collection, storage, security and use, as well as the infrastructure, workforce and governance arrangements that create a supportive ecosystem for digital health innovation, are required.
5	Secure the right mix of **trained staff** needed to design, implement and sustain DHIs	Securing the right mix of trained personnel who can effectively implement a digital health strategy and address administrative and technical issues is vital. Expertise needed will include software engineers and data managers, as well as information and communications technology (ICT) support staff able to resolve technical issues.
6	Ensure that the **ICT infrastructure** required for implementation of DHIs is available.	For digital health to function, there are essential ICT infrastructure needs. The specifics of these will depend on the nature of the DHI(s) being used. Core requirements would include essential utilities, Internet connectivity, computing hardware and software, storage infrastructure (physical or cloud-based), identification and authentication services and protocols, and data analysis and visualization tools. An expert may help to determine the specific ICT infrastructure a country requires to meet their needs.
7	Support seamless data-sharing and exchange through **adoption of common standards for data exchange**.	The exchange of data across an enterprise requires both syntactic and semantic interoperability standards. Adoption of standards is essential for interoperability and integration between ICT elements.

Annex B: Summary of policy considerations to support adoption of digital health (contd)

	Policies to support technical and financial partnerships	
8	Identify where **financial and technical partnerships** are required to address capacity and resource gaps.	Effective partnerships between the public, donors and development agencies (and sometimes the corporate and nonprofit sectors) are a distinguishing feature of successful DHIs, helping to fund, technically support and catalyse the process of development, implementation or expansion of digital health projects.
9	Establish **regional collaborations** for resource-sharing and development.	Where there is opportunity to share resources or – through collective development action – achieve economies of scale, PICTs may find value in working collaboratively. Regional development partners have a role to play in identifying areas where collaboration will be of value and in coordinating action.

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