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URBAN DIGITAL HEALTH

Insights from India, Bangladesh, and Nepal

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PATH is a global nonprofit dedicated to achieving health equity. With more than 40 years of experience forging multisector partnerships, and with expertise in science, economics, technology, advocacy, and dozens of other specialties, PATH develops and scales up innovative solutions to the world's most pressing health challenges.

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Abbreviations

5G	Fifth-generation (Wireless)
ABDM	Ayushman Bharat Digital Mission
ABHA	Ayushman Bharat Health Account
A-HMIS	Ayush Hospital Management Information System
AIDS	Acquired Immunodeficiency Syndrome
ARC	Asia Resilient Cities
CHW	Community Health Worker
COVID-19	Coronavirus Disease 2019
DAMS	Drug Administration Management System
DGHS	Directorate General of Health Services
DHIS2	District Health Information Software 2
DNF	Digital Nepal Framework
DVDMS	Drug and Vaccine Distribution Management System
EDP	External Development Partner
EHR	Electronic Health Record
EWARS	Early Warning, Alert and Response System
HBRIS	Hospital Based Rotavirus and Intussusception Surveillance
HFR	Health Facility Registry
HIV	Human Immunodeficiency Virus
HMIS	Health Management Information System
HPR	Healthcare Professionals Registry
HRIS	Human Resources Information System
HRMS	Human Resource Management System
HSS	Health System Strengthening
HuRIS	Human Resource Information System (Nepal)
ICCC	Integrated Command and Control Center
ICT	Information and Communications Technology
ID	Identification
IDSP	Integrated Disease Surveillance Program
InDEA	India Enterprise Architecture
INR	Indian Rupee

IPDMS	Integrated Pharmaceutical Database Management System
LGD	Local Government Division
LMIC	Low and Middle Income Countries
LMIS	Logistics Management Information System
MFS	Mobile Financial Services
MIS	Management Information System
MOHFW	Ministry of Health and Family Welfare (Bangladesh, India)
MOHP	Ministry of Health and Population (Nepal)
NDHS	National Digital Health Strategy
NEOC	National Emergency Operation Center
N-FAMS	National Health Mission Financial Accounting and Management System
NHA	National Health Authority
NHIP	Nepal Health Insurance Policy
NHM	National Health Mission
NIPORT	National Institute of Population Research And Training
NPR	Nepali Rupee
OOPE	Out-of-pocket Expenditure
OpenHIE	Open Health Information Exchange
PCDS	Priority Communicable Disease Surveillance
PFMS	Public Financial Management System
PLAMHAS	Planning and Management Assets in Health Services
PM-JAY	Pradhan Mantri Jan Arogya Yojana
SMS	Short Message Service
SSK	Shasthyo Surokhsha Karmasuchi
UHC	Universal Health Coverage
UHI	Unified Health Interface
USAID	United States Agency for International Development
UzHC	Upazila Health Complex
WHO	World Health Organization

Executive Summary

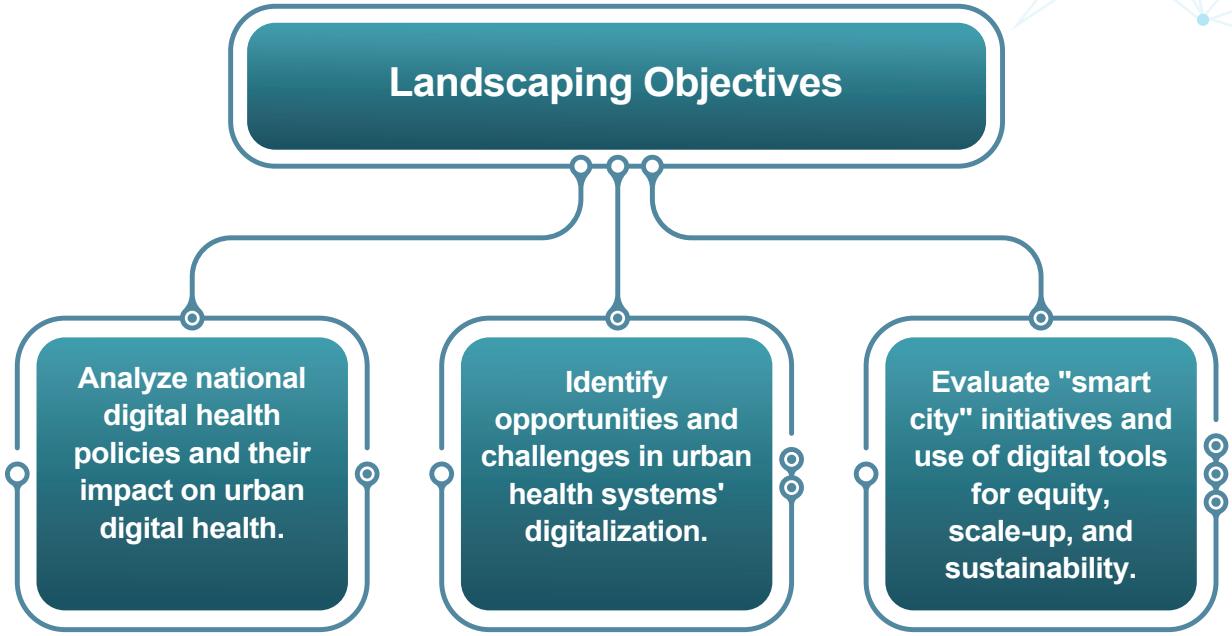
Background and Report Overview

The COVID-19 pandemic emphasized the importance of digital health and strong digital infrastructure in enhancing a country's resilience and response to crises, particularly in low- and middle-income countries (LMIC). With the projected global population reaching 9.7 billion by 2050 and urban residency expected to grow to 64%, city-level health systems in LMIC will face significant challenges. Therefore, there is a critical need to understand the current state of digital health policies, tools, and initiatives in urban spaces. To address this need, the Digital Square initiative at PATH with support from the United States Agency for International Development (USAID) Bureau for Asia, conducted a landscape analysis of the digital health ecosystem in five cities across three Asian countries: Ranchi and Imphal, India; Chattogram and Sylhet, Bangladesh; and Kathmandu, Nepal.

The landscaping exercise had three core objectives: (1) outline the national digital health policies across the three countries and explore how these policies influence urban digital health; (2) identify digital health opportunities and challenges unique to urban health systems, focusing on equity, quality, resource optimization, and resilience; and (3) explore how smart city initiatives (where applicable) and national and municipal health authorities leverage digital tools and lead digital transformation efforts, with considerations for health equity, scale-up, and sustainability.

To conduct the landscape analysis, Digital Square employed qualitative research methods to gather and analyze data. The methodology first included a high-level desk review of a few key country level documents to contextualize downstream activities such as interview guides and the overall report structure. This was followed by a focused desk review of country specific documentation and 30 in-depth stakeholder interviews, evenly distributed across the three countries and various governance levels, to elicit insights into challenges and opportunities in the urban digital health ecosystem. The team also consulted with USAID country and regional experts to ensure accuracy and completeness of the findings.

The core analysis of this report is covered in the sections “Digital Health Policy Review” and “Digital in Urban Health”, respectively. Each section concludes with relevant findings by way of summary. The policy review focuses on providing insights into national- and state-level policies, digital initiatives, and relevant governance around digital health, while Digital in Urban Health delves into the five focus cities and explores the relationship between digital health and aspects of equity, quality, resource optimization, and resilience at the urban level. The report then concludes by synthesizing information from the previous sections and shares actionable learnings and recommendations with the reader.



Findings

South Asian countries are increasingly recognizing the importance of digital infrastructure and making significant progress in developing their digital health policy landscape, positioning them as important players in the global digital health ecosystem. Despite challenges, the strides made in South Asia's digital health policy landscape provide promising indications of future growth and leadership in this field.

The policy review reveals that the adoption of digital policies and technologies in public health care varies across these three countries. The maturity of digital health depends on factors such as the existence of a digital health strategy, national-level electronic health record generation, a focus on interoperability, and mandated institutions with specific digital remits. Our analysis indicates that India, Bangladesh, and Nepal are moving toward a digital health ecosystem approach at the national level, with varying degrees of progress at subnational levels. India has designated digital health funding, empowered a digital health institution, and rolled out a foundational digital infrastructure, whereas Bangladesh and Nepal are in the process of taking these steps.

At the city level, the "Digital in Urban Health" section highlights growing salience and interest in harnessing digital tools among patients and health workers in Ranchi and Imphal (India), Chattogram and Sylhet (Bangladesh), and Kathmandu (Nepal). Municipal governments and city-level organizations are implementing context-appropriate digital technology, including for underserved populations. Efforts are also focused on improving the responsiveness of health care systems through legacy digital systems that enhance timeliness, quality, and reporting of data and processes.

We observed a continued high dependency of city-level health systems on the private sector and an imbalance between the capacities available and those required from public health workers. Additionally, health worker capacity building with respect to digital health continues to be a clear area of concern. While our focus cities have shown the ability to adapt their health systems to changing environments, the absorptive capacity of city-level systems appears to be weak. Challenges, including the gendered digital divide in accessing urban health care, a siloed approach to digital health and lack of interoperability of existing systems remain relevant.

Key Learnings

Our comprehensive review of digital health policies, in-depth analysis of urban health, and interviews with key stakeholders yielded eight important insights:

1. Urban health systems in the three focus countries struggle to provide sufficient and high-quality primary health care due to rapid and unplanned urbanization. However, digital infrastructure, such as electronic health records, facility and health worker registries, and a strong focus on interoperability, can help overcome these challenges.

2. Capacity building and increased staffing are vital prerequisites for deploying digital tools in public health. Urban health workers currently lack the necessary resources to fully leverage digital tools, hindering their potential to enhance work efficiency and reduce workload. Addressing these underlying challenges is crucial for successful implementation of digital health solutions, ultimately alleviating the burden on health workers and improving equity and quality in public health.

3. Engaging the private sector in digital health initiatives can enhance universal health coverage and address existing gaps in public health. However, it is crucial to monitor their involvement to ensure service quality and alignment with comprehensive efforts.

4. Data and technology at the city level is primarily being used to improve how cities adapt and respond once a shock (such as a pandemic or natural disaster) has occurred. However, technology and data must now be leveraged to improve how cities prevent, prepare for, and absorb the initial brunt of these adverse events.

5. Digital solutions alone cannot address the complex challenges facing urban health systems in the three focus countries. Investing in underlying crosscutting factors outside of the health sector, including smart city infrastructure, integrated command and control centers, scalable digital infrastructure, and smart grids is crucial. Further, policy and regulatory frameworks and effective public-private partnership models are also essential when building resilient urban health systems.

6. Customized approaches to national digital health that acknowledge the unique characteristics and nuances of each focus country, along with the comfort level of its citizens, are essential. While similarities exist, they should serve as a means for cross-border learning, exchanging best practices, and gaining insights into successful strategies, rather than aiming for uniformity.

7. Current data privacy and protection policies are either aged, simplistic, or contested. The focus countries should prioritize the improvement of comprehensive regulations to ensure responsible use of health data, build trust in digital health systems, and safeguard personal information for patient-centered care and population benefit.

8. Interoperability in our focus countries can be achieved through different approaches, not necessarily involving the integration of legacy systems. Leapfrogging older systems entirely and building core digital health infrastructure that is interoperable by design can be a viable option depending on the circumstances. Thus, considering both integration and leapfrogging strategies as pathways to achieve interoperability is crucial.

Recommendations

Municipal health authorities, the USAID Asia Bureau, USAID cross-sectoral communities of practice, and Asia Resilient Cities implementing partners can use these learnings to inform investment decisions, actions, and further research. The landscape highlights the following actions that we recommend be taken by donors, policymakers, and urban health ecosystem actors:

Conduct further research on how digital solutions can reduce out-of-pocket expenses and improve the financial sustainability of urban health systems (e.g., the growing use of digital health financing mechanisms and telemedicine to reduce health care costs and improve access to care).

Conduct further research into proxy access to digital tools for secondary caregivers, such as family members, to drive equity. Improving our understanding and developing user-friendly digital tools that enable these caregivers to deliver more effectively will help drive equitable health.

Conduct further research to deepen the understanding of gender dynamics in digital access, use, and impact, as well as a strengthen the collection and analysis of gender-disaggregated data, to help inform the development of a gender-transformative digital health strategy and guide targeted interventions for women and girls.

Make investments in smart city technologies that have the potential to enhance the public health ecosystem, improving health care delivery, access to care, and overall population health outcomes (e.g., scalable digital infrastructure, practical artificial intelligence applications, telehealth services, and integrated information systems).

Develop city-level One Health roadmaps, that leverage digital health based on existing national-level policies and guidance. The focus cities are undergoing transformative trends, necessitating integrated approaches that will help bolster their health systems.

Pilot resilience-focused early warning systems leveraging available databases and existing smart city infrastructure at the intersection of digital health and climate change. This could help mitigate the impact of non-health shocks and stressors. The pilot projects can be crucial in identifying best practices and informing further investments in digital health.

In conclusion, these insights into the digital health landscape in South Asia emphasize the potential of digital solutions to enhance urban health systems and outcomes. Future research can leverage our deep dive into these five cities to contribute to the growing knowledge base supporting the development of smart city approaches for advancing universal health coverage in South Asia.

1. Background

Building Healthy Cities (2017–2022) and Asia Resilient Cities, or ARC (2022 onwards), are two awards funded by the United States Agency for International Development (USAID) and led by John Snow Inc., in collaboration with a consortium of partners. Building Healthy Cities focused on understanding, documenting, and mapping urban health systems across four Asian cities (Da Nang in Vietnam, Indore in India, Kathmandu in Nepal, and Makassar in Indonesia) to bolster global learnings and approaches on urban health systems. ARC aims to build on the learnings from the Building Healthy Cities project to work with cities and their residents to create more resilient and livable environments.

To support core activities, contribute to the body of learning, and better align resources during the implementation of ARC, Digital Square at PATH conducted a landscape analysis to understand the current digital health ecosystem of select South Asian cities. The landscape analysis looked at five cities across three countries—Ranchi and Imphal in India, Sylhet and Chattogram in Bangladesh, and Kathmandu in Nepal—to understand their systems' development opportunities and challenges as they relate to digital health. Snapshot profiles of the five cities are highlighted in Figure 1 below.

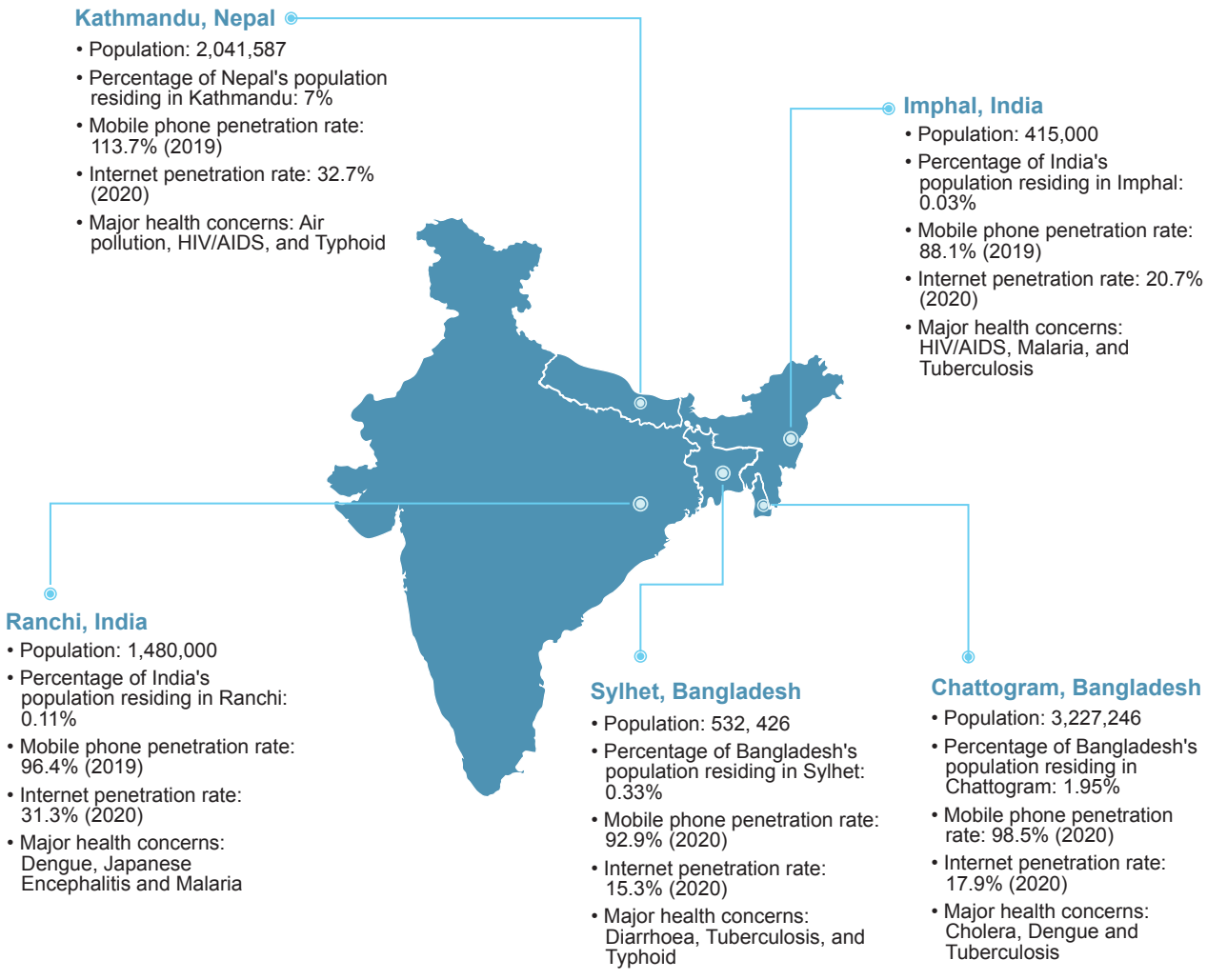


Figure 1. Focus city profiles across India, Bangladesh and Nepal.

The landscape analysis had the following objectives:

- Outline the national digital health policies across the three countries and explore how these policies influence urban digital health.
- Identify digital health opportunities and challenges unique to urban health systems, focusing on equity, quality, resource optimization, and resilience
- Explore how smart city initiatives (where applicable) and national and municipal health authorities leverage digital tools and lead digital transformation efforts, with considerations for health equity, scale-up, and sustainability.

Additional analysis, where possible, included identifying:

- Past or ongoing efforts of cities to address climate change and health shocks, plus their capacities to address the same in the future (i.e., resilience).
- Opportunities that may not be directly relevant to digital health policy or implementation but may inform the ARC core objectives of promoting sustainable urban growth (e.g., supporting resilient, low-carbon urban infrastructure) and integrating climate change and environmental considerations into urban approaches.
- Future research opportunities that may shed further light on or add value to addressing crosscutting urban development challenges in secondary cities in Asia.

This landscape will benefit ARC implementing partners and municipal health authorities, the USAID Asia Bureau, and USAID cross-bureau communities of practice focused on digital health and urban issues.

2. Technical Approach

To guide this landscape and ensure that core objectives are sufficiently met, Digital Square developed and used a theoretical framework that built on USAID's Vision for Health System Strengthening 2030 (i.e., equity, quality, and resource optimization);[1] the six health system "building blocks" framed by the World Health Organization (WHO) (i.e., service delivery; health workforce; health information systems; medical products, vaccines, and technologies; health system financing; and leadership/governance);[2] and the ARC focus area of urban resilience.[3] As such, the framework focuses on four outcomes of health system strengthening (HSS): equity, quality, resource optimization, and resilience. Further, within each of these outcomes the framework includes the WHO building blocks, sorted under each of the outcomes (see "Stakeholder interactions" in section 3). Each of these outcomes is described in more detail below. In this report the framework will be referred to as the "technical approach."

Equity

The equity lens examines how countries' governance, health systems, and digital ecosystems enable their community members to achieve the highest level of health for all. To provide a comprehensive overview of equity, the landscape will assess digital health and equity through a socio-ecological lens, examining them across three domains: the individual (individual-level access, awareness, and literacy with regard to digital tools); the family and home (the role of intermediaries and proxy caregivers in equitable access to health); and the community and workforce (the role of organizations, community health workers [CHWs], and governments in achieving equitable implementation of health initiatives).

Quality

The quality of a country's health care system may be influenced by its effectiveness, patient-centeredness, and safety. The landscape will analyze existing policies and governance mechanisms to determine whether they support digital health systems and how they are implemented at different levels of governance. The study also will focus on care delivery and the use of technology by urban health workers, as well as retention strategies, routine health information systems, and data use for monitoring. Finally, the study will examine the interactions among patients, health providers, and community members to assess the health care system's responsiveness at the field level.

Resource Optimization

The landscape will identify and evaluate the delivery mechanisms for health services in each country, including at the last mile, in terms of resource optimization. To do this, the landscape will examine the ways that finances are allocated through multiple levels of the health system, the availability of social protection schemes, the average cost to patients in a municipal system, and the role of digital tools and innovations in these parameters.

Resilience

The landscape will employ a resilience perspective to assess the impact of the existing level of digital transformation within WHO's health system building blocks on the capacity of cities and municipalities to effectively respond to shocks and stressors (Figure 2), such as disease outbreaks and population displacement. It will investigate the cities' capacity to absorb, the initial shock

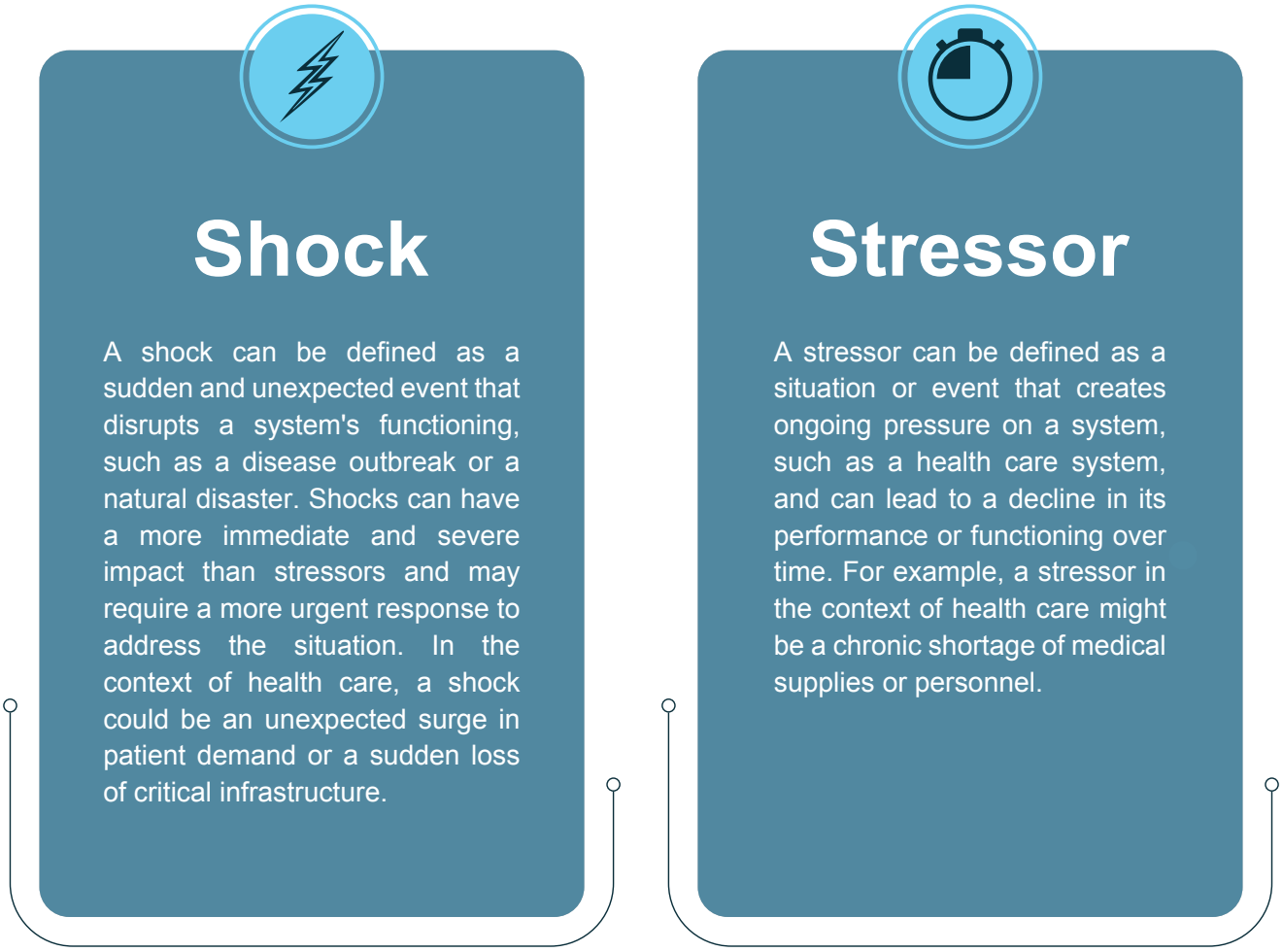


Figure 2. Definitions of "shock" and "stressor" as it relates to health system resilience.

in the face of an adverse event, and to adapt and change their infrastructure in the face of adversity. Additionally, the analysis will encompass the cities' transformative patterns and their potential willingness to upgrade digital infrastructure, all aimed at reducing chronic vulnerability and promoting sustainable, equitable, and inclusive development.[4,5]

3. Methodology

Digital Square used a qualitative approach to collecting and analyzing information for this landscape. This included a high-level desk review of broad and current research to inform the landscape's context and framing; a set of 30 key stakeholder interviews evenly divided between countries and across multiple governance levels; and a focused desk review of policies, strategies, and mandates around urban and digital health. When needed, the team held follow-up discussions with USAID country and regional experts. This section expands upon the methodology used.

Secondary Data Analysis - High-level Desk Review of Existing Research

Digital Square conducted a high-level desk review on certain key reports and documents from global and local partners to contextualize our initial activities. Using the National Health Authority (NHA) of India's Strategy Overview,[6] WHO's Digital Health Atlas,[7] USAID's Map & Match,[8] a Frontiers in Digital Health rapid review of Nepal article,[9] and an article on Bangladesh's digital health journey,[10] we were able to conduct multiple foundational activities that were essential to the report, represented in Figure 3.

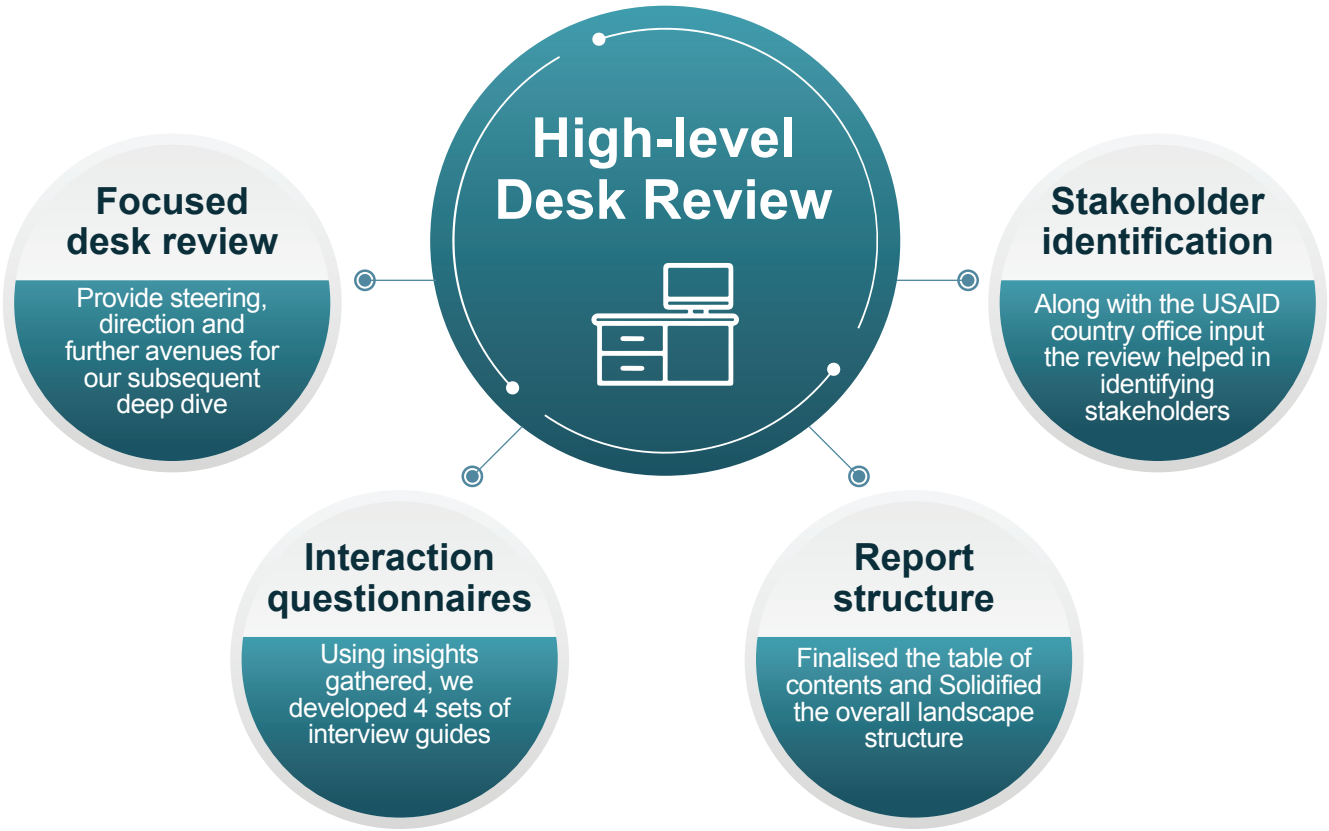


Figure 3. Overall activities resulting from the high-level desk review

Focused desk review of country-specific documentation

To achieve more targeted findings, Digital Square conducted a deep dive into the available literature by country, largely separated into three distinct categories: (1) government or government-affiliated policy, strategy, and legal documents; (2) scholarly articles; and (3) miscellaneous publications or reports by donors, international nongovernmental organizations, and third-party technology organizations. The technical approach overlaid our research during the in-depth desk review to ensure alignment to our main landscape objectives. Where applicable, the detailed desk review informed each of the three objective areas of this landscape—particularly the objective to outline the national digital health policies across the

National Policy/Plan/Strategy	Ministry	Validity
Perspective Plan of Bangladesh[11]	General Economics Division, Planning Commission	2021-2041
Smart Bangladesh: ICT Master Plan 2041	ICT Division	2023-2041
8th Five Year Plan July 2020 – June 2025[12]	General Economics Division, Planning Commission	2020-2025
e-Government Master Plan for Digital Bangladesh[13]	ICT Division	2019
Health, Nutrition and Population Strategic Investment Plan[14]	MOHFW	2016-2021
National Nutrition Policy[15]	MOHFW	2015
National Urban Health Strategy	Ministry of Local Government, Rural Development and Cooperatives	2020
Health Care Financing Strategy	MoHFW	2012-2032
National Health Policy	MoHFW	2011
National Social Security Strategy[16]	General Economics Division, Planning Commission	2015

Table 1. Description of Bangladesh's government or government affiliated policy, strategy, and legal documents reviewed during the in-depth desk review.

three countries and their influence on urban health. Furthermore, opportunity and gap identification, resilience, and future areas of potential research were highlighted as part of the desk review process.

Table 1 provides a non-comprehensive example of the related government or government-affiliated policy, strategy, and legal documents for Bangladesh; the rest are detailed in the "References" section of this report.

Stakeholder Interactions

Digital Square worked with the USAID missions in each country to identify ten key informants across governance levels to expand upon and validate the desk review findings. The interviews were conducted in a semi-structured format, allowing respondents to elaborate on their answers while also using prompts and probes to guide the conversation. Interviews were recorded and lasted between 40 to 60 minutes. To maintain the privacy of stakeholders, participants were briefed about the landscape and its objectives, how their responses would be used, and the option to opt out of the specific questions or the interview altogether. After this, consent was taken from the participants with regard to the recording, their anonymity, and the usage of data.

Four questionnaire sets were developed and divided across national, state/division, city, and field levels. Each set had an average of 6 to 8 core questions with an additional 15 probes for steering the conversation. The questions focused on the countries' understanding of its digital health blueprint, initiatives, tools, and financing; non-health stressors; the health system's ability to adapt

Landscape Objective	Technical Approach[a]	Question	Probe 1	Probe 2	WHO Building block
Objective 1 (outline the national digital health policies across the three countries and explore how these policies influence urban digital health)	Across all four	1.Could you briefly describe <insert country's> approach to digital health?	1.1 Does a blueprint or strategy for this approach exist?	How does the blueprint get implemented?	Governance
	Across all four		1.2 What opportunities exist within <country name> to expand and drive this blueprint/ strategy?		Governance/ Medical products, vaccines, and technologies
	Across all four		1.3 Do you see any challenges to Digital Health, from a policy level?		Governance/ Medical products, vaccines, and technologies

Table 2. An example of how our questions were mapped against multiple parameters of the technical approach.

[a] *The four technical approach areas are equity, quality, resource optimization, and resilience.*
Abbreviation: WHO, World Health Organization.

in crisis; service delivery mechanisms; and workforce capacity. Each question was mapped against the three core objective areas (see Section 1), the four technical approach areas (equity, quality, resource optimization, and resilience), and one or more of the six building blocks (service delivery; health workforce; health information systems; medical products, vaccines, and technologies; health system financing; and leadership/governance). An excerpt from our national-level questionnaire with the relevant mapping parameters is given below (for a more detailed view, please see Annexure B).

Feedback and Follow Up Consultations

The team conducted virtual calls with country USAID experts to identify challenges, lessons learned, and any potential areas of study specific to their country missions. Once data were synthesized and analyzed, a draft stakeholder report was shared with USAID Country Missions and, finally, with the USAID Asia Bureau teams for feedback. Digital Square used the feedback to finalize the report, expand upon potential research opportunities, and decide upon an appropriate dissemination model for this report.

In the next section of this report, we will provide an in-depth analysis of the digital health landscape in India, Bangladesh, and Nepal. Specifically, we will examine each country's policies, governance structures, and initiatives related to digital health. Using a focused desk review, we will explore the background, current status, opportunities, and challenges of digital health in each country. Additionally, we will assess how national-level actions translate into subnational-level implementation, at least on paper. By doing so, we aim to provide a comprehensive understanding of the digital health policy ecosystems in these three focus countries.

4. Digital Health Policy Review

Public health shocks, such as the outbreak of COVID-19, serve as a reminder of the crucial role digital health and a strong digital infrastructure play in a country's resilience and its ability to respond to crises.[6] This is particularly true for low- and middle-income countries (LMIC), where the presence of affordable and accessible digital infrastructure—including identification (ID) systems, databases, and secure payment mechanisms—can have a transformative impact. A recent review encompassing social protection programs across 85 countries[vi] explored how preexisting digital policies and infrastructure facilitated rapid information sharing and assistance during the pandemic.[17]

Digital health in South Asia is an emerging field, with a growing focus on using the existing (and expanding) technology infrastructure to improve health care delivery and outcomes in the region. The subregional focus of this landscape (i.e., India, Bangladesh, and Nepal) represents approximately 20.0% of the global population[18] and, due to a high burden of disease, 10.7% of the global disease burden,[19] which has led to a growing need for effective and efficient health care delivery systems.

There has been an increase in the use of digital technologies in health care in these countries, including electronic health records (EHRs), telemedicine, and mobile health (mHealth) applications. These technologies have the potential to improve access to health care in remote and underserved areas, as well as to improve the quality and efficiency of health care delivery.

In recent years there has been a significant shift in the approach to digital health from isolated pilot projects toward a more comprehensive and systemic approach. The pace of this shift, however, has varied among countries in the subcontinent. The following subsection will examine the policy landscape of India, Bangladesh, and Nepal, exploring the similarities and differences in their digital health developments.

India

In 2008, only about 4% of India's 1.2 billion citizens had a multipronged way of verifying their identity. By 2022, Indians verified their identity 38 billion times via digital means.[20] Similarly in 2008, bank account ownership hovered at around 25%, with digital payments being largely nonexistent. By 2018 close to 80% of the population[21] had an individual bank account,[22] and in December 2022, 7.8 billion individual transactions were being done per month on India's Unified Payments interface. Adoption of this interface is especially prominent in cities and towns, what with 35.4% of the total population living in urban areas.[23] Financial policy during the period from 2014 to 2022 was further strengthened through phased implementation of the Pradhan Mantri Jan-Dhan Yojana, also known as the National Mission for Financial Inclusion. A key objective of the Jan Dhan scheme was to promote financial inclusion and extend banking services to every household in India. The scheme focused on the individual's access (both digital and analog), enabling the person to open bank accounts, avail financial services, and benefit from various government welfare schemes.[25]

This leap in technology adoption occurred in tandem with a systematic and multisector rise in digital policy development. These policies looked at unique IDs and digital frameworks for government, payments, and health. The foundation for this effort was laid in 2008 with

the establishment of the Unique Identification Authority of India, which aimed to issue a unique ID number (i.e., Aadhaar) to all country residents.[26] This was followed by the launch of the National e-Governance Plan in 2010, which aimed to make all government services electronically available to citizens,[27] followed shortly by the 2013 drafts (revised in 2016) of the EHRs and metadata standards.[28]

A final enabler of this change was the rise in cellular and mobile telephones. In 2022 the number of mobile phone subscribers surged to 1.17 billion, covering over 80% of the population, while active internet users exceeded 624 million.[29] This widespread availability, coupled with low data costs, opened up the potential for access to digital technologies and services across urban and rural areas. Mobile devices became the primary communication and service delivery tools, while the internet empowered education, e-commerce, and government service access.

India Enterprise Architecture (InDEA)

The InDEA 2018 is a set of guidelines and best practices for the design, development, and management of digital systems and services in the government. The framework intended to help government agencies and organizations create a common and consistent approach to digital transformation and align their information technology systems with the overall goals and objectives of the government.

The InDEA is divided into four main layers: business, application, data, and technology.

The government of India often uses its second iteration (InDEA 2.0) as a blueprint for major digital initiatives to ensure that digital services are easily accessible and efficient and provide the intended benefits to the citizens.

Recognizing the interdependence of Jan Dhan, Aadhaar, and mobile phones in facilitating direct benefit transfers to citizens, this convergence came to be known both colloquially and officially as the JAM trinity.[30]

In 2015, the government launched the ambitious Digital India program, which acted as a watershed moment and aimed to transform the country into a digitally empowered society and knowledge economy, further accelerating the development of framework policies and papers, such as the ubiquitous InDEA.[30]

Looking specifically at digital health, India's NHA, Ministry of Electronics and Information Technology, and Ministry of Health and Family Welfare (MOHFW) jointly released the National Digital Health Blueprint, which took learnings from the InDEA and InDEA 2.0 frameworks.[31] This blueprint provided a roadmap to establish the necessary ecosystem for digitally enabled, comprehensive health care delivery across the country with the help of a Digital Health ID, a unique ID number for each citizen, along with other features such as a health data

management system, health data exchange, and health card. The National Digital Health Blueprint would later crystallize into the Ayushman Bharat Digital Mission (ABDM), led by the NHA, which currently drives the building blocks of India's digital health ecosystem.

Current landscape

The Indian government has taken several steps in recent years to promote the use of digital technology in the health care sector, with the goal of improving access to health care and increasing efficiency. The most recent and prominent step was the launch of the ABDM in 2021 by the NHA, with the "aim to develop the backbone necessary to support the integrated digital health infrastructure of the country."[32] This "backbone" would revolve around a set of core foundational components that focus on integration, registration, and security, including the following:

- **Ayushman Bharat Health Account (ABHA) Number:** This is a unique citizen account number - over 300 million of which have been created already[33] - that serves as a reference number for longitudinal health records and enables tracking of an individual's interactions across various stakeholders during their patient journey, including doctors, hospitals, labs, and chemists.

- **ABHA application:** Similarly, the application enables ABHA account holders to manage and create their personal information, history, and EHRs. The application allows individuals to control their own data securely and works on the principle of consent-based sharing. Currently users can give and revoke consent, ensuring that their health data are no longer indefinitely accessible to the recipient. After the consent period expires, providers lose access to the data. However, health care facilities in the ABDM ecosystem (where the record is created) always have access to records, even while other providers require user consent to access previous health records.

- **Health Facility Registry (HFR):** This is a comprehensive registry of public and private facilities in India's health care ecosystem. While participation is required for public health facilities, with over 150,000 facilities verified on the HFR,[21] private facility registration remains voluntary. However, a Digital Health Incentive Scheme launched recently has implemented a financial incentive structure in the hope of increasing private facility adoption.[34] Under the incentive program, registered facilities on the HFR can receive a financial benefit. Facilities that can demonstrate over 100 "transactions" per month, which refers to the creation of an ABHA-included EHR, are eligible to receive INR 20 (US$0.24) for each transaction starting from the 101st transaction and beyond. This incentive aims to reward facilities for their active participation in generating a substantial number of ABHA-linked EHRs.[35]

- **Health Care Professional Registry (HPR):** Like the HFR, the HPR serves as a database for doctors and nurses across modern and traditional medicine areas. The HPR has close to 136,000 verified professionals and counting,[21] as awareness and information regarding the benefits of the HPR disseminate across India. Basic information is collected from the professionals, including medical council registration details, for verification. The verification process plays a crucial role in

tackling the prevalent problem of uncredentialed providers ("quack" doctors) and health care professionals operating beyond their authorized scope of practice, such as pharmacists engaging in direct diagnosis and prescription of medications to patients. Currently the professionals registered can make their profile public, in which case information like their name, medical registration number, educational qualification, and experience will be visible to others. However, the display of additional details, such as photo, address, and phone number, will depend on the settings chosen by the health care professional. Nevertheless, they can still access patient health records with the patient's consent.

- **Unified Health Interface (UHI):** Designed as an open protocol network that serves to integrate health service providers and user-facing applications, the Unified Health Interface is the bridge that enables digital health service delivery for patients. These services include teleconsultations, service discovery, and provider appointment booking and scheduling. There is a wider net of growing services being offered, as the NHA continues to offer more pathways for end user applications.

The government continues to demonstrate an appetite for deepening its digital health ecosystem after increasing its annual financial allocation to ABDM by 70%, from INR 2 billion in 2022/23 to INR 3.41 billion in 2023/24.[36]

The minimal burden of legacy systems[37] has reduced barriers and allowed the government to focus on a policy approach that shaped digital public infrastructure in a step-by-step manner. This has also allowed, from a solutions perspective, an open source and digital public good ecosystem to thrive. Some examples of platforms and tools that have emerged from this ecosystem include the India global stack, the National Health Stack, Arogya Setu application, and the Modular Open Source Identity Platform.[38]

Looking ahead and heralded by its Group of Twenty Presidency in 2023, India continues to build on its digital health policy landscape with a focus on security, private-sector involvement, and an exchange of best practices to form a truly active digital ecosystem.

Opportunities

With a burgeoning emphasis on digital and the recent release of the data empowerment and protection framework, the topic of personal data security and privacy presents itself as a huge opportunity in India. The Indian government has demonstrated its willingness to tackle this sensitive topic when it introduced the Personal Data Protection Bill in 2019 for parliamentary and judicial review.[40] The judiciary, industry, and citizens debated the bill until the government withdrew the bill in August 2022. Based on stakeholder feedback, the Indian government revised the bill and presented an updated version for discussion and review.[41] A well-thought-through and robust data protection policy would be a game changer in the South Asian region, akin to the General Data Protection Regulations in Europe.

Equitable access to digital services is key to any development indicator, health or otherwise. As digital health and overall digital adoption have grown, so has the gender gap in access to digital services. Between 2019 and 2021, male mobile internet users increased from 36% to 51%, while female smartphone ownership only increased from 14% to 25% in the same period.[42] Existing policies and programs, like the National

Data protection in India

The Personal Data Protection Bill 2019 was a proposed legislation aimed at safeguarding personal data and establishing a comprehensive data protection framework in India. It included provisions for data localization, emphasized informed consent and purpose limitation, granted individuals rights over their data, and proposed the establishment of a Data Protection Authority. Similar to global examples like the European Union's General Data Protection Regulations, the bill aimed to protect individuals' privacy and regulate the processing and handling of personal data. Its enactment would have provided a legal framework for data protection in India and replaced the long-standing Information Technology Act, 2008 (Amendment).

The Personal Data Protection Bill went through four iterations, and due to the number of changes made by judicial and joint parliamentary committees, the government sought to submit a fresh iteration of this bill in August 2022.

The most recent iteration of data protection legislation, known as the Digital Personal Data Protection Bill, 2022, has been released for public feedback, indicating progress towards its introduction in 2023. This bill has been questioned for removing key aspects of collection and storage limitation and has been approved for its potential presentation in the Parliament.

Digital Literacy Mission[43] and Pradhan Mantri Gramin Digital Saksharta Abhiyaan,[44] are focused on driving digital literacy to the last mile. These initiatives have been successful, with the number of benefitted citizens continuing to increase. There is a huge opportunity for a policy and program focused on balancing the digital gender gap, making India a unique digital policy leader in the region. Future research should explore avenues for strengthening digital policies, particularly in addressing technology-mediated violence against women.[45] Additionally, emphasis should be placed on enhancing digital governance transparency, thereby improving accountability, and promoting trust in technological advancements.

Bangladesh

Bangladesh, home to around 169.8 million people, is experiencing a rapid urbanization trend, with 39.4% of the population living in urban areas.[46] By 2030, the urban population is expected to become the majority in the country. This demographic shift underscores the necessity for robust infrastructure, improved connectivity, and advancements in mobile financial services (MFS) to meet the evolving demands of the population.

Addressing these demands, Bangladesh has experienced significant mobile penetration, with approximately 174 million mobile connections covering nearly 100% of the territory and population, achieved without subsidies or regulatory intervention. Despite low adoption of 4G mobile handsets (below

20%) and smartphones (below 40%) due to higher tariffs, mobile phones have successfully connected previously unconnected citizens.[47,48] Moreover, the introduction of MFS has allowed millions of unbanked individuals to join the formal banking system. Bangladesh Bank has granted 15 licenses for bank-led MFS, with bKash[49] and Rocket[50] emerging as frontrunners, boasting extensive customer bases and agent networks. In 2020, over US$66 billion worth of transactions were conducted by more than 32 million unique MFS account holders, marking a significant increase from 2019's $51 billion.[51]

Bangladesh's digital and health policy journey also has evolved rapidly, beginning with the announcement of "Bangladesh Vision 2021" in 2008, which aimed to transform the country into a middle-income nation.[52] In 2009, the government established the Digital Bangladesh program to leverage information and communications technology (ICT) tools for economic advancement. The same year, after the 2008 general elections, the National ICT Policy was developed, serving as a roadmap for realizing the vision of Digital Bangladesh. Further, the emphasis on digital policy before the introduction of the National Health Policy in 2011[53] reinforced the latter's focus on digital health" citing "effective use of information technology in health care management" (p. 9) as one of its primary goals when it was launched.[54] The MOHFW also implemented the Health Nutrition and Population Sector Program, currently in its fourth version (2017–2024). Further policies, such as the 2018 revision of the National ICT Policy and the E-Government Master Plan for Digital Bangladesh (2019), were subsequently introduced to strengthen digital initiatives. While not a comprehensive list, these policies helped inform the digital health development in Bangladesh.

Since its inception, the National ICT Policy has accounted for the transformative potential of ICT in promoting equitable opportunities, addressing social and economic disparities, and driving inclusive economic growth across the Republic. To align with the evolving vision of a "Digital Bangladesh," the National ICT Policy underwent revisions in 2015 and 2018. It laid the foundation for a comprehensive framework comprising a single vision, eight objectives, 55 strategic themes, and 343 action items. Regular monitoring of action plans and periodic reviews of strategic themes ensure the policy's continued relevance and effectiveness in driving digital advancement. The policy would also provide impetus for frameworks such as the Health Informatics Standards and Data Structure for Bangladesh (2014)[55] and the Bangladesh National Digital Architecture guidelines in 2019.[56]

Further, integration of digital health into the health policy landscape became evident with the introduction of two operational plans in the fourth Health Nutrition and Population Sector Program (2017–2024).[57] These 2 operational plans, out of a total of 29, specifically target health information systems and e-Health, overseen by the Directorate General of Health Services (DGHS) and Directorate General of Family Planning, respectively. These operational plans play a crucial role in implementing digitization across various health care operations, such as human resource management, immunization, routine aggregated health information, hospital management, EHRs, and management information systems (MISs).[29] For instance, under this policy, a substantial budget from the MIS-DGHS core funding was allocated to trainings on the District Health Information Software 2, or

DHIS2 (which now has an average reporting rate of 98% across public health facilities) and Open Medical Record System (Open MRS+).[58]

Current landscape

In 2022, Bangladesh launched Vision 2041, aiming to eradicate extreme poverty, achieve upper middle-income country status by 2030, and ultimately become a high-income country by 2041. This vision has spurred initiatives to leverage digital technology in health care, including the establishment of a core technology stack (Bangla Stack) with essential infrastructure for hosting, datasets, and analytics. It envisions the transformation of Bangladesh into a "smart" nation, prioritizing data-centric design and human-centric experiences beyond automation and digitization. The plan is built upon four key pillars: governance, democratization, decentralization, and capacity building,[59] or Smart Citizen, Smart Government, Smart Society, and Smart Economy.[60]

As an implementation roadmap of Vision 2041, the Smart Bangladesh: ICT Master Plan 2041 was released by the national ICT Division in 2023 and encompasses over 40 digital programs. All smart health care projects under the ICT Master Plan are centered around the “health stack” infrastructure, aimed for rollout from 2024 onwards. Taking best practices from other countries, including India, Singapore, and Estonia, the health stack will be centered around Bangla Stack, tied to universal digital ID.[61] The four layers of the proposed Health Stack are as follows:[39]

- The health services layer aims to establish a common digital highway, enabling individuals to seamlessly access digital health services provided by both the government and the private sector. With the objective of enhancing convenience and accessibility to health care services, this layer hopes to improve the way people seek medical assistance.

- The health data layer, comprising the Facility Registry, Encounter Registry, Terminology, Providers Registry, Disease Surveillance, and Electronic Medical Record systems, aims to improve accurate recording and standardized management of health data, potentially empowering health care providers with reliable information for improved decision-making, detection and health care delivery.

- To streamline financial transactions within the health care ecosystem, the payments layer has been designed to establish interlinked digital payment systems and gateways. The goal here is to simplify financial processes, reducing administrative burdens and enhancing financial efficiency in health care services.

- Finally, the health identity layer intends to create comprehensive health profiles for each citizen, encompassing their health records and relevant information. If successfully implemented, these profiles can facilitate centralized and easily accessible health data, ensuring continuity of care and personalized health care services tailored to individual needs.

According to the current implementation plan, these 4 layers will be built upon (and connect to) the proposed overarching access layer of the Bangla Stack, which will provide the necessary infrastructure and connectivity to support seamless interaction between different components of the health stack.

Looking ahead, a team under the DGHS is drafting a national digital health strategy (NDHS) to build a national health information exchange system.[62] Although partially aligned with the ICT master plan, the focus of the NDHS (2021–2025) seems to lie on the proliferation of shared EHR, as opposed to an explicitly stated approach. According to stakeholders in the DGHS, the shared EHR is intended to serve as the integration point of a plethora of available systems, in turn enabling easy access to high-quality digital services for its citizens.

> **"In my area, the digital implementation looks like reporting health related information through DHIS2 platform. (..), There is lack of integration of data between directorates and other relevant departments under MoHFW"**
>
> *– A Health Officer, Chattogram Division, Bangladesh*

Opportunities

The digital health landscape within multiple departments of the MOHFW currently comprises 114 actively deployed digital systems (including certain subsystems). These platforms are largely siloed and differ in terms of hosting, ownership, funding, and maintenance.[63,64] These include approximately 32 DHIS2 instances and further independent platforms, like the COVID-19 surveillance system, Surokkha Vaccine Management system, Integrated Digital Healthcare Platform, and multiple electronic health management information systems (HMISs), which contribute to a fragmented digital health ecosystem. It is crucial to continue investment in enhancing interoperability among these existing platforms, while also considering upcoming unifying initiatives under the ICT Master Plan.

Over the past decade, a multitude of policies, vision documents, and action plans have been rolled out, as highlighted in the paragraphs above. These initiatives have been carefully aligned in principle to guide the development and progress of Bangladesh across sectors. Examples include the recently extended fourth Health Nutrition and Population Sector Program, Perspective Plan 2041, E-Government Master Plan, ICT Master Plan 2041, and upcoming NDHS. A significant opportunity to align in action, particularly for future digital health initiatives, presents itself. An accelerated rollout of core infrastructural programs under the ICT Master Plan, including the Universal Digital ID, Bangla Stack, and the health stack, would benefit both legacy and downstream digital health initiatives, giving them a base layer upon which to build solutions.

Nepal

Historically slower to urbanize than its contemporaries in the region, approximately 66% of Nepal's 29 million citizens currently reside in urban areas, with 7% of this urban population concentrated in Kathmandu (Figure 4). In 2015, Nepal adopted a new constitution as part of its new federal structure, with seven provinces and 753 local governments.[65] Health care followed a similar governance structure, with the federal Ministry of Health and Population (MOHP) driving policy at the national level and monitoring trends, while provincial and local governments are constitutionally mandated to provide health governance and free-of-cost

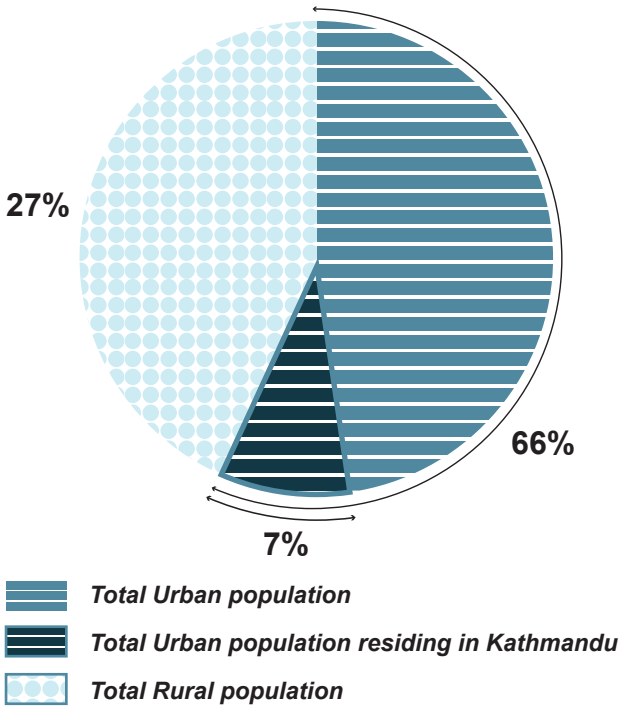


Figure 4: Percentage of Nepals urban population concentrated in Kathmandu

basic health care delivery to citizens at the provincial and local levels.[66]

As of 2021, digital penetration and internet usage in Nepal are increasing steadily. According to the World Bank, nearly half of Nepal's population, approximately 47%, is currently using the internet.[67] This statistic, along with the estimated mobile penetration rate of 130 subscriptions per 100 persons, suggests a growing trend and a strong inclination among the population toward digitalization. The phenomenon of subscriptions surpassing populations can be attributed to factors such as the prevalence of dual SIM (Subscriber Identity Module) phones, which enable individuals to benefit from different calling rates and coverage options.[68] Additionally, migratory populations contribute to this trend by maintaining active connections across different regions.[69] Overall, there is a significant digital appetite among policymakers and citizens in Nepal.

This appetite was demonstrated at an early stage when a central health management database, the integrated HMIS,[70] was established by the Planning and Monitoring Division of Department of Health service as early as 1994.[71] Nepal also saw its first telemedicine projects piloted in 2004, with the HealthNet Nepal telemedicine network being the most prominent.[72] This would begin a trend of innovation and experimentation through pilot testing for close to a decade.

In 2014, the first iteration of the National Health Policy aimed to improve the health status of the Nepali population by increasing access to high-quality health care services, reducing health inequalities, and strengthening the health system. While not explicitly tackling digitalization, a key objective of the policy was strengthening health systems such as information technology, financing, and human resources.

Since the 2015 earthquakes and government restructuring, the government has been working to improve the country's performance across all development indicators through key policies that leverage digital technology. The Ministry of Information and Communication's National ICT Policy (2015)[73] articulated the government's commitment to open source software and conformity with national and international standards. It also placed an emphasis on data and system interlinks so that the country's digital sector would develop coherently as the country became more federalized.

The MOHP's Nepal Health Sector Strategy (2016)[74] highlighted key aspects of digitalization, including an integrated HMIS, for which a roadmap was later drafted in

2021. The roadmap was extended beyond its five-year mark, through to 2030.[75] Additionally, the Health Sector Strategy emphasized use of data for action in monitoring, analysis, and policy formulation across health verticals.

The government's approval of the National e-Health Strategy 2017[76] served as the launchpad for the country's future digital health activities. This policy emphasized access to high-quality health care services, particularly for marginalized and remote populations, using cost-effective, standardized, efficient, interoperable, and user-friendly e-health solutions and applications. The strategy also aimed to enhance the use of health information systems and strengthen the capacity of health care workers to use digital tools.[77] With the aim to prevent further fragmentation at the policy level, the government aligned the National e-Health Strategy with the latest versions of both the National Health Policy (2019) and Nepal Health Sector Strategy (2016–2021).

Current landscape

A more centralized approach to data and digital health began in 2011 when the MOHP launched the DHIS2 Software Operational Guideline Nepal.[78] These guidelines, coupled with a stronger emphasis on migrating older systems to newer ones, resulted in the migration of the health management system database and early warning surveillance into the DHIS2 system by late 2013. The DHIS2 would be successfully adapted and used across various health use cases in Nepal over the years.[79,80]

While the DHIS2 will continue to play a significant role in Nepal's digital health landscape, the next significant phase was marked by the introduction of the Digital Nepal Framework (DNF) in 2019. The DNF is the government's most recent approach to increasing digital literacy and advancing ICT in Nepal. The framework introduces an ecosystem-based approach to digital transformation, serving as a roadmap for leveraging digital efforts to drive economic growth. It aims to efficiently address crucial societal concerns and identify opportunities for Nepal to actively participate in the global

A DHIS2 success snapshot: HIV care and antiretroviral therapy

The DHIS2 was effectively used to improve Nepal's HIV response through the HIV Care and ART Tracking System. Led by the National Center for AIDS and STD Control in collaboration with multiple organizations, the system, based on the DHIS2 Tracker platform, was successfully rolled out nationwide following a pilot phase in three HIV treatment centers. Despite initial challenges such as inconsistent data transcription and user reluctance, the system now offers benefits, including reduced workload for health care workers, improved accuracy in regimen tracking, streamlined procurement planning, and prompt response to supply stockouts.

economy. The DNF includes 80 activities divided into eight sectoral categories: Health, Agriculture, Digital Foundation, Education, Governance, Infrastructure, Entrepreneurship, and Tourism.[81]

Rollout of the Digital Foundation category is focused on three main pillars: digital connectivity, digital governance, and digital skills:

- Digital connectivity has seen a significant increase in Nepal, with mobile and internet penetration rising in recent years. According to the Nepal Telecommunications Authority,[82] over 1.27 million households (approximately 30% of the total population of Nepal) have internet subscriptions, and the government is in the process of testing 5G technology. However, challenges such as affordability, the digital divide, access, and digital literacy persist in many parts of Nepal.

- In terms of digital governance, the government already has made efforts to digitize public services, such as digitizing data from land revenue offices and customs offices through the Nepal National Single Window system.[83] However, the DNF policy accelerated the digitization of government services, resulting in the launch of the Nagarik App in 2020. This application has over 500,000 unique users and offers a range of services, including PAN (permanent account number) registration, access to local government information and tax submission details, use of Citizen Investment Trust services, access to police clearance reports, etc.[84] These services are continuously and gradually being expanded to cater to the evolving needs of the users. Finally, the National ID card also was intended to ease the digitization of services.[85] However, after a successful pilot rollout to 117,000 individuals, the National ID is currently undergoing essential upgrades before an intended nationwide scale-up.[86]

- The digital skills pillar remains a significant implementation gap that needs urgent attention. Prominent think tanks, including the Nepal Economic Forum,[87] have advocated for the implementation of a comprehensive “digital skill agenda” to expedite progress in this crucial area.[88]

Currently, health projects under the DNF support the government's goal of providing high-quality basic health care to all citizens by using digital technologies such as videoconferencing, e-learning, and mobile health for Nepali citizens.[54] The COVID-19 pandemic did accelerate the adoption of digital health services, with an increase in online physical and mental health consultation services. Additionally, the government used the opportunity to accelerate the development of a National digital health ID which aims to provide a unique ID number to each citizen of Nepal. This ID number will be linked with the demographic and health information of citizens and to the aforementioned National ID card.

Opportunities

A lack of core legacy systems presents Nepal with a huge opportunity to avoid cumbersome development steps in its digital health journey. Two opportunities include increased emphasis on a layered architecture and further harmonization of Nepal’s international support.

Nepal’s National e-Health Strategy embedded OpenHIE (open health information exchange)

as a guiding framework, and various health registries adopted the DHIS2. While interoperability as an idea may be prevalent at the national level, its conceptual understanding still needs to be driven at the state and municipal levels. This empowered and decentralized governance structure should be recreated in a similarly decentralized digital health architecture that will benefit Nepal.

Along similar lines, international donor support and initiatives, if not well managed, could lead to further fragmentation, with multiple donors driving siloed pilots and only aligned with the national strategy in principle. Official development assistance currently makes up 24% of the annual budget,[89] and Nepal manages the inflow of international development in a structured manner, harnessing it through policy mechanisms like the sector-wide approach, Joint Annual Review, Joint Financing Agreement, Joint Coordination Mechanism, and Health Sector Development Partners Forum. With a heavy shift in trend toward digital health projects, further alignment and harmonization to the core digital health frameworks highlighted in the section above will only strengthen country level health systems, thereby reducing duplication and fragmentation.

Parameter	Focus country		
	India	Bangladesh	Nepal
Dedicated Digital Health Strategy	National Digital Health Blueprint (now ABDM)	NDHS 2020–2025 (under development)	eHealth strategy, 2017
Designated funding	Dedicated budgets, allocated annually to the NHA	Dedicated funding for digitalization in partnership with international nongovernmental organizations	Pooled funding, directed as part of health systems funding platform and sector-wide approach
Designated funding (Subnational)	**Jharkhand:** US $300k **Manipur:** US $111k	**Sylhet:** No dedicated funding **Chattogram:** No dedicated funding	No dedicated funding; provincial-level digital health funding that is guided by donors and volunteers
Data governance policy	No unified data protection legislations; country defers to Information Technology Act, 2008 (Amendment)[93]	Digital Security Act, 2018,[94] supplemented by Information and Communication Technology Act of 2006[95]	No unified data protection legislations, country defers to the Privacy Act 2075 (2018)[96]
National - level electronic health record (EHR)	The ABHA number, along with national- level registries (HFR &and HPR), underpin EHRs	No national-level EHR; a shared EHR repository was piloted in one district but was discontinued[97]	Individual EHR (Nepal EHR) pilots are in progress, and a national HFR has been active since 2018
Sub-national adoption of EHR	ABHA, HFR, HPR, and EHRs are all being created at the state and city levels	None	Nepal EHR (program of MOHP) is soon to be adopted in all provinces; no provincial-level EHRs currently exist.

Parameter	India	Bangladesh	Nepal
Empowered institutions (National)	NHA of India, established in 2018	No explicitly empowered institution, with the Aspire to Innovate (a2i) program[98] having some digital remits under the ICT Division	No dedicated institution established, with progress currently under the purview of the MOHP
Empowered Institutions (Subnational)	NHA and NHM drive digital health through state ABDM offices	MOHFW leads, and ICT Divisions and LGDs drive digital health (proposed)	There is no dedicated body for the provinces
Focus on interoperability	Unified Health Interface (open protocol network) enables interoperability across health services	There is a very low level of interoperability, with health informatics standards and data structure as the only available guiding framework	OpenHIE framework was adopted in 2017, with rollout in progress; DHIS2 is the primary method of enabling interoperability across health services
Innovation & experimentation	While successful at state level, the country is moving away from the pilot model to a top-down model of innovation	The rich pilot ecosystem showcases successful digital deployments, yet the lack of cohesion hampers interoperability	Telemedicine pilots began as early as 2004; however, these pilots remain fragmented, leading to further challenges in interoperability

Table 3. How national and subnational efforts measure up against WHO parameters.

Adapted from: World Health Organization (WHO). Global Strategy on Digital Health 2020–2025. Geneva: WHO; 2021.
Abbreviations: ABDM, Ayushman Bharat Digital Mission; ABHA, Ayushman Bharat Health Account; DHIS2, District Health Information Software 2; EHR, electronic health record; HFR, Health Facility Registry; HPR, Healthcare Professionals Registry; ICT, information and communications technology; LGD, local government division; MOHFW, Ministry of Health and Family Welfare; MOHP, Ministry of Health and Population; NHA, National Health Authority; NHM, National Health Mission; OpenHIE, open health information exchange; WHO, World Health Organization.

Findings

As demonstrated by the policy review, the adoption of digital policies and technologies in the health care sector has been uneven across countries. Although the overall direction of digital transformation is similar, the starting point for each country differs greatly. It is crucial to assess, rather than compare, the level of digital maturity of each country's health care policy. To determine maturity and necessary steps for improvement, we used common themes that emerged in WHO's Global Strategy on Digital Health from highly successful country-level digital health care systems. Mature digital health policy and framework development share certain common parameters, including a dedicated digital health strategy, national-level EHRs, a focus on interoperability, and empowered institutions with specific digital remits, among others. [90,91,92]

While these parameters do not need to occur sequentially, it is good to ascertain where our three countries stand. Table 3 provides a detailed taxonomy of each and represents how some of the parameters discussed translate to the subnational level. The subnational levels in relation to our focus cities include the Indian states of Jharkhand and Manipur, the Bangladeshi divisional zones of Sylhet and Chattogram, and the province of Bagmati in Nepal.

Although differing levels of work remain to be done, this section described some of the pivotal policy steps each country has taken toward a mature digital health ecosystem. These have included establishment of strategies, foundational frameworks, system rollouts, national identifiers, data legislature, and system innovations. The digital health policy landscape in South Asia is rapidly developing, at times leapfrogging archaic legacy steps, with all signs pointing to each country's establishing itself as a digital health leader in this global ecosystem.

While we have touched on subnational translation and adoption of policies in the preceding paragraphs, the next section will dive deeper and explore the significance of equity, quality, resource optimization, and resilience in the context of the five focus cities. We also will investigate the impact of digital tools, solutions, and approaches on city-level best practices and challenges in urban health. Each subsection will focus on one pillar of the technical approach, using a common definition or framework as a reference point, before delving into each pillar in more detail.

5. Digital in Urban Health

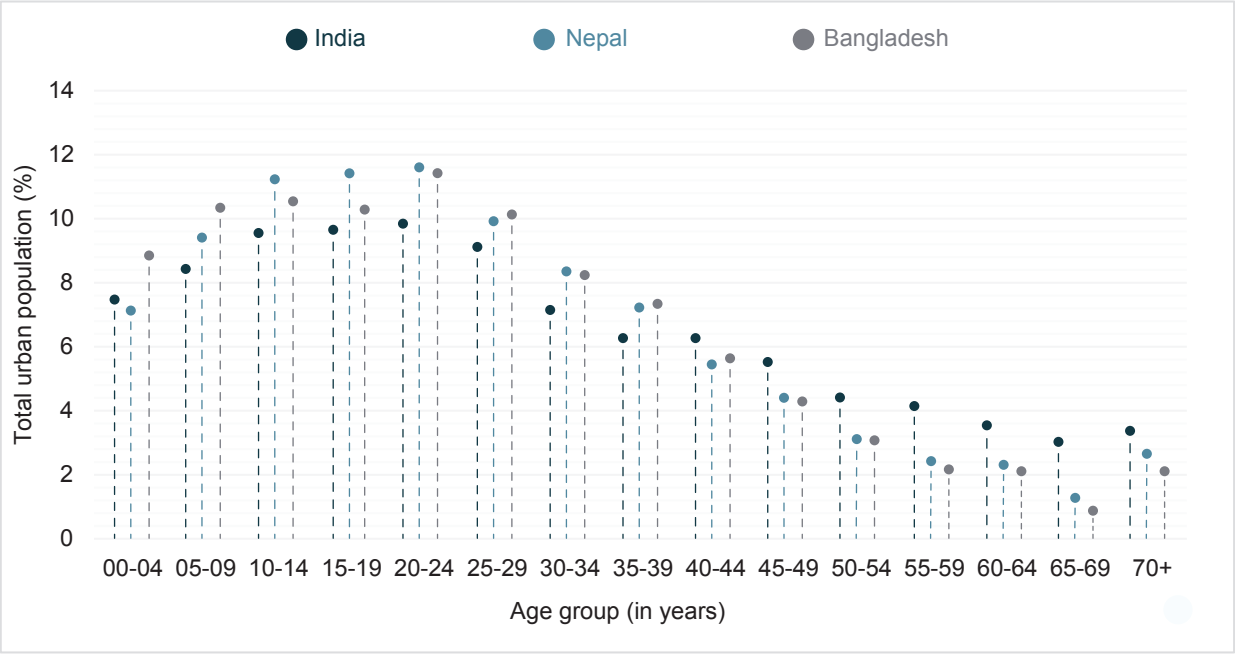


Figure 5. Young, dynamic digital natives—demographics of urbanizing populations across India, Nepal, and Bangladesh.

Source: The World Bank. Data Bank: World Development Indicators. Accessed March 01, 2023 https://databank.worldbank.org/source/world-development-indicators#

An individual's health is directly related to where they live, work, play, and grow.[99] As the global population is projected to reach 9.7 billion by 2050, the world is experiencing a rapid increase in urbanization. Currently, 55% of the world's population resides in urban areas, and it is expected to rise closer to 70% by 2050. For many of us, our health will be affected by the cities we inhabit, and the urban health systems that govern them.[100]

In South Asia, much of this urban population is expected to be adolescents, or young and dynamic "digital natives" (Figure 5), geared toward leveraging digital tools and systems to improve their access to services across all areas.[64] In this context, it is important to understand how current digital policies, tools, and initiatives permeate existing health systems.

While no two countries—and in some cases, cities—are alike in how they organize and deliver health care, there are certain features that can be attributed to higher-performing country-level health systems. These include a reduction in cost barriers and provision for universal health coverage (UHC); high adaptability and resilience to external shocks; a focus on ensuring all communities have equitable access to high-value services; removal of any administrative barriers, such as complex paperwork or replication of activities, that may divert efforts away from appropriate health care provision; and an emphasis on social services and safety nets.

In this section we explore the significance of equity, quality, resource optimization, and resilience across urban health. Further, this section will examine to what extent digital tools, solutions, and approaches are being used to drive best practices or exacerbate challenges in public health across our focus cities. Each subsection highlights one pillar of the technical approach, building on a common definition or framework as a reference point, before deep diving into each pillar.

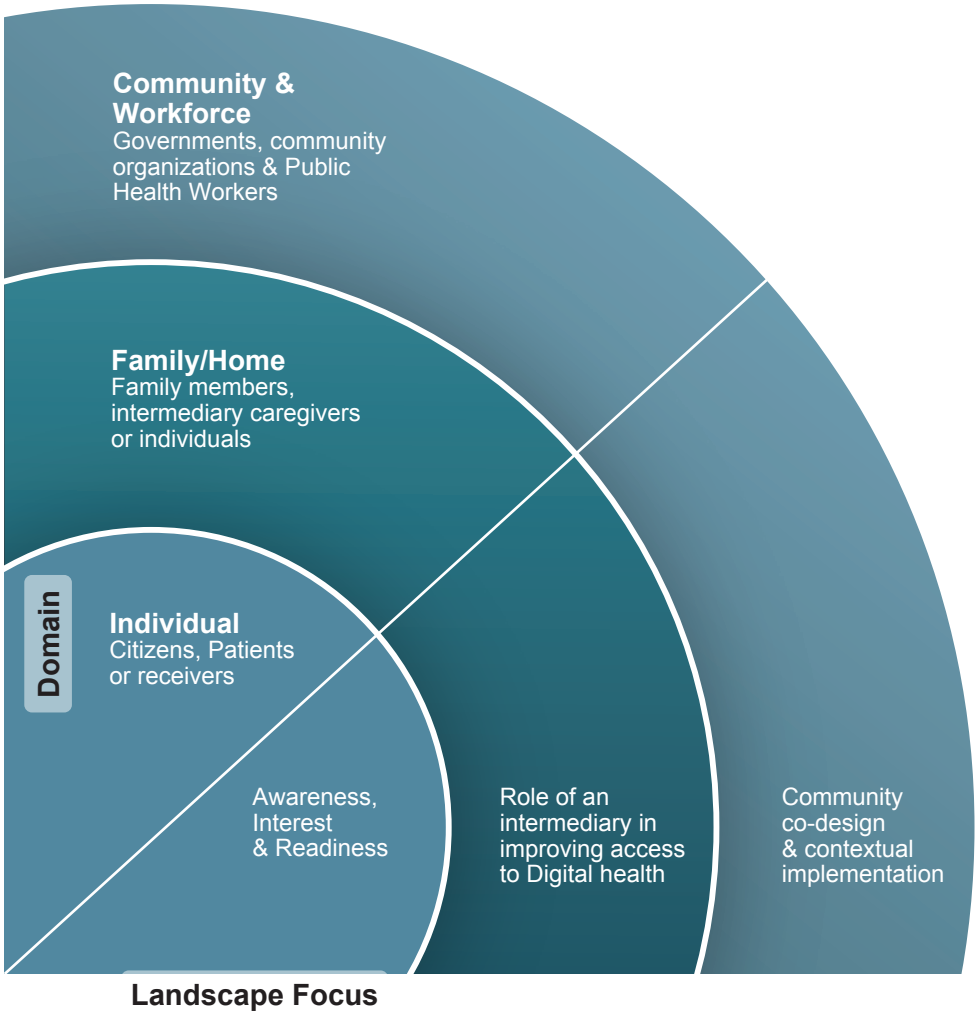


Figure 6: Socio-ecological framework for Digital Health Equity used as part of the landscape (Adapted from Lyles, Wachter & Sarkar, 2016)

Equity

Traditionally, an equitable health system is one that ensures all individuals are afforded equal opportunity to achieve the same level of health, regardless of their background or circumstances. At a time of swift digital evolution in health care, there is a heightened focus on achieving health equity. In this context, digital health enhances in-person health care through communication, education, and remote care management. These methods have the potential to address some of the fundamental obstacles faced by marginalized communities, such as reducing access barriers based on location and time. However, if the digitalization of health care progresses without proactive engagement, planning, and implementation, it may lead to further inequity.

The South Asian context also presents some unique societal nuances for which we need to account, including equity in relation to the family dynamics within which individuals receive health and the complexities of

extending care to informal urban populations or slums. Households in our focus countries include between 4.5 and 6.0 members,[101] markedly different from high-income countries, which have an average household size that is closer to 2.0 members.[102,103] Our focus countries also embody similar family dynamics, such as extended and blended families, where achieving health (through remote or digital tools) is done by including a support structure that includes family members. Further, the proportion of urban dwellers living in slums has shown relative stability at between 55% and 40% over the past decade in the three focus countries. According to World Bank's 2020 estimates, slum populations account for 49% of the urban population in India, 52% in Bangladesh, and 40% in Nepal, making these informal settlements an important consideration.[104] While many factors can be used to evaluate digital health equity, this report will look at it through a socio-ecological lens, defined across three domains (Figure 6):

1. Individual: Exploring individual-level access, awareness, and literacy with regard to digital health.

2. Family and home: Understanding the role of intermediaries and proxy caregivers in equitable access.

3. Community and workforce: Examining the role of organizations, health workers, and governments in achieving equitable implementation of health initiatives. [105]

Individual level

While we have discussed mobile phone penetration in the policy review section, it is important to note that penetration does not always guarantee equitable access. Digital health factors, such as gender-balanced ownership of mobile phones, the type of mobile phones (e.g., smartphones, feature phones, or basic phones), and internet usage all play a gatekeeping role in achieving equity through digital means, or vice versa. Although capturing these data accurately in absolute numbers can be challenging, a 2019 study on ICT access and use that was based on nationally representative surveys provides valuable insights into these aspects, as shown in Table 4.

While digital tools may improve equity in some areas, they may also deepen inequity in others, as evidenced by our city-level interviews and the aforementioned data. Gender remains a concern across our three countries, both in urban and rural settings.
The trends in the Table 4 suggest that more men tend to own phones and use the internet than women, with varying degrees of difference. Additionally, urban areas exhibit differences in phone preferences, with Nepal standing out as an outlier due to its widespread use of smartphones, while feature phones are more common in Bangladesh, and basic phones dominate the market in India. Fewer women, both in urban and rural areas, tend to own smartphones, indicating potential barriers to accessing advanced digital technologies. This highlights the need to address gender disparities and

Future research should prioritize the collection and analysis of comprehensive gender-disaggregated data, which can facilitate the development of gender-transformative digital health strategies at the country level.

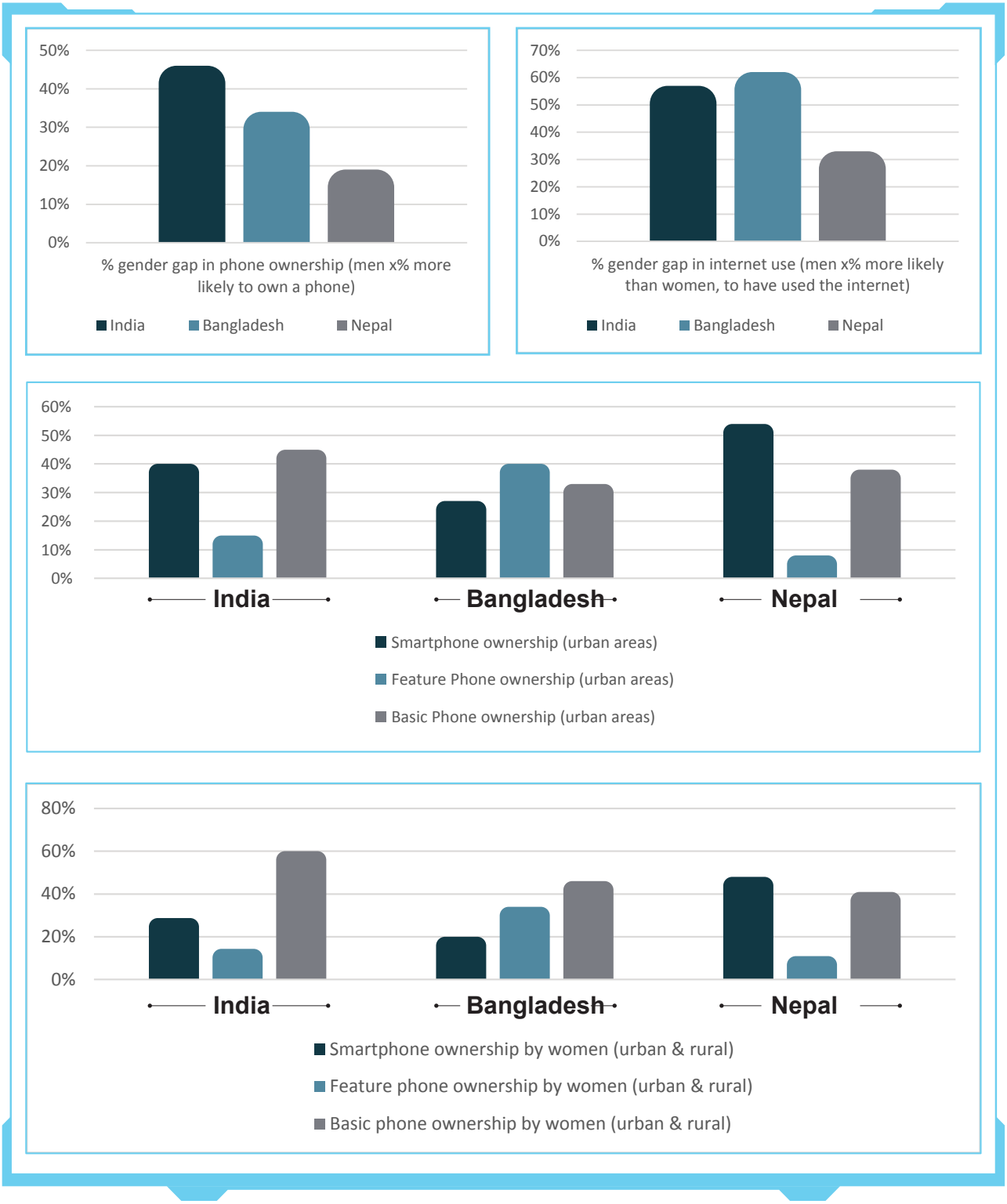


Table 4. Digital health factors as they relate to equity, by focus country.

Adapted from: LIRNEasia. AfterAccess: ICT Access and Use in Asia and the Global South. Version 3.0. Colombo: LIRNEasia; 2019. https://lirneasia.net/wp-content/uploads/2019/05/LIRNEasia-AfterAccess-Asia-3.0-update-28.05.2019.pdf

Parameter	Focus city				
	Ranchi	Imphal	Sylhet	Chattogram	Kathmandu
Available telemedicine platforms	eSanjeevani (public)	eSanjeevani (public) / TeleECHO (private)	None	United hospital portal (private)	National Telemedicine Teleconsultation center (public) / Multiple providers (private)

City level callout 1: Available telemedicine platforms

promote equitable access to digital technologies, including mobile phones and internet, in these regions, with efforts aimed at bridging the gender gap in phone ownership and internet use for the empowerment of women in areas such as health, education, and economic opportunities.[106]

Although the trends identified above are based on limited data, it is crucial to acknowledge that the gendered digital divide necessitates a comprehensive understanding. While this divide can be attributed to broader factors, including insufficient access to mobile devices within households and a lack of awareness regarding available services, it is important not to overlook the nuanced aspects that also contribute to this divide,[107] such as reliable digital media literacy and skills, affordable and reliable internet connectivity, and relevant and tailored content, as well as a supportive family and environment.[108,109] Future research should prioritize the collection and analysis of comprehensive gender-disaggregated data, which can facilitate the development of gender-transformative digital strategies at the country level.[110]

At the city level we found considerable awareness of and interest in using digital technologies, particularly through our stakeholder interactions. In-person interactions with public health workers in cities like Imphal and Chattogram indicated that, while the population has become accustomed to digital technologies in other areas, such as payments, taxes, and transportation, they have yet to realize the same potential in the context of health. This aligns with available data on internet use across all three countries, where internet awareness is higher compared to actual internet use.

Innovations like eSanjeevani, the government of India's teleconsultation platform, have greatly improved individual-level awareness and acceptance in urban areas. A senior stakeholder in the city of Ranchi estimated that between 2021 and 2022, remote consultations on eSanjeevani went up 400%, with close to half a million consultations. Though COVID-19 may have been the driver here, the increase highlights the fact that, without a population comfortable with the idea of digital tools, this sort of uptake would not have been possible.[111]

Other telemedicine channels were available during the pandemic, including message- and video-based consultations through popular messaging applications, such as WhatsApp, where payments are managed through private payment gateways.[112]

Uptake also varies in relation to how complex digital solutions are, where sometimes simpler solutions have more acceptance and utility at the urban level. In Chattogram, our initial interactions indicated a limited or generic awareness regarding digital health initiatives that were being discussed at the national level. Two recent studies also supported this finding, highlighting a lower level of urban and semi-urban digital literacy prevalent across Bangladesh.[113,114] While residents of both Sylhet and Chattogram have access to paid telemedicine services, such as Niramoy by Grameenphone[115] or Robi Health Plus[116] (see "Normalization of Remote Care in Cities" subsection below), we found a significantly higher adoption rate of the national health helpline and interactive voice response initiative Shastho Batayon 16263[117] in comparison to other solutions. A reason for this higher uptake might be due to users needing to select specific numbers in response to questions or prompts rather than requiring them to navigate an app or browser. Citizens found this easier to adopt as it did not require English literacy or technical knowledge to configure their devices. In summary, while there may be a lower level of digital literacy in certain areas, simpler digital health solutions like Shastho Batayon 16263 can be widely accepted and adopted.

Expanding on the significance of language proficiency and ease, the linguistic diversity of countries like India, Bangladesh, and Nepal significantly influences access to digital resources and services. Most digital initiatives typically commence implementation with one anchor language (e.g., Hindi, Nepali, Bangla) and English. Although efforts are made to broaden the range of available languages, the implementation often falls short, exacerbating the digital divide. For instance, in India, the ABHA application and eSanjeevani are available in only two languages. With over 1,600 languages spoken across the country,[118] focusing solely on Hindi and English may exclude speakers of regional languages like Tamil, Telugu, Bengali, and Marathi. This may result in limited participation in the digital sphere, impeding care and social opportunities for marginalized communities. To bridge this gap, it is crucial to prioritize language inclusivity, invest in language localization, and collaborate to ensure equitable digital access for all linguistic backgrounds.

Finally, in urban informal settlements, individuals face multiple overlapping challenges that threaten equity, including poverty, overcrowding, inadequate infrastructure, and land tenure insecurity. These challenges increase the risk of exposure to environmental pathogens, leading to higher rates of infectious and noncommunicable diseases in low-income urban areas. Although research on the intersection of digital health, equity, and slums is limited, interventions such as BRAC's Manoshi digital fingerprint and unique health record,[119]as well as MaMoni[120] and Surrokhito digital health enablement interventions targeting ready-made garment workers and slum dwellers,[121] provided valuable insights into this understudied field.

It is evident that digital health equity encompasses multiple nuances beyond "inadequate infrastructure." In the context of Manoshi, participants revealed that their reluctance to use fingerprinting was due to various reasons. The prevalent concerns revolved around the requirement of family permission, a perceived lack of necessity,

apprehensions regarding the potential misuse or abuse of their fingerprint records, and the perception that it would consume significant time. As digital health continues to gain relevance, further research in this intersectional space will be essential to deepen our understanding and address the evolving complexities.[80]

In conclusion, at the individual level, efforts are needed to bridge the gender gap, leverage the growing awareness around digitalization, and promote acceptance of digital health initiatives, particularly in urban, semi-urban and informal areas within the focus cities in this landscape. While positive developments such as increased remote consultations are seen, there is still a need for wider adoption of digital health interventions. Simpler solutions like Shastho Batayon 16263 show potential for acceptance based on individual comfort and understanding. It is important to recognize that digital tools can both improve equity and create deeper inequity, necessitating ongoing efforts to ensure inclusivity and benefit for all individuals in diverse contexts.

Family and home level

As mentioned earlier, support structures in South Asia often include immediate or extended family members who act as intermediaries. A recent study on inequity in Bangladesh found that many young participants were repeatedly asked by their family members to find health information through digital means, but the family members did not actively seek out such information themselves. Even though individuals knew that the information or services were available, they often deferred to intermediaries rather than accessing the digital resources directly. It is worth noting that digital health interventions in South Asia are beginning to account for this unique nuance to equity. For example, the COVID Vaccine Intelligence Network, India's vaccination application during the COVID-19 pandemic, allowed individuals to add family members and schedule appointments as a proxy. The vaccination drive began with the vulnerable aging population (60+) and has currently aided in the vaccination of over 1.1 billion people.[122] While data on this grouping are not readily available, proxy caregivers likely played a key role in this effort.

The importance of secondary caregivers and family support has become abundantly clear in a post-COVID-19 health system. Therefore, it is crucial to take this support structure into account when discussing equity in digital health. However, this subarea of digital health equity remains largely unexplored in LMIC and requires detailed analysis going forward.[123,124] The exploration of proxy access to digital health solutions and how they are accounted for would be an area of deep dive for future research.

It is worth noting that digital health interventions in South Asia are beginning to account for this unique nuance to equity. For example, the COVID Vaccine Intelligence Network, India's vaccination application during the COVID-19 pandemic, allowed individuals to add family members and schedule appointments as a proxy. The vaccination drive began with the vulnerable aging population (60+) and has currently aided in the vaccination of over 1.1 billion people.[82]

Community and workforce level

Equity in digital health goes beyond providing access to technologies; it also requires that these technologies are designed and implemented in ways that consider the specific needs and contexts of the communities they serve. This includes understanding the local culture and social norms, as well as the digital health tools and initiatives being offered to patients. For many LMIC, the community includes a blend of the public health workforce, digital health tools, and other trusted community and nongovernmental organizations.

Community engagement plays a critical role in health care delivery across LMIC. Trust between health care providers and patients is particularly important in our focus cities, where health care systems are often underresourced and overburdened and patients may have limited access to health care services. However, trust cannot be established without health workers' being comfortable and proficient with the digital solutions they are delivering and ensuring that the level to which these solutions enable equitable health is not reduced.[125,126] Across our focus cities, insufficient operational skills among health care personnel—including what was referred to in discussions as a "skill-mix imbalance" and lack of training and availability of training resources—affect the workforce's ability to effectively translate digital initiatives at the ground level. For instance, in Kathmandu, common challenges identified across multiple digital interventions were lack of skills, experienced doctors' lack of information technology knowledge, and insufficient training. [127,128,129]

> **We are happy with new digital initiatives but feel there is room to [better] understand how to use them well.**
>
> *– A City level Health Worker, Kathmandu*

The impact of hybrid approaches on equitable health has been extensively studied.[69,130,131] These approaches leverage digital tools to enhance health access and equity, capitalizing on the strong relationships and rapport built by CHWs. Several impactful initiatives demonstrate the power of hybrid approaches in promoting equitable health.

In Jharkhand, India, the School Health and Wellness Program has been implemented in 200 schools, including Ranchi, with a focus on improving child and adolescent health and digital access. The program involves multi-stakeholder collaboration and community involvement, with teachers, health

Haqdarshak in India (active in Manipur and Jharkhand) connects citizens with social protection services through a tech-driven platform and a network of over 30,000 trained Haqdarshaks (CHWs). This program has delivered benefits worth over INR 4200 crore to 3 million families and recently introduced the Yojana Card to empower individuals in discovering their eligibility for welfare schemes and accessing necessary support.[94,95]

workers, and students actively participating in and receiving training on digital tools.[132] In Bangladesh, the Tonic program (discontinued in August, 2021) used the existing Grameen network of CHWs to effectively engage its target population. Tonic provided its members with four key benefits: daily health tips (Tonic Jibon), round-the-clock medical advice (Tonic Daktar), significant fee reductions at hospitals (Tonic Discounts), and financial assistance for hospitalization costs (Tonic Cash).[133] Additionally, Haqdarshak in India (active in Manipur and Jharkhand) connects citizens with social protection services through a tech-driven platform and a network of over 30,000 trained Haqdarshaks (CHWs). This program has delivered benefits worth over INR 4200 crore to 3 million families and recently introduced the Yojana Card to empower individuals in discovering their eligibility for welfare schemes and accessing necessary support.[134,135]

Transitioning from community-level initiatives to initiatives implemented by international organizations, we observed a shared emphasis on delivering contextual solutions to ensure the inclusion of marginalized populations that have historically been overlooked. The WHO Early Warning, Alert and Response System (EWARS) in a box is a portable and self-contained system designed to support disease surveillance and response in remote and resource-limited areas. The system has been implemented in several countries around the world, including South Sudan, Myanmar, the Democratic Republic of the Congo, and Bangladesh. While its implementation in urban health will be covered under the “Resilience” section later in this report, it is important to highlight its focus on contextualization before implementation. In Bangladesh, WHO uses tools like operating procedures, which require needs assessment and coordination with local CHW networks; a 16-episode multilingual training video series; and monitoring and feedback loops to improve how the solution is implemented, ensuring that these solutions account for and reach refugee, migratory, and underserved populations.[136]

In conclusion, equity in digital health at the community and workforce level requires a comprehensive approach that considers community engagement, trust, workforce training, and context-specific design of digital technologies. By prioritizing these factors, city-level systems can work toward a more equitable and effective health care system that meets the diverse needs of communities across LMIC. Identifying workforce pressures as a definite barrier to equity and exploring how digital tools and solutions can effectively

alleviate that pressure can further improve the inclusivity of health systems.

Quality

WHO, USAID, and the International Organization for Migration all define quality in health care as services that are effective, people-centered, and safe.[1,137,138,139] In other words, quality in health care includes systems that are proven to work (effective), provide care that is centered around an individual's needs and preferences (people-centered), and ensure that this care provision protects people and does no harm (safe).

While effectiveness and people centricity are examined below, safe care provision is a crosscutting phenomenon in this subsection, including the role played by capacity building of health workers in improving overall safety and quality.

Right at the outset, it is important to note that quality of care in LMIC remains low, with approximately 8.4 million deaths a year attributable to poor-quality care in LMIC.[140] Further, in urban areas, including the focus cities, factors such a high patient load contribute to markedly low quality that varies from street to street. However, our landscape found certain efforts in the health care delivery across Imphal, Ranchi, Kathmandu, Sylhet, and Chattogram that leverage a combination of latest technologies, available frameworks, and workforce improvements to begin improving quality of care in urban areas.

Effectiveness - *a delivery system that works*

Effective health care looks to provide services that are appropriate, well managed, and monitored and that act based on data.

Improving management of facilities, clinics, and patients; entering comprehensive data; streamlining logistics and assets; and ensuring appropriate trainings, disease surveillance, and drug distribution are just a few factors that contribute toward effective health care. India, Bangladesh, and Nepal have dedicated significant time, experimentation, and resources to improving the effectiveness of their respective health care delivery systems through digital means.

A growing emphasis on digital management tools that are designed to improve the aforementioned factors exists across Ranchi, Kathmandu, Sylhet, and Chattogram. This emphasis has translated to the urban level over the years, making data available to support effective decision-making by health service providers, managers, and local health workers.[141] For instance, Nepal developed a comprehensive information system to collect and manage health service data from various sources, including hospitals, clinics, and health centers. The system has undergone multiple iterations, with DHIS2.3 being the latest update leveraged at the delivery level. In Kathmandu, all facilities are required to report their data to the health office of their respective local governments. The health offices oversee the management of data from all health facilities within their jurisdiction. Monthly reporting is mandatory for all health facilities, with online reporting being the preferred method. In situations where health facilities lack the necessary equipment, logistics, or connectivity, the municipalities take charge of data entry. Kathmandu has approximately eight digital systems with built-in feedback loops that aim to improve quality significantly.[142]

What aids effective care delivery?	Examples of public digital tools that can be leveraged at the urban level to drive effectiveness				
	Ranchi	Imphal	Sylhet	Chattogram	Kathmandu
Facility level information	HMIS 2.0 / e-Sushruth / e-hospital	HMIS 2.0	DHIS2 (MIS-DGHS) / electronic HMIS		Integrated HMIS
Logistics management	DVDMS/LMIS	DVDMS	Electronic LMIS		Electronic LMIS
Financial Management	PFMS / N-FAMS	N-FAMS	Integrated Budget and Accounting System +		TABUCS/SuTRAa
Asset management	N/A	N/A	Asset Management System		PLAMHAS
Human resources	Jharkhand HRMS	Integrated HRMS	HRMS		HuRIS
Training Information management	Training MIS	Omnicurus	HRIS-DGHS, training management systems (NIPORT and MaMoni)		Training Information Management System
Ayurveda / other	A-HMIS, NAMASTE	None	None		None
Drugs	e-Aushadhi / IPDMS	None	Supply Chain Management Portal		DAMS, online post-marketing surveillance
Disease surveillance	IDSP	IDSP	HBRIS, PCDS, Institutional Disease Surveillance		EWARS
Patient Grievance / Feedback	Mera Aspataal (My Hospital) / NHM grievance redressal system	Mera Aspataal (My Hospital)/ NHM grievance redressal system	MoHFW Grievance Redressal system (part of MIS-DGHS)		MoHP Grievance redressal system

Table 5. Currently available city-level digital health tools across the five focus cities (non-exhaustive).

Abbreviations: A-HMIS Ayush Hospital Management Information System; DAMS, Drug Administration Management System; DGHS, Directorate General of Health Services; DVDMS, Drug and Vaccine Distribution Management System; EWARS, Early Warning, Alert and Response System; HBRIS, Hospital Based Rotavirus & Intussusception Surveillance; HMIS, health management information system; HRIS, human resources information system; HRMS, human resource management system; HuRIS Human Resource Information System; IDSP, Integrated Disease Surveillance Program; IPDMS, Integrated Pharmaceutical Database Management System; LMIS, logistics management information system; MIS, management information system; MOHFW, Ministry of Health and Family Welfare; MOHP, Ministry of Health and Population; NAMASTE, National Ayush Morbidity And Standardized Terminologies Electronic Portal; N-FAMS, National Health Mission Financial Accounting and Management System; NHM National Health Mission; NIPORT, National Institute of Population Research and Training; PCDS Priority Communicable Disease Surveillance; PFMS Public Financial Management System; PLAMHAS Planning and Management Assets in Health Services.

The phenomenon of multiple available systems is not unique to Kathmandu, as shown in Table 5. All five cities have made available multiple systems designed to enhance various aspects of care delivery, from financial management to training.

However, these systems are seldom interoperable, with different departments, organizations, and levels of care. This siloed approach to technology adoption further exacerbates interoperability challenges. While national-level strategies are aiming to establish common data exchange and interoperability networks, it will be some time until urban-level systems are able to embrace interoperability.

When viewed through the lens of the larger health ecosystem, public digital tools coexist with a rapidly expanding and dynamic private sector. The health landscape continues to evolve with the incorporation of innovative technologies, smaller pilots and proprietary systems, often driven through the private health sector.

The proliferation of private-sector data and systems in digital health further compounds the problem of low interoperability. While the private sector actively champions digital health initiatives, the absence of a unified framework and effective governance hinders the seamless exchange and integration of health data. In Bangladesh, larger hospital chains operate on closed systems, like the Apollo Group,[143] which use its proprietary Apollo Hospitals Information System.[144] Similarly, the Labaid group,[145] a Bangladeshi conglomerate that employs its Labaid Information System for managing clinical operations, works on a private (closed) network.[146]

> **"As the private sector is growing very fast in Bangladesh, we need to ensure that they are well regulated and governed"**
>
> *– A Senior Official, DGHS Bangladesh*

Although digital systems have been implemented at the urban level to enhance effective delivery, such as the e-Hospital in Ranchi or the divisional deployment of DHIS2 in Sylhet, their effectiveness in improving the quality of health care services can only be realized if they are used efficiently. Our discussions called attention to the fact that while availability is not a concern, peripheral factors such as capacity, equipment, and awareness do affect timely and accurate reporting. Additionally, usage of these urban systems is not uniform across urban areas. Even though an urban center like Kathmandu had a high percentage of digital reporting, approximately 1,400, or only 34% of the total public health facilities in Nepal, were using DHIS2 monthly at the national level.[100]

While originally designed to make health care delivery more effective, these legacy systems are proving to be cumbersome at the worker level, with replication of reporting, lack of interoperability, and continued prevalence of analogue systems proving to be detrimental to the quality of care. However, new, more integrated approaches, such as the ABDM, ICT Master Plan, and DNF are ushering in a new focus on systems that are interoperable first.

People-centered – *an individual's needs & preferences at the center*

People-centered care means ensuring that health services are tailored to people's needs and are provided in partnership with those people, rather than simply given to them. Here we examine whether urban health is leveraging digital solutions and initiatives to increase an individual's agency over improving his or her own care. These solutions may be through increased information provision that aids in decision-making; control over personal data through patient management apps; or improved choice and reduced replication through EHRs and service provider registries.

While there are still challenges to accessing basic health care, digital interventions in urban cities have begun improving individuals' ability to evaluate and select available health services. For example, in India, the introduction of the ABDM at the state level—which includes a registry of about 1,000 health professionals and close to 2,000 health facilities, allowing patients access to different specialists and facilities and with fewer restrictions for migrating between doctors due to the availability of EHRs and other digital referral systems—has increased the impetus for leveraging digital tools to improve the quality of care delivery in the country's urban centers.

Specifically, citizens in Jharkhand have created close to 6 million individual ABHA account numbers, greatly increasing the choices available to them with regard to high-quality health services, including consultations, appointments, and EHRs. As of February 2023, Jharkhand has generated over 7 million EHRs, of which Ranchi, the state's capital, generated 1.5 million.. Similarly, Manipur began implementing digital tools as a single source of truth for its state health system, with over 27% of its capital city's population possessing an ABHA account number. Additionally, close to 68% of all EHRs generated in the state are in the urban center of Imphal.[21]

Due to funding and scaling limitations, Bangladesh successfully piloted a similar but more complex shared health record project, which was prematurely terminated due to funding constraints. However, simpler systems have been adopted by urban health systems to enhance citizens' ability to leverage tailored care. During our conversations with city level health officials in Chattogram, initiatives that put people at the center of health were lauded, including the following:

Parameter	Focus city				
	Ranchi	Imphal	Sylhet	Chattogram	Kathmandu
City level body driving digital health	State ABDM office, Jharkhand	State ABDM office, Manipur	ICT Division & LGD, Sylhet	ICT Division & LGD, Chattogram	No dedicated body
Number of EHRs generated	1.5 million	442,000	None	None	None

City-level callout 2. Designated digital health body and city-level EHR numbers.

Abbreviations: ABDM, Ayushman Bharat Digital Mission; EHR, electronic health record; ICT, information and communications technology; LGD, local government division.

- **Shastho Batayon 16263:** A 24/7 health care delivery helpline operation running on 8 hourly shifts per doctor, with a rotation of 15 doctors and multiple health information officers engaged per shift. While Chattogram accounts for the second-highest utilization of the service, Sylhet sits at the bottom, accounting for only 3% of the calls to the helpline.[147]

- **Sukhi Poribar:** A family health record system developed in Bangladesh that aims to improve the health of families by keeping track of their health information and vaccination records and providing reminders for medical checkups.

However, these systems will be replaced, as the upcoming ICT Master Plan and NDHS aim to concentrate efforts on more advanced people-centered information systems that support service provision and shared EHRs as a major strategic priority.

Although Nepal's 2015 constitution guarantees basic health care as a fundamental right, access to patient-centered, high-quality, and comprehensive care is still primarily a privilege.[105] In some instances, digital technology has been employed in Kathmandu to deliver high-quality care but in a siloed manner. Among successful initiatives is the mDiabetes program, launched in 2016 by the Nepali government and WHO, which employs text messaging and mobile applications to deliver diabetes education and self-management support specific to the patient and his or her needs. Similarly, Trishuli Hospital's EHR system has enhanced medical staff decision-making, reducing the unnecessary repetition of diagnostic services and medication prescribed to patients.

Our landscaping noted a shift in urban health focus from legacy systems or MISs to more people-centered systems that prioritize the quality of care, reflecting the evolving understanding of the importance of patient-centered approaches in cities.

Safe—*health workers with the capacity to ensure improved safety and quality in service delivery*

Urban public health continues to face increasing demands to address emerging challenges.[148] As pointed out earlier, the workforce often lacks necessary skills due to inadequate education and training, coupled with a high patient-population burden and an overreliance on on-the-job learning, often leading to an overall skills deficit. Capacity building of health workers is crucial for ensuring public health and safety. COVID-19 highlighted the critical role of health workers in detecting, responding to, and preventing public health threats, including outbreaks of infectious diseases, natural disasters, and other emergencies.[150]

To enhance these capacities at the urban level, measures such as fundamental competency building, credentialing, accreditation, and structured evaluations are routinely rolled out in our focus cities by governments and partner organizations.[151,152] Digital tools have proven to benefit capacity building directly by increasing the access to, flexibility of, and efficiency of training programs and facilitating the exchange of medical knowledge and expertise among health workers.

While worker capacities have been found to be low, our interactions across all five cities revealed a culture of learning prevalent in urban health systems, with stakeholders recognizing the potential impact of new

innovations, systems, and processes on day-to-day patient safety and quality of care.

At a broader level, governance bodies and policies established by national and state governments have tried to address capacity building as it relates to safety and quality of care in the three focus countries. For example, in Nepal the MOHP established the National Health Professional Council to regulate health professionals and promote high-quality health care services. Similarly, in India the National Health Systems Resource Centre is responsible for the development of policies and guidelines related to health care quality improvement.

At the local level, there have been efforts to translate these larger policies and bodies into action. For example, some health care facilities have implemented training programs for their staff to improve patient safety and quality of care. In Bangladesh, the MOHFW established a Quality Improvement Secretariat position to ensure the continuous improvement of health care services through the implementation of quality standards and guidelines. The effect of these guidelines was seen at the urban level when the Directorate General of Family Planning introduced the Family Planning Clinical Supervision team and Quality Assurance Team to ensure that its voluntary sterilization and family planning program was carried out in a safe manner in areas such as Sylhet and Chattogram.[153] With teams like these ensuring active information sharing, accurate data entry and uniform guidelines have become available to all concerned health workers.[154]

As mentioned before, the health workforce is directly responsible for ensuring safe, careful, and harm-free health care delivery. In all three countries there is an emphasis on continuing medical education of health professionals to improve structural quality through upskilling, credit courses, and registration renewal. The Manipur Medical Council and Jharkhand State Medical Council lead their respective city implementations of continuing medical education,[155] using digital tools such as the Omnicuris platform[156] to assist in remote learning, progress tracking, and notification.

In Ranchi and Imphal, multiple digital tools have been deployed to ensure that quality of care through capacity building is not only maintained but progresses over time, including the following:

- **Sahiya Sangi portal:**[157] Developed for strengthening home-based newborn care activities and led by the community mobilization cell and the National Health Mission (NHM) in Jharkhand.
- **Participatory Learning & Action portal:**[158] Used by an extensive network of over 40,000 last-mile Accredited Social Health Activists to digitally improve health care delivery.
- **TeleECHO:** Rolled out in partnership with NHM Manipur, conducting remote sessions where primary care clinicians and health care workers from various locations share patient cases with specialist teams and each other and ensuring a continuous cycle of learning, mentorship, and peer support.[159]

Another important consideration is the safety of the health workers. Research found that the capacity of health care workers to safeguard the public's health is contingent on ensuring their own safety. Therefore, for health care professionals to deliver care that is safer for patients, it is crucial for cities to evaluate health worker safety.[160,161]

The pandemic underlined this importance across multiple fronts, including infection prevention control, occupational hazards, and mental health and well-being. Cities like Kathmandu, Imphal, and Ranchi benefited from national-level measures taken for health worker safety. The measures included human resource augmentation, personal protective equipment disbursal, repeated free COVID-19 testing, a 24/7 mental health helpline, and digital capacity building. In India, digital efforts also included several online trainings and webinars for physicians and nursing personnel,[162] using the Integrated Government Online Training (iGOT) platform[163] for self-learning and internal dashboards.[164]

Across our five cities, digital health is increasingly being leveraged to improve the quality of service delivery systems by providing health workers with opportunities to improve their capacities. While there have been successful initiatives, challenges remain in scaling digital health solutions due to factors such as high urban-population burden, low worker capacity, and lack of integrated systems. Nevertheless, the ongoing efforts of national and state governments in leveraging digital technology to improve the safety of care delivered in urban areas are a positive step toward achieving high-quality health care for all.

Resource Optimization

This subsection examines first resource optimization through the lens of funding availability, allocation, and management of current resources; second, the effect of these current practices on out-of-pocket expenditure (OOPE) borne by urban residents; and third, the use of social protection to optimally drive limited resources. The role of digital tools across these three highlighted areas will continually be evaluated.

As India, Nepal, and Bangladesh are LMIC, optimizing resources is both a key requirement and an inherent challenge faced by all three countries. In this regard, Ranchi,Imphal, Kathmandu, Sylhet, and Chattogram have unique features and dependencies in their health financing that affect the availability and allocation of resources.

Availability, allocation, and management of financial resources

IIt is prudent to note that LMIC face repeated constraints on the availability of resources. How each country optimizes its available financial budget plays a key role in the development outcomes of the country. India, Bangladesh, and Nepal spend less than the suggested 5% of their total gross domestic product on health.[165] These countries also vary in how they allocate it at the urban level. Due to their federal nature, we will first look at India and Nepal, which both have unique dependencies and features in how they structure their federal health financing, affecting the availability and allocation of resources.

India's federal financing structure relies heavily on the states, which contribute approximately 65% of the total resources for health care. However, most states spend a small portion of their gross state domestic product, usually about 2%, on health care, indicating the need for more resource allocation in this sector. To boost the total funding for health care, the states need to prioritize and allocate more resources toward this sector, while the central government needs to increase its allocation to the MOHFW to a level exceeding the 2.2% of the annual budget allotted in the previous budget (2022/23).[166,167,168] State- and city-level allocation then occurs through the digital Public Financial Management System

(PFMS), for which a unique receiver account is created at the state or district authority level for depositing funds. The PFMS allows for transparency on use of funds and reports on progress. While the PFMS is effective, it still is lacking as far as interoperability and the extent to which all states leverage it.[169] Finally, at the state level onwards, the National Health Mission Financial Accounting and Management System (N-FAMS) is used to manage fund allocation down to village levels. Thus India, in principle, has begun leveraging digital tools to manage fund optimization across health governance levels. Through our interactions at the city level, we did note that there remained multiple instances of analogue bookkeeping and ad hoc usage of these systems.

Following a more recent decentralization, a larger portion of the Nepali health care budget has been assigned to the provincial level. From fiscal year 2014/15 to 2018/19, per capita health funding at the provincial level increased by an average of 34%. However, despite the gradual increase over the years, per capita spending on public health remains low, at US$22.30, in comparison to a broadly agreed-upon per capita target of $86.95 for fiscal year 2019/20. In fiscal year 2020/21, more than 63% of the budget for the MOHP was funded by external development partners (EDPs), including direct funding and pooled funding. Direct funding from EDPs accounted for 47% of the MOHP's budget, while contributions from the sector-wide pooled fund accounted for 16%. Both pooled and direct funding as a share of the MOHP's budget have increased over the years—particularly direct funding, although this may be partially explained by improved expenditure reporting by EDPs.[170,171]

Bangladesh has a more linear funding allocation structure, where the main source of revenue for the health care system is annual national allocations. Last year, health care accounted for just over 5% of the overall national budget, with a budget allocated for local government divisions that ultimately finance the urban local bodies. While the government's health-related expenses account for 7% of total government expenditure, most of it is directed toward low-income rural populations, leaving the health needs of low-income urbanites

Parameter	Focus city				
	Ranchi	Imphal	Sylhet	Chattogram	Kathmandu
City-level digital health budget allocation (USD)	State of Jharkhand allocated $300k for digital health, of which Ranchi will be the primary beneficiary	State of Manipur allocated (US$ 111k) for digital health, of which Imphal will be the primary beneficiary	None (overall city budget for fiscal year 2022/23 is $96M[174])	None (overall city budget unavailable)	None (overall city budget for fiscal year 2022/23 is $193M, $3.8M of which is earmarked for health[175])

City-level callout 3. Available city-level digital health budgets.

inadequately met by public interventions. One reason for this is that public authorities historically have not considered slums an integral part of the city. Therefore, the responsibility for financing urban public health has been borne by urban local bodies (e.g., city corporations and municipal governments), which rely on various sources of revenue, such as transfers and grants from the central government, taxes, fees, fines, rents and leases, and loans. Additionally, local government divisions may provide general revenue block grants and support for specific projects.[172]

While the budgetary allocation for health may be low overall and dedicated government digital health is nonexistent in all but one country, our landscape explored whether digital tools are being used to manage and optimize these resources. Although data at the urban level are limited and mostly anecdotal, there is more clarity at higher administrative levels, such as districts, zilas, and states. Some examples of digital tools to manage and optimize include Bangladesh's Integrated Budget and Accounting System;[173] Nepal's multiple, comprehensive digital financial-reporting tools, established post-2015; and departmental MISs such as N-FAMS in India.

N-FAMS is an online financial management and accounting system implemented by the NHM in India to improve financial accountability, transparency, and efficiency in implementation of health programs and activities at the state and district levels. The system enables real-time monitoring and tracking of financial transactions, budget allocations, and expenditure for various health programs and schemes under the NHM. Health officials can access real-time financial data through N-FAMS to make informed decisions on budget and resource allocation while preventing financial irregularities, fraud, and misuse of funds through strict financial controls and audit trails. The system is enabled for multiple user levels, and apart from the national and state levels, users at the district, block, panchayat, and village levels can access and leverage this tool to improve financial management and accountability in their respective areas.

While digital tools for optimization of resources are available, low usage, lack of integration, replication of systems, and prevalence of analog data gathering at the urban level

In Nepal, the multiple systems we referenced include:

- Electronic annual work plans and budgets used by the MOHP.
- Government of Nepal's Source Book for foreign assistance.[176]
- Financial monitoring reports.
- (TABUCS) Transaction Accounting and Budget Control System used by the MOHP.[177]
- Line Ministry Budget Information System.[178]
- Provincial Line Ministry Budget Information System.[179]
- (SUTRA) Subnational regulatory treasury application.[180]

greatly reduces the potential impact of digital optimization across the three countries. This further exacerbates the availability of resources for citizens, driving them to private health care and increasing the amount they are required to spend.

Effect of current practices on OOPE borne by urban residents

The high level of OOPE experienced by citizens across the three focus countries is a widely recognized phenomenon. A lack of available resources and the low quality of health service delivery account largely for the high OOPEs. While routine basic health care services are offered at a nominal fee or no cost across India, Bangladesh, and Nepal, there is a high dependency on the private health sector for a perceived better-quality and more reliable care. This leads to significant costs for consultations, prescriptions, food, transport, and hospital fees, which deepens poverty, exacerbates exclusion, and creates long-term stressors on the health systems.

Comparing pre-COVID-19 OOPEs for the three focus countries (Figure 7), the highest average OOPE was for Bangladesh at 72.68% of the total health expenditure, followed by Nepal at 57.91%, and India at 54.78%.[181] As of 2021, a few sources report marginally improved indicators, with Bangladesh and India both having reduced their OOPEs to 69% and 48%, respectively. However, these are recent data points based on budget projections and utilization trends and do not account for fluctuations in service delivery during the COVID-19 pandemic.

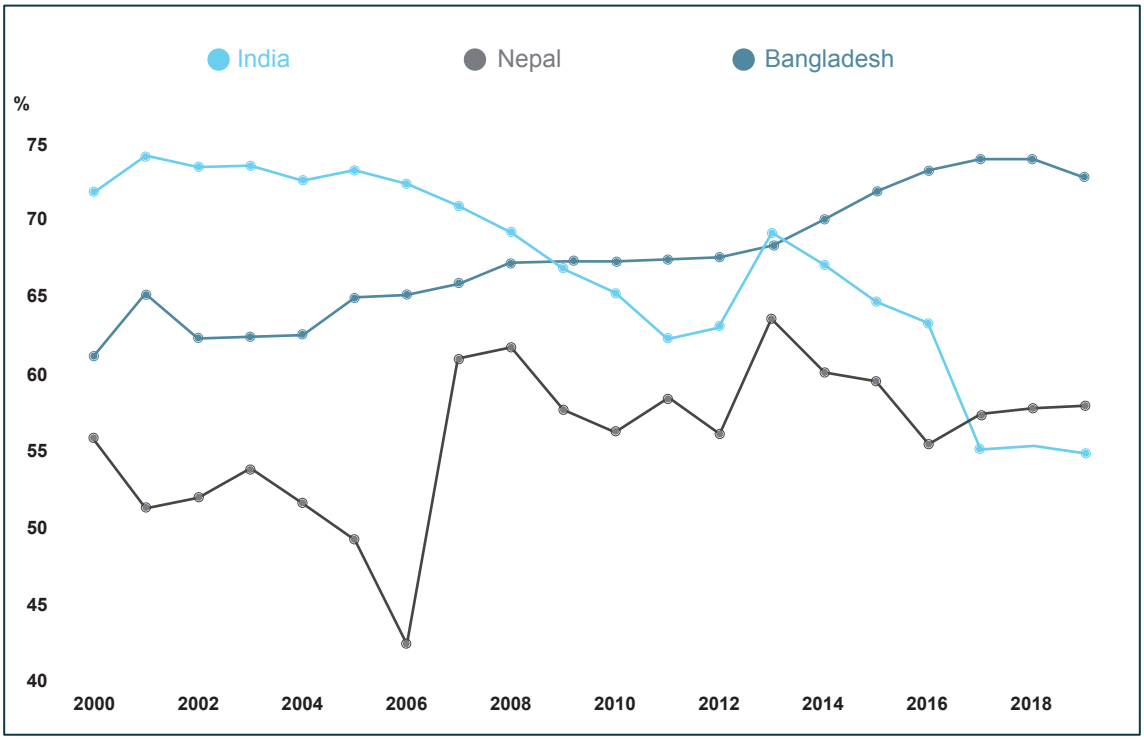


Figure 7. Comparison of country-level OOPE (% of current health expenditure).

Source: The World Bank. DataBank: World Development Indicators: Out-of-pocket expenditures (% of current health expenditure) – Bangladesh, Nepal, India. Accessed July 3, 2023. https://data.worldbank.org/indicator/SH.XPD.OOPC.CH.ZS?end=2019&locations=BD-NP-IN&start=2000&view=chart

In Bangladesh, our divisional interactions in Sylhet and Chattogram highlighted further the high burden borne by both citizens and the health system. During an interview, one stakeholder inquired into whether digital solutions could help reduce this burden on the urban health system, citing examples such as home-based care, telemedicine, consultations, and digital bulletins, which were used during the pandemic as potential test beds for reducing this high cost. While it is difficult to estimate city-level OOPE, we have given approximations below based on interactions with senior health officials, previous statistical analyses, and national estimates.[182,183]

Parameter	Ranchi	Imphal	Sylhet	Chattogram	Kathmandu
Average approximated OOPE (as % of total health expenditure)	~65%	~70-75%	~60%	~70%	~65%

City-level callout 4. Estimated city-level OOPE.

Abbreviation: OOPE, out-of-pocket expenditure.

Digital health solutions such as internal management tools, telemedicine, remote pharmacies, and digital payment systems have been recognized as drivers in reducing the OOPE burden in LMIC. These solutions help to reduce costs, limit travel requirements, reduce fraud, enable digital payments, and pool funds together.[184-186] Current research on eSanjeevani in Jharkhand estimates that on average, an individual who uses the platform saves INR 941.51 (about US$11) in out-of-pocket costs and reduces distance travelled by 21.59 km.[187] While this is only one example, the impact of digital tools on the OOPE burden is being increasingly highlighted in current research and presents an interesting area for further exploration in South Asian cities.[188]

Use of social protection to optimally drive limited resources

Social protection schemes focused on health are an important tool in optimizing the limited funds available, as they can help to optimally target funds toward vulnerable populations that may require resources the most. These schemes also promote equity, reduce financial barriers, and improve health outcomes. Digital technology can be a powerful lever for downstream optimization of social protection schemes, improving program coverage and efficiency, enhancing beneficiary outcomes, and ensuring that resources are effectively targeted to those who need them most. In the paragraphs below, we assess each of the three country's flagship health-based social protection scheme and how each scheme uses digital tools to reach individuals, many of whom live, work, and access health in urban cities.

- **Pradhan Mantri Jan Arogya Yojana (PM-JAY):**

In 2018, India merged several health insurance schemes to launch PM-JAY, which covers health care services for underprivileged households at empaneled hospitals. The PM-JAY benefit package and ceilings were expanded to around US$6,000/year per family and restructured

the governance and purchasing arrangements.[189] The PM-JAY database is based on the 2011 Socio Economic Caste Census (SECC). Identifying whether a person seeking care belongs to a household listed in the economically weaker PM-JAY database has been a practical challenge, despite the availability of the SECC database. To simplify the process of confirming beneficiaries' identities at health care providers, India has implemented the Aadhaar ID system. This approach has resulted in improved efficiency and facilitated access to COVID-19-related health services and cash benefits to citizens.[190]

The city of Ranchi currently has 1.1 million individuals actively using the scheme, with close to 210,000 hospital admissions covered so far. Similarly, Imphal has 116,000 Ayushman Card holders, accounting for 30% of the total covered hospital visits.[191] To ensure coverage for individuals left behind due to factors such as record availability, states have implemented their own schemes in conjunction with PM-JAY.

One such example is Manipur's Chief Minister-gi Hakshelgi Tengbang scheme,[192] which caters to the health needs of individuals newly added to SECC, Antyodaya Anna Yojana Card holders, the disabled, and widows. The homepage of the Chief Minister-gi Hakshelgi Tengbang scheme illustrates its relationship with PM-JAY, stating "health cover for newly added SECC, Antyodaya Anna Yojana Card holders, Disabled, and Widows," making it easier for people to understand its benefits.

- **Shasthyo Surokhsha Karmasuchi (SSK):** In Bangladesh the SSK scheme is used, a health insurance model introduced as a pilot program in 2016 for below-poverty-line households in Kalihati Upazila of Tangail District. In 2017, the program was expanded to two other Tangail subdistricts, Modhupur and Ghatail. Currently, a total of 96,432 enrolled

A citizen's digital journey to access health insurance in Ranchi and Imphal

When an individual visits a hospital for the first time, his or her Aadhaar smart card's QR code is scanned to capture identity details. Using the PM-JAY system, the Aadhaar number can be linked to the household members recognized as eligible in the PM-JAY database, which is stored in the web-based PM-JAY Beneficiary Identification System. This linking process involves demographic authentication. Due to possible variations in name spellings and geographical locations between the Aadhaar ID and PM-JAY databases, an algorithm is used to compute a confidence score that indicates the likelihood of the person being the same. If the confidence score exceeds a certain threshold, the Aadhaar code is connected to the eligible household. Once eligibility is confirmed, the person receives an Ayushman Card, which serves as proof of entitlement under PM-JAY. During subsequent hospital visits, the person can present the Ayushman Card to be promptly recognized as eligible

below-poverty-line households use the SSK scheme. The program offers primary inpatient and outpatient care through the Upazila Health Complex (UzHC), with a structured referral to the district hospital at Tangail for complicated cases. Although non-SSK patients can also receive health care at the UzHC, they are not entitled to the free inpatient and outpatient care provided by the SSK scheme. Usually individuals are required to pay a fee for consultation and admission at the UzHC.[193]

Enrolled households in the SSK scheme receive an electronic health card that is valid for one year, with plans for annual renewal. This card provides coverage of up to 50,000 Bangladeshi Taka per year (or about US$461) for inpatient care for 78 different disease groups and includes consultation, drugs, and diagnosis. Outpatient consultation is also covered for a government-financed premium of 1,000 Bangladeshi Taka (about US$9) per household per year.[137] The scheme is financed through a Health Economic Unit–generated pool fund, using government-allocated premiums from below-poverty-line households. The UzHC and district hospital are reimbursed for providing free health care to SSK patients from this fund based on verifiable patient records submitted as claims. Reimbursement follows a simplified diagnosis-related group system based on the case and diagnosis. Although the government of Bangladesh plans to expand this scheme nationwide, there has been underutilization during the initial years, with only 8% of eligible individuals using its benefits. The reason for this is primarily a lack of awareness among the target population.[194]

• Nepal Health Insurance Policy (NHIP): The NHIP is a government-run program that provides health insurance coverage to eligible Nepali citizens. Launched in 2016, its aim is to provide financial protection to eligible households against catastrophic health expenditures and to increase access to high-quality health care services. The NHIP covers basic health services such as inpatient care, outpatient care, diagnostics, emergency care, and some specialized services. Under this policy, eligible households pay an annual premium of NPR 2,500 (about US$21) per household and receive a health insurance card that can be used at designated health facilities across the country. The insurance covers up to NPR 100,000 (about US$850) per household per year for health services. The premium for targeted populations is paid by the federal government, while provincial and local governments, as well as some nongovernmental organizations, pay the premium for below-the-poverty-line and marginalized people to ensure their coverage.[195]

The NHIP has been implemented for six years and covers 77 districts and 745 local governments. Despite having a supportive policy environment, the program has not produced promising outcomes, as many people have opted out and chosen not to pay the premium. Currently, the NHIP is used in conjunction with various other schemes, such as voluntary private insurance, the Social Security Fund, and the Employee Provident Fund.[138] Multiple evaluations pointed out the sparse use of digital tools, which represents a significant opportunity area for optimizing these systems. Our stakeholders also identified this as a crucial aspect for enhancing the NHIP's effectiveness.

Country / Parameter	India-PM-JAY	Bangladesh-SSK	Nepal-NHIP
Unit of Identification	Individual/family	Household	Household
Share of population enrolled	17.25%[196]	0.06% (100,000 households)[197]	21.35% (32.14% households)[198]
How digital tools are leveraged at delivery level	Digitally enabled smart cards, including Aadhaar ID and Ayushman Card, to support patient management and processing at facilities; publicly available dashboard to view national- and state-aggregated performance data; identity confirmation algorithms; digital claims processing	Electronic card and database, with MIS-DHGS team leading enrollment and data management	Insurance MIS, through which providers can claim expenses
Opportunities for digital tools to be levered in the future	Deeper integrations into the ABDM infrastructure, including the Unified Health Interface and health claims exchange	A comprehensive digitization and integration plan in accordance with the SSK concept paper	Government-identified areas, including biometric enrollment and verification at service points, and integration with existing databases

Table 6: A comparison of the three country schemes.

• **City-level schemes:** In addition to the national-level schemes, the landscape also mapped a few schemes available at the city level that could complement or supplement national-level social protection, summarized below.

Parameter	Focus city				
	Ranchi	Imphal	Sylhet	Chattogram	Kathmandu
Available city-level supplemental social protection schemes	Mukhyamantri Swasthya Bima Yojana	Chief Minister-gi Hakshelgi Tengbang	Maternity Allowance program (donor-funded benefit)	None available	Contribution-driven social security scheme

City-level callout 5. Available city-level social protection schemes (non-comprehensive).

Resilience

As previously mentioned, the increasing cost of health care has a significant impact on people's quality of life. It is also essential to acknowledge that health care demands are influenced by various factors, such as population growth, climate change, population demographics, and health- or non-health-related disasters. Therefore, there is a growing need for innovative digital solutions and advanced health care system models that can help prepare and address these challenges effectively.

This landscape defines resilience as the ability of a health system to withstand shocks and stressors and enable cities and municipalities to absorb them, such as disease outbreaks and population displacement. The focus is primarily on how countries prepare, absorb, and subsequently recover from these stressors and ultimately adapt and transform for the future. Thus, we will explore the absorptive, adaptive, and transformative capacities at the city level.

Absorptive capacity

"Absorptive capacity" in a health systems context refers to the ability to maintain the same level of basic health care services and protection in terms of quantity, quality, and equity, while maintaining the same levels of service delivery despite facing shocks. This ability is critical at the city level, where populations are concentrated and most vulnerable to disasters, epidemics, and other stressors.

Examining the impact of the recent pandemic,[199] it is evident that initial responses at the city level were diverse yet predominantly centered on leveraging existing health care worker networks and technologies to gauge the magnitude of the crisis. Online bulletins on compliance with health protocols, public service SMS, monitoring, and reporting through messaging apps such as WhatsApp swiftly became established practices within health departments and facilities in cities like Kathmandu, Ranchi, and Chattogram.

In Bangladesh, mobile medical teams were established at the zila and district levels using the existing health workforce and kept ready for deployment as a regular practice. In cases of urgency and necessity, the cities, and districts, in coordination with the DGHS, shared resources and coordinated the deployment of personnel across areas to maintain the basic level of health services.

In November 2019, a few months before the pandemic, India launched an updated version of its National Disaster Management Plan. The plan emphasized adherence to global response frameworks in the event of "global catastrophic risks," including "failure to manage a natural pandemic."[200] However, at the city level there was little knowledge of or

> **"[In Sylhet] standard preparation for responding to the stressors didn't work completely at least in the initial period of COVID 19. Due to lockdown, movement of the healthcare providers and supply chain got disrupted. Also lack of standard infection prevention practice raised the fear of being infected. Limited availability of personal protective equipment, (..) restrained service providers in their ability to engage in service provision"**
>
> *– A City level Health Official, Sylhet*

adherence to exalted global response frameworks. As state capitals, Ranchi and Imphal were adhering to state-level response plans, including coordinating ad hoc emergency operation centers, relief commissions, and identifying agencies that could coordinate with the state disaster management authority to ensure continuity of services. These response plans also emphasized use of available technology to ensure the sustainability of risk management.

Social media and crowdsourced information played a major role in how cities absorbed the initial shock to the health system.[201] Information—such as bed availability, caseload information, "hot zones," and rapidly changing understanding and subsequent guidance of the disease—was being shared across social media platforms with reliability of information, curtailing of misinformation, and fact-checking.[202] Our interactions in Kathmandu indicated that some instances of citizens' leveraging available technology helped control patient flow and overcrowding.

While there were instances of isolated positives during the early stages of the crisis, most traditional city- level health systems failed when faced with the full extent of the crisis. In the context of resilience, failure is defined as a maladaptation, indicating that the system has not effectively adapted to address the underlying issues. It is important to note that failure is not regarded as a complete breakdown or malfunction of the system but rather as an indication that adjustments need to be made to enhance the performance of individuals or organizations in alignment with the prevailing conditions.

Adaptive capacity

The need to adjust has been felt clearly at different points in time in our focus countries. This includes during health scares, such as the severe acute respiratory syndrome outbreak in 2002/03 and Ebola outbreak from 2013 to 2016, the 2017 Rohingya refugee migration, and current climate change concerns, coupled with ongoing flooding and pollution. Adaptation in resilience requires pivoting traditional systems to overcome shocks and stressors, which is largely enabled by digital health.

After the 2015 earthquake in Nepal, which affected over 5 million people, urban reconstruction funds needed to be distributed effectively to ensure that Kathmandu could rebuild its city-level systems in a time of crisis. In just over 120 days, a team of 3,000 engineers equipped with electronic tablets was dispatched by Nepal and the Kathmandu Living Labs to gather 10 terabytes of data and 10 million photographs from the city and other remote regions of Nepal. Multiple data, surveys, and socioeconomic initiatives led by the National Statistics Office (formerly the Central Bureau of Statistics) were built on the technology-enabled model used here. Labelled the "post-earthquake digital revolution," it became an example of resilience and adaptation by leveraging innovation.[203]

Existing urban-level infrastructure is often repurposed to varying degrees of success when adapting to a crisis. In 2015, under the Ministry of Housing and Urban Affairs in India and the flagship Smart Cities Mission initiative,[204] Ranchi-along with 69 other cities-developed Integrated Command and Control Centers (ICCCs). The purpose of an ICCC is to facilitate real-time monitoring of various amenities by authorities. While initially focused on managing water and power supply, sanitation, traffic flow, integrated building management, city connectivity, and internet infrastructure, many ICCCs expanded into COVID-19 "war rooms," using the existing digital tools for COVID-19 response and management.[205]

Similarly, in 2014 WHO supported the development of a Health Emergency Operation Center in Kathmandu,[206] and in 2021 an additional control room was placed at the COVID-19 Unified Central Hospital. In coordination with the MOHP, the control room's responsibility was to manage and deploy necessary infrastructure, medical supplies, and human resources during the pandemic, leveraging MIS tools and dashboards. It was also responsible for leading communication and coordination with COVID-19 designated hospitals when necessary. In addition to this, the National Emergency Operation Center has been operational since 2010 to complement newly established ICCCs in Nepal. Available ICCCs and other available existing infrastructure (including designated disaster management offices) available across the five focus cities are highlighted below.

Globally available digital solutions also have been adapted to make health systems more resilient. A key example of this is the city-level deployment of WHO EWARS during the Rohingya displacement. The EWARS network consists of over 400 community-based surveillance volunteers who are trained to recognize and report symptoms of priority diseases, including cholera, measles, and diphtheria. The system uses mobile phones and a digital platform to collect and report data on suspected cases of disease in real time. Public health officials analyze the data to identify and respond to potential outbreaks. Leveraging this digital tool helped identify a diphtheria outbreak in 2017, followed by a suspected measles cluster in 2019, both of which resulted in effective targeted vaccination campaigns. Conversations are now underway to scale up EWARS to all major urban and rural areas of Bangladesh.[96]

The COVID-19 pandemic accelerated the adoption of digital health solutions to address health care challenges, including immunization, which was a weak point across India, Bangladesh, and Nepal. The pandemic served as a catalyst for these countries to leverage digital tools and platforms to rapidly scale up their immunization efforts. India's COVID Vaccine Intelligence Network app, which enabled individuals to schedule vaccine appointments and add family members as proxies, played a pivotal role in the country's successful vaccination campaign. Similarly, Bangladesh's Surrokha app and Nepal's innovative strategies—such as SMS-based appointment systems and door-to-door vaccination campaigns by community health care workers—contributed to their high vaccination rates during the pandemic. Digital health acted as an enabler for these countries to overcome long-standing immunization and vaccination challenges and achieve remarkable success in immunization during a crisis.

Parameter	Focus country				
	Ranchi	Imphal	Sylhet	Chattogram	Kathmandu
Availability of command and control centers	Jharkhand disaster management center / state COVID-19 ICCC	Imphal ICCC / Emergency Operation Center	NEOC, Sylhet (under development)	NEOC, Chattogram (under development)	Unified Central Hospital COVID-19 control room / NEOC, Kathmandu

City-level callout 6. City-level disaster management and COVID-19 control infrastructure.
Abbreviations: ICCC, Integrated Command and Control Center; NEOC, National Emergency Operation Center.

While our focus cities and countries were unable to absorb the initial brunt of shocks, they still demonstrated a high level of adaptation, through effective collaboration, monitoring, and solutions.

Transformative Capacity

Transformative capacity refers to the city's ability to transform the functions and structure of the health system in response to a changing environment. Our interactions revealed a positive attitude toward the adoption of new digital applications and the resilience of health systems against disruptive events, such as the COVID-19 pandemic. This subsection highlights a few transformative trends that were identified over the course of this landscaping.

Normalization of remote care in cities:

Before the COVID-19 pandemic, remote care or telehealth services were being used for

> **"Resilience in terms of digital aspects of [the Indian] health system, I think improved a lot. People became conversant in seeking teleconsultation, doctors became conversant in providing teleconsultation. So, I think a lot of corrections happened."**
>
> *– A Joint Director, NHA, India*

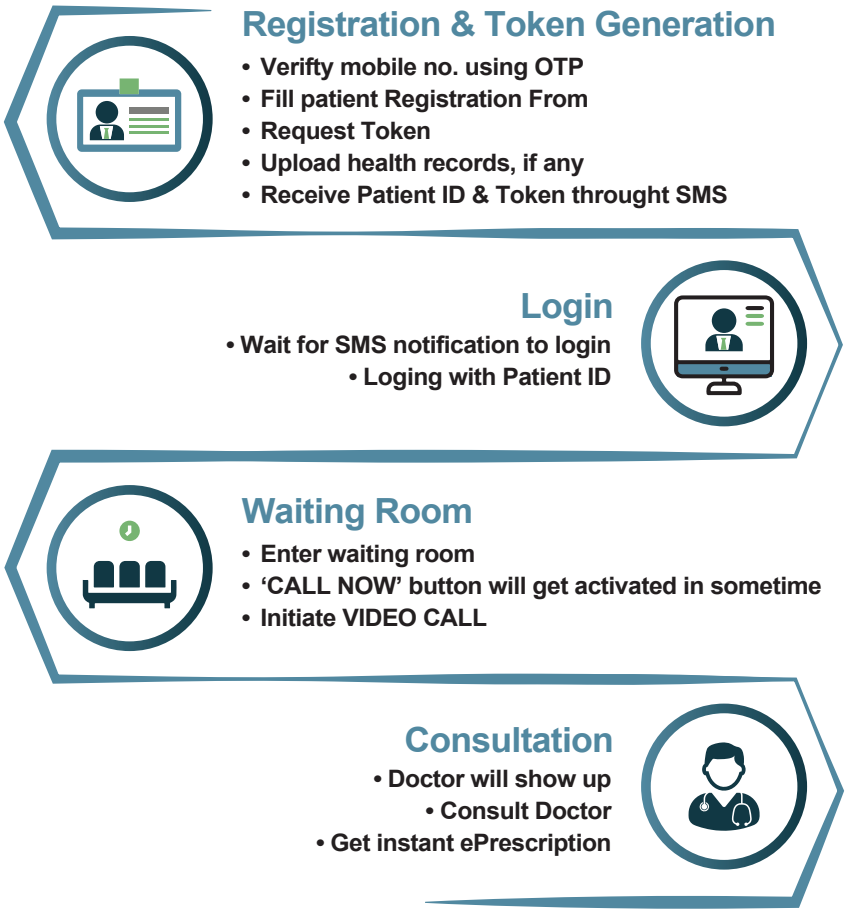


Figure 8. Patient journey of eSanjeevani.

Abbreviations: ID, identification; OTP, One Time Password; SMS, Short Message Service.

emergencies, crises, and to a lesser extent, routine care in South Asia. However, the pandemic significantly accelerated their usage. During the pandemic, remote care services have been widely used for patient screening and triage, home monitoring, remote clinical visits, and off-site patient care supervision.

It is anticipated that a significant proportion of these telehealth services will persist after the pandemic, such as remote monitoring and management of a larger number of patients. This is because it provides greater convenience and better patient-centered care, which helps address health care system flow rates and capacity challenges. The Indian government's teleconsultation platform, eSanjeevani (Figure 8), serves over 92 million patients and is highly regarded by a city-level stakeholder as having benefited Imphal as a whole.[208] Similarly, Shastho Batayon continues to receive over 2 million calls annually for consultation, health information, and ambulance services. Anecdotally, colloquially, and in terms of sheer numbers, the emphasis on remote care remains strong, indicating a positive outlook for the development of resilient systems.

While eSanjeevani serves as an example of an Indian public telemedicine platform, it is worth noting that Bangladesh and Nepal limited their public telemedicine initiatives, which results in reliance on available private alternatives. In the Bangladeshi cities of Sylhet and Chattogram, a range of private telemedicine providers available to citizens include DoctorKOI[209], Daktarbhai[210], Sebaghar[211], Niramoy, and Robi Health Plus. The accessible services range from video consultations, physical appointment bookings, elder care, and ePharmacy services.

The presence of these providers can have certain advantages, such as raising public awareness and familiarity with the teleconsultation model. However, it is important to acknowledge that these private alternatives are fee-based (and on average set a citizen back between US$1.90 and $9.52, depending on the specialty offered by the doctor) and often lack comprehensive data-sharing and interoperability mechanisms. The significance of addressing these limitations becomes particularly crucial as Bangladesh's Smart Vision 2041 ICT Master Plan enters phase 2 of its implementation. To achieve the goals set forth in the plan, ensuring seamless data exchange and interoperability among telemedicine providers will be vital.

An ecosystem approach to digital health:

As more people come online and pandemics and climate change expose the digital divide, South Asia is seeing a shift in country-level approaches to digital health, emphasizing enterprise architecture, interoperability, and service-oriented, user-friendly health systems. This shift is reflected in initiatives such as Digital India, the DNF, the ICT Master Plan, and the upcoming Bangladesh NDHS. This comprehensive approach to building digital systems trickles down to urban and rural health systems, promoting more resilient health systems across the region.

During our interactions with stakeholders, we found that many of them were aware of the transformational initiatives taking place in public health delivery, with many attributing this awareness to their work or involvement in the health sector. They also provided examples of how this rebuilding is permeating across all levels, such as communication efforts and posters in clinics, as well as reports that highlight the changes taking place. Overall, our discussions revealed a widespread understanding of the need to build back better and create more resilient health systems across South Asia.

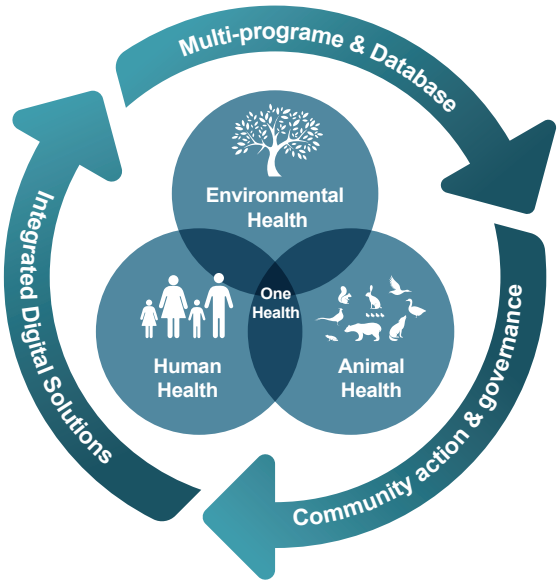


Figure 9: One health approach emerging in urban cities

A Focus on One Health:

Over the past three years, technology has been increasingly deployed to track, trace, and vaccinate individuals. These efforts have been carried out on a countrywide scale, with state and city governments using data for effective planning and delivery. This also has coincided with the emphasis on a One Health approach (Figure 9) and antimicrobial resistance, which places importance on increasingly coordinated strategies and digital interventions.

Countries, including those in our study, appreciate that One Health can only be achieved through synergized digital systems beyond health. Accordingly, cities are reevaluating their approaches to siloed digital interventions. In India, the new Integrated Health Information Platform aims to replace traditional surveillance data-entry systems by leveraging a multi-program and database approach. Drawing from lessons learned in the global north, a focus on community-led action, incorporation of new central registries and databases, and refinement of comprehensive surveillance will be a key building block on the journey toward healthy, resilient cities.

Integration of Smart City Infrastructure:

One of the growing trends noted in urban development is the notion of a “smart city.” A smart city can be defined as a municipality that leverages ICT “to increase operational efficiency, share information with the public, and improve the quality of government services and citizen welfare.”[212] Key features of a smart city include, but are not limited to technology-based infrastructures, a focus on environmental initiatives, effective and functional public transportation, innovative and progressive city planning, and city resources that meet and support people’s needs.[213]

As cities embrace digital transformation and become "smarter," they gain increased resilience to shocks or stressors. In terms of health systems, digital tools enhance resilience by enabling users to track and predict disease trends, exchange health information with the community, and respond swiftly during crises. These tools also have the potential to bridge gaps in health care accessibility among different socioeconomic levels within a city.

Ranchi and Imphal are already a part of India's Smart Cities Mission, with further development focused on integration of digital services across sectors, including health. While a smart city program is largely nonexistent in Kathmandu, Nepal has continued its sustainable approach to building smart cities with the example of Wailing in western Nepal acting as a torchbearer.[214] Bangladesh has been the most recent entrant in this transformative trend, stating its intention to establish both smart cities and smart villages in a late 2022 high-level workshop titled, "Vision 2041: Building Smart City and Smart Village in Bangladesh." These plans, however, are yet to be acted upon, and the focus cities of Sylhet and Chattogram remain without a defined program.[215]

Parameter	Focus country				
	Ranchi	Imphal	Sylhet	Chattogram	Kathmandu
Smart city program	Ranchi Smart City	Imphal smart city limited	Discontinued – Digital Sylhet city	None	None
Availability of command & control centers	Jharkhand disaster management center / Covid state ICCC	Imphal ICCC / Emergency operation center	National Emergency Operation center (NEOC) under development	NEOC (under development)	NEOC, Kathmandu

City-level callout 7. Existing or previous smart city initiatives.

Abbreviations: ICCC, Integrated Command and Control Center; NEOC, National Emergency Operation Center;

It is important to note here that smart city initiatives come hand in hand with risks to more informal settlements. The risks associated with the concept of smart cities for informal dwellers include the potential for exclusion and forced evictions. Smart cities, if not inclusive, can lead to the displacement of slum populations and the destruction of their homes. Without proper measures in place, slum communities may face the threat of losing their settlements due to urban transformation initiatives that prioritize the idea of a smart city without considering the needs and existence of low-income urban communities. While there may be occasional recognition of the risks associated with smart city programs across the three countries, the majority of research and articles tend to convey the opposite perspective when it comes to their implementation.[216] The presence of smart cities across our three focus countries is summarized below.

> **During Covid we learnt a lot [about smart cities] and regarding the importance of command centers. Once Smart Cities are well integrated with health, it will be beneficial for the city of Imphal.**
>
> *– A Senior Health Official, NHM, Manipur*

To drive development, the momentum toward data-enabled and digitally connected cities must be sustained. This will pave the way for integrated health care that synergizes with crucial services like public safety, environmental health, housing, and social services. With targeted investments, local implementation, and rigorous research, the urban health care ecosystem has the potential to achieve greater integration and interoperability across health systems and industries alike. Effectively leveraging smart cities could result in a significant reduction in the region's disease burden, estimated at 8-to-12 million disability-adjusted life years, leading to extended life expectancy and improved quality of life for communities.[217]

Findings

Our findings on digital health in urban settings highlight several key observations across equity, quality, resource optimization, and resilience.

Firstly, we observed a growing interest at the individual level in using digital tools, with a focus on digital health equity. Municipal governments and city-level organizations are making efforts to implement context-appropriate digital technology, including for underserved populations in cities, such as Shastho Batayon 16263 in Chattogram and Sylhet. However, to fully leverage digital health, health worker capacity building with respect to digital tools remains a clear area of concern that needs to be addressed.

Secondly, there has been a shift toward people-centered systems, such as the penetration of ABDM in Ranchi and Imphal, that prioritize individual access to higher-quality health care. Efforts have been focused on improving the responsiveness of health care systems through legacy digital tools that enhance timeliness, quality, and reporting of data and processes (see Table 5). However, we found that although city-level digital tools are available, their influence on improving the quality of care delivery is hampered by an imbalance between the capacities available and the capacities required from public health workers. Furthermore, there is a continued high dependency of city-level health systems on the private sector.

Thirdly, we found demonstrable value in how digital tools are being leveraged for resource management, including evidence in the literature on the relationship between digital tools and reduction in OOPE, through examples such as eSanjeevani. Additionally, discussions on flagship social insurance schemes highlighted varying degrees of success in how digitalization was being leveraged to optimize the limited resources that the focus cities have available to them. The high OOPE by citizens also reflected the high private-sector dependency, but as most traditional indicators suggest, this does not translate to improvements in health delivery.

Finally, while our focus cities have shown the ability to effectively adapt their health systems to changing environments, the absorptive capacity of city-level systems appears to be poor. Existing systems are struggling to withstand the initial impact of shocks, examples of which include Kathmandu during the 2015 earthquake and health system failures in Ranchi and Sylhet during the initial phases of COVID-19, highlighting the need for more resilient and adaptive systems that can cope with shocks and stressors. It is important to plan and prepare at the city level to build such systems. We also observed several

growing transformative trends that leverage digital tools to build resilient health systems. This transformative capacity seems only to accelerate with the advent of new shocks or stressors.

Below are summarized some of the comparative city-level findings that were highlighted at different points in this section.

However, we also identified several challenges. The gendered digital divide in urban health care remains significant and requires more attention, as it is often masked by increasing digitization and use of digitally enabled tools. As pointed out above, a siloed approach and lack of interoperability at the national level also trickle down to cities, resulting in fragmentation, replication, and redundancies within city systems, which need to be addressed for improved effectiveness. Additional research is needed also to explore smart city strategies that can bolster slum resilience through the application of technological innovations. Finally, the need for training on digital health in the health workforce has been repeatedly highlighted in the literature and through our interactions, including training on the use of currently deployed systems, understanding national-level digital health policies, and improving communication regarding digital health. Increased investment in digital health training for the health workforce is necessary to enhance the effectiveness of urban health care.

Parameter	Ranchi	Imphal	Sylhet	Chattogram	Kathmandu
Subnational body driving digital health	State ABDM office, Jharkhand	State ABDM office, Manipur	ICT Division & LGD, Sylhet	ICT Division & LGD, Chattorgram	No dedicated body
Number of EHRs generated	1.5 million	442,000	None	None	None
City-level digital health budget allocation (USD)	State of Jharkhand allocated $300k for digital health, of which Ranchi will be the primary beneficiary	State of Manipur allocated $111k for digital health, of which Imphal will be the primary beneficiary	None *(Overall city budget for fiscal year 2023 is $96M[174])*	None *(Overall city budget unavailable)*	*None* *(overall city budget for fiscal year 2023 is $193M, $3.8M of which is earmarked for health[175])*
Average estimated OOPE (as % of total health expenditure)	~65%	~70-75%	~60%	~70%	~65%

In the next section, we will present the synthesized learnings obtained from our comprehensive digital health policy review, in-depth analysis of urban health, and interviews with key stakeholders. Additionally, we will explore the way forward, including recommendations on how to effectively use the insights provided in this report. This will guide policymakers, practitioners, and other stakeholders in leveraging digital health to address the challenges and opportunities in urban health care. We also will provide guidance on how to use the report as a practical resource for informing policy decisions, driving interventions, and promoting positive changes in urban health outcomes.

Parameter	Ranchi	Imphal	Sylhet	Chattogram	Kathmandu
Additional / Supplemental social protection schemes	Mukhyamantri Swasthya Bima Yojana	Chief Minister-gi Hakshelgi Tengbang	Maternity Allowance program (donor-funded benefit)	None available	Contribution-driven social security scheme
Smart city program	Ranchi Smart City	Imphal smart city (limited)	Digital Sylhet City (discontinued	None	None
Availability of command & control centers	Jharkhand disaster management center / state COVID-19 ICCC	Imphal ICCC / Emergency operation centre	NEOC (under development)	NEOC (under development)	NEOC, Kathmandu
Available telemedicine platforms (public & private)	eSanjeevni (public)	eSanjeevni (public) / TeleECHO (private)	None	United hospital portal (private)	National Tele-medicine Teleconsultation centre (public) / Multiple provid-ers (private)

City-level callout 8. Summary table of all city-level callouts.

Abbreviations: ABDM, Ayushman Bharat Digital Mission; ICCC, Integrated Command and Control Center; ICT, information and communications technology; LGD, local government division; NEOC, National Emergency Operation Center; OOPE, out of pocket expenditure.

6. Learnings and Recommendations

Key Learnings

The digital health landscape in LMIC is complex and dynamic, and urban areas present unique challenges that require innovative solutions. Through a digital health policy review and deep dive into urban health systems in Ranchi, Imphal, Chattogram, Sylhet, and Kathmandu, we identified eight key learnings that can inform efforts to strengthen digital health in these and other similar urban-level settings. These eight key learnings highlight the potential for digital solutions to overcome barriers to high-quality primary health care delivery, the need for careful consideration of private-sector involvement, the importance of broader HSS efforts, the role of technology in addressing urban health workforce challenges, the importance of contextually designed approaches, and the potential for leapfrogging to achieve interoperability:

1

During our country-level policy review and national interactions, we noted an inadequate level of primary health care provision in urban health systems across all three LMIC. As we further explored at the city level (see “Quality" in the previous section), this is in part because the population in these cities is constantly fluctuating, making it difficult for urban health systems to effectively meet the health care needs of their residents. Due to the lack of clarity around the base population and their health care needs, urban health systems are struggling to provide sufficient and high-quality care.

While not a silver bullet, leveraging digital infrastructure and technologies such as unique IDs and EHRs can enable city-level health systems in LMIC to overcome some of the challenges associated with providing high-quality primary health care in dynamic and resource-constrained urban environments.

2

While the health workforce in rural areas of LMIC has been well institutionalized—and to some extent digitized through initiatives such as the Accredited Social Health Activists Program in India, Shasthya Sebikas in Bangladesh, and the Female Community Health Volunteer Program in Nepal—the urban health workforce faces significant challenges, such as limited funding, strained supply chains, high demand, and a skill mix imbalance.

Our findings on both equity and quality suggest that before driving digitalization, building capacity and increasing staffing are necessary at all levels of public health, not just among health care workers but also among nurses, staff, and doctors. As such, workers in cities like Sylhet and Kathmandu are not yet able to fully leverage digital tools that may augment their work and reduce their burden, and the focus needs to remain on solving the root causes of the challenges to effective digital health implementation.

3

In urban areas, the term “private care” does not always equate to higher-quality care. While our landscapes found a heavy reliance on

private providers across various levels of care, particularly when looking at country-level health expenditure and city-level resource optimization, we must remain aware of the risks posed by private actors in the urban health ecosystem. These commonly recognized risks include a reduction in the public-sector workforce, overtreatment of patients for financial gain, and a weakening of the case for publicly supported system-level public digital initiatives such as DPI, EHRs, and Unique Health IDs (for an expanded list of public digital health initiatives, see Table 5). While acknowledging the role of private providers in filling gaps in underdeveloped public services, it is imperative to monitor their practices to ensure that they operate in a manner that complements rather than detracts from the provision of high-quality health care.

It also is essential that digital health is integrated into broader HSS efforts in cities, with a focus on leveraging digital solutions to support the engagement of private providers in UHC efforts while addressing potential risks and ensuring that equitable and high-quality care is provided to all.

4

Over time, technology has helped city-level systems adapt and transform when faced with stressors such as climate change, pandemics, and population swelling. However, when faced with the initial shock, urban systems in the focus cities did not hold up and were prone to failures (see “Resilience”), examples of which include grid failures during temperature spikes, infrastructural collapses during earthquakes, and the inability to deliver basic health services due to insufficient resources and/or lack of preparedness during COVID-19. Technology and data must now be leveraged to improve the ways that cities preempt, plan, and absorb the initial shocks presented by adverse events.

5

Building upon our earlier observations in equity, health systems in major cities across LMIC are at an inflection point, from where digitalization can either drive UHC or contribute to deepening the divide. Cities have reached this point owing to an increase in the number of digital solutions (see Table5), a normalization of digitalization post-COVID-19, and a growing emphasis on digital infrastructure across both public and private health systems. Although not all five focus cities have reached this point, they are each moving toward it.

However, digital solutions alone cannot address the complex challenges facing urban health systems. To ensure that they enhance health outcomes and drive UHC, it is crucial to invest in underlying non-health factors such as smart city infrastructure, policy and regulatory frameworks, interoperability with non-health databases, public trust, and effective

public-private partnerships. Only by addressing these broader issues can digital tools contribute to strengthening urban health systems and reducing health inequalities.

6 The proximity of borders, culture, and language does not necessarily mean that the three countries discussed in this landscape are at the same stage of development in digital health. Each country requires its own approach to digital health, designed contextually with its unique features in mind. However, the similarities between these countries can be used as a bridge for cross-border learning and best practice exchange.

7 Presently, data privacy and protection measures in the three focus countries are either aged, simplistic, or on occasion, subject to much debate. To ensure the responsible use of health data and build trust in their digital health systems, India, Bangladesh, and Nepal should prioritize revisioning and implementing comprehensive data privacy and confidentiality regulations. These regulations should address the unique challenges and opportunities of digital health, providing clear guidelines for data collection, storage, sharing, and access. Conducting regular policy reviews and incorporating international best practices will help these countries stay abreast of technological advancements and emerging concerns. By safeguarding personal health information and promoting patient-centered care, they can leverage health data responsibly for the benefit of their populations.

8 Achieving interoperability in LMIC does not always require integrating legacy systems with each other. While integration is a desirable objective, we learned through both city- and national-level examples that leapfrogging legacy systems entirely is also a viable option. While this approach may entail initial costs and disruptions to existing workflows, it can ultimately lead to greater benefits in terms of data sharing and care coordination. Hence, it is crucial to consider both integration and leapfrogging strategies when working toward interoperability in LMIC.

> **"Emergencies are the perfect place to get things done which have not been done for many years. [For instance] something not done in 10 years, could have been done in 10 days, so a lot of lot of leapfrogging was done due to [Covid] and our systems became resilient"**
>
> *– A Joint Director, NHA, India*

Recommendations

Municipal health authorities, the USAID Asia Bureau, USAID cross-communities of practice, and ARC implementing partners can use these learnings to inform their investment decisions, actions, and further research. This landscape also highlights a few targeted actions we recommend be taken by donors, policymakers, and urban health ecosystem actors:

Conduct further research on how digital solutions can reduce OOPE and improve the financial sustainability of urban health systems (e.g., the growing use of digital health financing mechanisms and telemedicine to reduce health care costs and improve access to care).

Support a shift toward integrated smart city approaches that empower municipal actors to transform health outcomes for urban dwellers by investing in smart city technologies and infrastructure (e.g., a growing scalable infrastructure, usable artificial intelligence that improves and does not hinder, telehealth services, and integration of existing information systems into urban planning and infrastructure). By leveraging data and technology, cities can optimize health care delivery, improve access to care, and enhance population health outcomes. This also may involve partnerships between city governments, digital health innovators, and local communities to co-create solutions that are contextually relevant and address the unique challenges of urban health in LMIC.

In our focus countries secondary caregivers (e.g., family members) play a significant role in delivering care, especially in urban areas. Conduct further research into the impact of proxy access to digital tools for secondary caregivers to drive equity in South Asian cities. Improving our understanding of and helping to develop user-friendly digital tools that enable these caregivers to deliver care more effectively will help drive equitable health at the city level.

To develop a comprehensive understanding of the gendered dynamics of digital access, use, and impact, strengthen the collection and analysis of gender-disaggregated data, specifically focusing on rural and urban areas, to inform the development of a gender-transformative digital strategy. By using these data, policymakers can shape targeted interventions that address the specific needs of adolescent girls in different locations and integrate gender-sensitive digital budgeting into broader policy plans and budgetary priorities.

Following national-level policies and guidance, develop city-level One Health roadmaps. Cities in LMIC are experiencing

transformative trends, such as incorporating the growing integrated approaches that include human, animal, plant, and ecosystem health. Developing city-level One Health roadmaps for these trends and leveraging digital solutions to build resilience in health systems can have a significant impact on health outcomes.

Pilot early warning systems that leverage currently available databases and infrastructure. Investment and action are required at the intersection of digital health and climate change, and the potential for digital tools to help mitigate the impact of climate change on health in urban areas, such as by enabling early warning systems for extreme weather events, require facilitating disaster response efforts and promoting climate-resilient health systems.

In conclusion, these learnings provide insights into the digital health landscape in LMIC and highlight the potential for digital solutions to strengthen health systems and improve health outcomes in urban areas. Future research may leverage the lessons learned from our digital health deep dive into five South Asian cities, contributing to a body of knowledge that benefits the building of smart city approaches that can advance UHC in South Asia.

Annexures

Annexure A. Glossary of Terms

Arogya Setu: Mobile app that was developed by the government of India to help in the fight against COVID-19 and that provides real-time information, self-assessment tools, and contact-tracing capabilities to help individuals stay informed and safe during the pandemic, as well as enables users to share their health status with relevant authorities for effective response and containment.

DHIS2: Open source, web-based platform most commonly used as a health management information system.

Digital health: Development of interconnected health systems using computational technologies, smart devices, and communication media to aid health care professionals and patients in managing illnesses and health risks, as well as in promoting health and well-being, and therefore inclusive of eHealth and advanced computational technology for health (e.g., artificial intelligence, data analytics, and machine-aided learning and practice).[62]

Digital health ecosystem: Combined set of digital health components representing the enabling environment, foundational architecture, and information and communication technology (ICT) capabilities available in a given context or country.[218]

Digital health intervention: Discrete functionality of digital technology to achieve health-sector objectives.[219]

Digital public good: Open source software, open data, open artificial intelligence models, open standards, and open content that adhere to privacy and other applicable best practices, do not harm, and are of high relevance for attainment of the United Nation's 2030 Sustainable Development Goals.

eHealth: Cost-effective and secure use of ICT in support of health and health-related fields, including health care services, health surveillance, health literature, and health education, knowledge, and research.[220]

Enterprise architecture: Blueprint that outlines current and planned ICT systems and provides an overview of the standards, information exchange, and interoperability profiles that can be optimized across these systems using a four-layered foundation (business process, technology hardware, application software, and data collection/sharing) for designing increasingly complex systems to support the workflow and roles of people in a large enterprise, such as a health system.

Health information exchange: Electronic transfer of clinical and/or administrative information among the organizations, people, and technologies that host the defined ecosystems.[221]

India Global Stack: Integrated digital platform that aims to provide a unified infrastructure for various digital services in India and encompasses multiple components, such as digital identity, payments, and data sharing, to enable seamless and secure interactions between individuals, businesses, and government entities, fostering innovation and inclusivity.

Interoperability: Ability of different information technology systems and software applications to communicate with one another by accessing, exchanging, and making use of data in a coordinated manner to achieve health goals.[222]

Modular Open Source Identity Platform: This tool is an open source platform that enables countries to develop and implement robust, scalable, and privacy-enhanced digital identity systems. It provides a modular and interoperable framework for identity management, allowing governments to customize and adapt it to their specific needs.

National Health Stack: Comprehensive digital health infrastructure in India that aims to provide universal health coverage and improve health care delivery and that includes components such as electronic health records, telemedicine services, health data analytics, and a unified health identification system.

One Health: Approach that recognizes that the health of people is closely connected to the health of animals and our shared environment.[223]

OpenHIE (Open Health Information Exchange): Community of people building an open framework to support nations as they develop health information exchange systems to improve patient care, public health, and management of health resources.

Open source: Technology with source code that is freely available to use, modify, and redistribute.

Smart city: Municipality that leverages ICT to increase operational efficiency, share information with the public, and improve the quality of government services and citizen welfare.[145]

Standard: Agreed-upon, repeatable way of doing something.

Technology stack (or "stack"): Collection of software tools, frameworks, and programming languages that works together to build and support a particular software application or system and consists of multiple layers, each serving a specific purpose and interacting with the others to provide the necessary functionality.

Universal health coverage: System in which all people and communities are assured access to and use of the promotive, preventive, curative, rehabilitative, and palliative health services they need, and of sufficient quality to be effective, while also ensuring that the use of these services does not expose the user to financial hardship.

Annexure B. Stakeholder interview guide

Tables B1 through B4 provide the four stakeholder questionnaires used in the landscape report, divided by national, divisional, district, and city level, respectively).

The objectives referred to in the table(s) below refer to the three core landscape objectives.

These are:

(Objective 1) outline the national digital health policies across the three countries and explore how these policies influence urban digital health;

(Objective 2) identify digital health opportunities and challenges unique to urban health systems, focusing on equity, quality, resource optimization, and resilience; and

(Objective 3) explore how smart city initiatives (where applicable) and national and municipal health authorities leverage digital tools and lead digital transformation efforts, with considerations for health equity, scale-up, and sustainability.

KEY

Interview design:	Interviews will be semi-structured, allowing respondents the freedom to expand on their responses, while also providing several probes to guide the discussion.
Consent:	Each stakeholder will be explained the study's objective and given the option of skipping any question he or she does not feel comfortable answering. Interviews will be recorded only for purposes of transcription and translation (in cases of regional languages).
Navigating:	This workbook contains four sets of questionnaires that will be used during the United States Agency for International Development / Asia Bureau's urban digital health landscape. The questionnaires are divided based on stakeholder administrative level (national, divisional, zila, and worker levels).
Alignment:	Columns with gray headings are for internal use and help us align each question to an overall indicator, such as our Objectives or a World Health Organization health system strengthening pillar.

Table B1. National-level interview guide.

Objective alignment	Tech approach alignment	Core question	Probe 1	Probe 2	HSS outcome alignment
Objective 1	Overall	1. Could you briefly describe <insert country>'s approach to digital health?	1.1 According to you, into what does implementation of the blueprint translate?		Governance
	Overall		1.2 What opportunities exist within <country name> to expand and drive this blueprint?		Governance/ technology
	Overall		1.3 Do you see any challenges to digital health from a policy level?		Governance/ technology
Objective 1	Equity	2. How are public digital initiatives financed in the country?	2.1 Is there a separate ministry/department for digital initiatives, or is it a part of each ministry/department?		N/A
	Equity		2.2 Has there been a drive toward equitable financial services and social protection? If yes, can you give a few examples?		Financing

Objective alignment	Tech approach alignment	Core question	Probe 1	Probe 2	HSS outcome alignment
	Resource optimization		2.3 What existing mechanisms are used to support equitable financing?		Financing
	Resource optimization		2.4 Where do you see opportunities to improve access to financing?		Financing
Objective 3	Resilience	3. How have non-health stressors (earthquakes /floods/migration, etc.) affected the overall health systems?	3.1 Has COVID-19 changed how <Insert country> responds to these stressors?		Governance
	Resilience		3.2 How adaptable have governance structures been when responding to these crises?		Governance
	Resilience		3.3 What are the identified improvements in governance around handling/managing these crises?		Governance

Objective alignment	Tech approach alignment	Core question	Probe 1	Probe 2	HSS outcome alignment
Objective 2	Resilience	4. Have digital tools and technologies influenced the way <country> responds to crises at a national level?	4.1 Could you give examples of a few technologies which are supporting high-quality delivery of health care (e.g., HMIS / routine disease tracker / EWS)?		Technology
Objective 3	Resilience		4.2 Recently (4-year period), has the government adapted or upgraded its digital infrastructures to support crisis preparedness? If not, are there plans or willingness to do so?		Governance
Objective 3	Resilience/ equity	5. During normal health service delivery, as well as crisis, how does the government plan and engage with citizens? How are the systems adapted?	5.1 If yes to #5, are digital means used for engagement?	If yes, what digital mechanisms does the government employ to increase information sharing across the country?	Technology

Objective alignment	Tech approach alignment	Core question	Probe 1	Probe 2	HSS outcome alignment
	Resilience/ equity		5.2 What are some learnings from COVID-19 as far as information dissemination ?		Information
	Resilience/ equity		5.3 What opportunities exist for digital tools to support crisis preparation and management ?		Technology/ information
Objective 1	All	6. In your opinion, what are the three main issues that need to be addressed to ensure stronger, more resilient, and more reliable health systems in the country?	6.1 Are there efforts in place from a policy and implementation perspective to address these? And at what stage?		Overall
Objective 1	All		6.2 What is the anticipated role of digitalization in addressing these?		Overall
Objective 3	All	7. Does climate change have an Impact on health indicators and health service delivery?	7.1 Is there a focus on considering the impact of climate change while planning HSS measures?		Overall

Abbreviations: EWARS, Early Warning, Alert and Response System; HMIS, health management information system; HSS, health system strengthening.

Table B2. Division-level / State level interview guide.

Objective alignment	Tech approach alignment	Core question	Probe 1	Probe 2	HSS outcome alignment
Background	Rapport building	Describe your current role within the country's health system. What are your current responsibilities ?	N/A		N/A
	Rapport building	Briefly describe the division's municipal or urban health system. How are the health systems designed in terms of infrastructure and use of technology/digitalization?	What are the peculiarities of urban health in the division?		All
Objective 2	Overall	1. Could you help us understand <Insert Country>'s digital health blueprint, if any?	1.1 According to you, what does its implementation look like at the division level?		Technology
	Overall		1.2 What opportunities exist within the country to expand and drive this blueprint?		Technology/ governance
	Overall		1.3 Do you see any challenges to digital health from a policy level?		Technology/ governance

Objective alignment	Tech approach alignment	Core question	Probe	Probe 2	HSS outcome alignment
Objective 3	Resilience	2. What kind of division responses are in place to deal with system stressors and crises (e.g., disease outbreak, climate disaster, population displacement , floods)?	2.1 Has COVID-19 changed how <Insert Division Name> responds to these stressors?		Governance
	Resilience		2.2 How adaptable have governance structures been when responding to these crises?		Governance
	Quality		2.3 Has the division adapted or upgraded its infrastructure to support crisis preparedness and make systems resilient? if not, are there plans to do so?		Service delivery
Objective 1	Resource optimization	3. How has the health workforce changed or adapted to manage crisis situations (e.g., COVID-19)?	3.1 Probe on a concrete example, if not given.		Health workforce
	Resource optimization		3.2 Are there any additional capacity-building measures which have been initiated for crisis management?		Health workforce

Objective alignment	Tech approach alignment	Core question	Probe	Probe 2	HSS outcome alignment
	Resource optimization		3.3 Has COVID-19 led to adoption of digital tools for service delivery, management, or monitoring?	If yes, how has the level of adoption by the workforce been?	
	Equity	4. How does the state/division communicate and share information across its districts during normal service delivery and during a shock or stressor? How has the system been adapted?	4.1 What digital mechanisms does the state employ to increase information sharing across <Insert State/ Division>?		Technology
	Resilience		4.2 How is information used to prepare for unknown crises?		Information
Objective 3	Resource optimization	5. How does the <Division> approach financing of health care services?	5.1 Is there a financial mechanism to support division-specific health intervention (s)?		Financing
	Equity		5.2 What is the average (OOPE) cost to patients for health care services?		Financing

Objective alignment	Tech approach alignment	Core question	Probe 1	Probe 2	HSS outcome alignment
	Resource optimization		5.3 Do you see any untapped opportunities to increase patient access to financing?		Service delivery
Objective 1	Quality	6. What mechanisms does the division use to ensure delivery of health care services? And what role does digitalization play in that?	6.1 How does the division ensure that the resources are optimally used?		Service Delivery
	Equity		6.2 Are there any MLE digital tools which are deployed to monitor performance and service delivery?		Service Delivery
	Equity		6.3 Does the division have an integrated health dashboard to monitor service delivery and health indicators?		Service Delivery
Objective 3	All	7. Does climate change have an impact on health indicators and health service delivery in the division?	7.1 Is there a focus on considering the impact of climate change while planning HSS measures?		Overall

Abbreviations: HSS, health system strengthening OOPE, out-of-pocket expenditure.

Table B3. District-level interview guide.

Objective alignment	Tech approach alignment	Core question	Probe 1	Probe 2	HSS outcome alignment
Background	Rapport building	Describe your current role. What are your current responsibilities ?	N/A		N/A
Objective 1	Quality	Briefly describe the municipal or urban health system.	How are the health systems designed in terms of infrastructure and use of technology/digitalization?		All
			What are the peculiarities of urban health in the city/district?		
Objective 2	Overall	1. Could you help us understand the overall digital systems landscape at the division level and how it leverages country-level systems?	1.1 According to you, what does its implementation look like in your district / municipality?		Technology/ governance
	Overall		1.2 What opportunities exist within the country to expand and drive digital health?		Technology/ governance
Objective 3	Resilience	2. Has any stressor apart from COVID-19 had a particular impact on <Insert City> (e.g., earthquake, flood, migration)?	2.1 How has the city responded to it?		Governance
	Resilience		2.2 Probe any unique response to 2.1.		Governance

Objective alignment	Tech approach alignment	Core question	Prob 1	Probe 2	HSS outcome alignment
	Resilience	3. What kind of digital responses are in place to deal with shocks and crises (e.g., disease outbreak, climate disaster, population displacement, floods)?	3.1 Has COVID-19 changed how the district/city responds to these stressors?		Service delivery / governance
	Resilience		3.2 How adaptable and responsive have governance structures been when responding to these crises?		Governance
	Quality	4. What is the existing smart city infrastructure in the city?	4.1 If available, how is the smart city infrastructure being used for health service delivery and management		Service Delivery
	Quality		4.2 What do you feel is key to adoption of digitalization?		
	Quality	5. Have digital tools and technologies influenced the way your city manages health care?	5.1 Could you give examples of a few technologies which are supporting high-quality delivery of health care (HMIS / routine disease trackers / EWS)		Technology

Objective alignment	Tech approach alignment	Core question	Probe 1	Probe 2	HSS outcome alignment
	Quality		5.2 What are the main challenges you have seen to adoption of health infrastructure in the city?		Technology
	Overall		5.3 Does the city/district have an integrated health dashboard to monitor service delivery and health indicators?		Technology
Objective 1	Quality / resource optimization	6. Briefly describe the composition and reach of the health worker network in <Insert City>.	6.1 Has there been any change in the number of workers since COVID-19?	[If increase] Has there been a drop-off in numbers post-COVID-19?	Health workforce
	Resource optimization		6.2 What are the most common barriers to effective service delivery via health workers?		Health workforce / service delivery
	Quality		6.3 What mechanisms are in place to support health care workers in delivering care?	Probe on workforce retention strategies, capacity strengthening	Health workforce

Objective alignment	Tech approach alignment	Core question	Probe 1	Probe 2	HSS outcome alignment
	Resource optimization	7.Is the use of digital finance services widespread in the city?	7.1 Is digital financing used in health care, as well?		Financing
	Equity		7.2 What social protection schemes are most popular in <Insert City>)?		Service delivery / financing
	Equity		7.3 What would you consider the average cost (OOPE) to patients here?		Financing
Objective 1/objective 3	Overall	8. In your opinion, what are some issues that need to be addressed to ensure a stronger, more resilient, and more reliable health system at the city level?	8.1 Can digitalization or technology be used to address these or some of these issues?		All
Objective 1/objective 3	Resilience	9. Does climate change have an impact on health indicators and health service delivery in the city?	9.1 Is there a focus on considering the impact of climate change while planning HSS measures?		Overall

Abbreviations: EWARS, Early Warning, Alert and Response System; HMIS, health management information system; HSS, health system strengthening; OOPE, out-of-pocket expenditure.

Table B4. City-level interview guide.

Objective alignment	Tech approach alignment	Core question	Probe	HSS outcome alignment
Background	Rapport building	Describe your current role. What are your current responsibilities?	N/A	N/A
Objective 2	Overall	1. Are you aware of any <Insert Country> digital health blueprint?	1.1 According to you, what does its implementation look like in your area of work?	Technology/ governance
	Overall		1.2 What opportunities exist at the worker level to expand and drive digital health?	Technology/ governance
Objective 3	Resource optimization	2. What role do digital tools play in your daily work?	2.1 Could you give examples of a few technologies which are supporting you in your current role (HMIS / routine entry / analysis platforms)?	Health Workforce
	Resource optimization		2.2 Do you use different systems for different verticals, or integrated ones?	Health workforce
	Resource optimization		2.3 [If captured] Do you use the data you capture for decision-making?	Health workforce
Objective 1	Quality	3. What do you feel is key to adoption of digital tools?	3.1 What are the main challenges you have seen to adoption of digital health tools?	Technology

Objective alignment	Tech approach alignment	Core question	Probe	HSS outcome alignment
	Quality		3.2 If offered a preference between digital and analogue tools, which would you choose?	Technology
	Quality		3.3 Has there been any change in the trend of digital adoption since COVID-19?	Technology
	Quality		3.4 Do you require capacity building on digital and/or digital tools?	Health workforce
Objective 3	Equity	4. Briefly describe the composition and reach of the health worker network (role specific) in <Insert City>.	4.1 Has there been any change in the number of workers since COVID-19?	Health workforce
	Equity		4.2 [If increase] Has there been a drop-off in numbers post-COVID?	Health workforce
	Equity		4.3 What are the most common barriers to effective service delivery during your work?	Health workforce
	Equity		4.4 What mechanisms are in place to support you in delivering care (e.g., workforce retention strategies, capacity strengthening, incentives, etc.)?	Health workforce
Objective 3	Resilience	5. Please describe your experience of work during a non-health-related stressor (such as climate change / earthquakes / floods).	N/A	Health workforce

Abbreviations: HMIS, health management information system; HSS, health system strengthening.

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