

Electronic Health Records in Nepal: Readiness Assessment

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Acronyms

BHCC	Basic Health Care Center
CHW	Community healthcare worker
COPD	Chronic obstructive pulmonary disease
DHIS2	District Health Information Software 2
DLI	Disbursement-Linked Indicator
DLR	Disbursement-Linked Result
DoHS	Department of Health Services
EHR	Electronic Health Record
EMR	Electronic Medical Record
GIZ	German Agency for International Cooperation
HMIS	Health Information Management System
HRIETF	Human Rights, Inclusion and Empowerment Umbrella Trust Fund
ICT	Information and Communications Technology
IRI	Intermediate Results Indicator
LMIC	Lower Middle Income Country
MBBS	Bachelor of Medicine and Bachelor of Surgery
MoCIT	Ministry of Communication and Information Technology
MoHP	Ministry of Health and Population
PDO	Project Development Objective
PforR	Program for Results
PHCC	Primary Health Care Center
TF	Trust Fund
UHC	Universal Health Coverage

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Executive Summary

This report presents the findings of an Electronic Health Records (EHR) readiness assessment conducted by the World Bank in coordination with the Government of Nepal. Through the Nepal Quality Health Systems Program-for-Results (PforR), a World Bank-funded program, the Government of Nepal aims to improve healthcare quality, enhance health insurance coverage, and strengthen health emergency preparedness. As part of the program, the government intends to implement the first phase of a national EHR rollout. Primary objectives for the EHR system include increasing healthcare quality and decreasing costs by enabling efficient, secure sharing of and access to digitized patient information among authorized users. To support this initiative, a World Bank team undertook a rapid readiness assessment to identify challenges and develop strategies around EHR implementation in the Nepali context. The target audience for the report includes World Bank staff, development partners, the Government of Nepal, health and technology sector professionals, and members of academia and the media.

The readiness assessment focused on six key areas:

- **Strategic and governance framework:** Nepal has established strategies and frameworks to leverage technology for healthcare delivery. However, coordination challenges and ad hoc investments hinder effective data utilization and decision making. Data privacy and cybersecurity are also key challenges.
- **Senior leadership and key stakeholders:** The Government of Nepal is committed to enhancing healthcare delivery through digital technology. However, there is a lack of unified implementation plans and bottom-up input from healthcare professionals. Stronger coordination and stakeholder engagement are crucial.
- **Institutional structures, responsibilities, and capabilities:** Nepal's transition to a decentralized federal structure, including a new federal structure for healthcare delivery, poses challenges for digital initiatives. Limited IT implementation capacity and understanding of EHRs among senior leaders and in the civil service need to be addressed. Institutional arrangements and roles with respect to EHR rollout need to be clarified, along with attention to capacity building and staff training and recruitment.
- **Government data management policies, procedures, and data availability:** Data sharing and interoperability among different levels of government need improvement. Efforts have been made to develop standards and guidelines, but implementation and enforcement remains unclear. The government's decision to adopt the Open Health Information Exchange (OpenHIE) framework for interoperability, and its establishment of several key registries, represent important steps. Overall, data quality, privacy concerns, and horizontal/vertical coordination of data systems and standards are key priorities.

- **Demand for EHRs at the hospital level:** Efforts have been made to implement EHRs in some healthcare facilities. Successful case studies indicate potential EHR benefits, but challenges such as inadequate IT skills, infrastructure limitations, and the lack of national guidelines persist. Stakeholder buy-in and ongoing training are essential.
- **Technical and skills infrastructure:** Inadequate physical infrastructure and skills shortages pose significant barriers to EHR implementation. Limited internet access, unreliable power supply, and network access in rural areas need to be addressed. Stronger digital infrastructure, storage servers, and cloud storage are necessary. Training programs and collaboration with the private sector can help bridge skills gaps.

The report recommends leveraging lessons learned from prior EHR implementations. For example, in 2014, in partnership with the government, an NGO decided to embark on the country's most ambitious EHR implementation to date; this was at the privately-run Bayalpata Hospital, which at the time had 25 beds and saw up to 600 outpatients per day. The implementation's success demonstrated that EHRs can be leveraged effectively to support management and delivery of healthcare in resource-constrained environments. In selecting a system and designing the implementation, the following were priorities:

- Affordability, reliability, simplicity, and suitability for resource-poor settings, including offline work capability and accessibility via mobile app for off-site community health workers
- Scalability and modularity, so that it could ultimately be deployed at a national level
- Patient tracking and performance monitoring features
- Integration across sites of care (e.g., hospital inpatient, outpatient, clinic, emergency, laboratory, pharmacy, home visit)
- Usefulness for quality improvement, impact evaluation, and public health monitoring

The implementation experience suggests the following lessons learned:

- Local leadership, ownership, and capacity building have been key
- Significant attention to training was essential to system uptake, and ongoing training is important due to staff turnover
- Change management was handled skillfully: a staff physician was selected as an in-house champion to coordinate training, system announcements, and staff feedback, which was very helpful; also, an interdepartmental team at the hospital was formed to meet quarterly to discuss ways to improve the system
- Results, and stakeholder feedback on the design, implementation, and monitoring of the system, have guided ongoing iterative improvements; this approach started with the initial rollout and has continued with subsequent initiatives
- Stakeholders have deep concerns about data security and privacy risks
- Attention to data quality has been important via daily "data quality sweeps" and constant monitoring of EMR use

Building upon the experience of Bahmni implementation in Bayalpata Hospital and a subsequent implementation in Dolakha District, in 2018 MoHP decided to introduce the system at a public facility, Trishuli District Hospital. This served as a pilot for a potential nationwide EHR rollout. The system enabled digital patient registration and recordkeeping, with data backed up off-site and the ability to reprint lost or damaged hospital cards. Bahmni linked pharmacy data with service provision and stock information, shedding light on inefficiencies and potential malpractice. The implementation team ensured compliance with the national interoperability plan, allowing for electronic transmission of aggregate service delivery statistics to the District Health Information Software 2 system (DHIS2).

A study conducted by the Nepal Health Research Council showed that Bahmni improved data quality, decision making, and hospital efficiency at Trishuli District Hospital. Positive factors contributing to this included good teamwork and willingness among the staff to embrace the new system, and strong government commitment to making it work. However, challenges such as staff turnover, a lack of IT skills among staff, infrastructure issues, and limited technical support posed sustainability challenges. Consultations in 2023 revealed that the system is not fully utilized, and the desired improvements in healthcare delivery have been difficult to achieve. Stronger leadership, change management, and capacity building are needed for successful implementation.

Based on the assessment findings, an action plan is proposed for consideration:

- 1) Create an institutional home in MoHP for the national EHR system
- 2) Define the scope of the envisioned national EHR system
- 3) Create minimum EHR Standards (see Annex 5 for relevant international standards)
- 4) Start with one to three pilot hospitals rather than implementation across the two provinces as currently envisioned, and select pilot location(s) based on readiness
- 5) For each pilot hospital identify an EHR champion from among hospital management, establish a diverse working group, develop a change management plan and a communications plan, and invest in the pilots so they can experiment with business process reengineering and demonstrate tangible impact
- 6) Prioritize user-friendliness and simplicity, and patient protections and rights, in software design and processes
- 7) Invest in capacity and the enabling environment
- 8) Increase emphasis on data quality and data analytics
- 9) Regarding preparation of the World Bank Nepal Quality Health Systems PforR, an additional DLI is proposed (see Table A)

Table A. Proposed changes to PforR results framework

Proposed additional DLI	Responsibility for achieving results	Implementing agencies	
		National	PLGs
Adopt a digital health information policy and data management plan including data sharing, data use, patient rights and data protections (yes/no) [note: this would incorporate existing DLR 2.1, “EMR standards adopted by MoHP”]	MoHP	- MoHP	- Provincial Health Directorate - District Health Office / District Public Health Office - Hospitals

To address the binding constraint of limited personnel capacity, attention to stakeholder engagement, training, and recruitment is recommended. Strong leadership and policies at all levels of government are also essential for successful EHR implementation.

The rest of the report is organized as follows. First, the *Introduction* explains the motivation and methodology for this diagnostic assessment. The second section, *International Experience with EHRs*, provides a brief review of relevant literature on implementing EHRs around the world, primarily focusing on low- and middle-income countries, with specific country examples and experiences. *Problem Identification* provides some background on the health sector in Nepal and the rationale and objectives for EHR implementation. The main body of the report, the *EHR Diagnostic*, presents key findings from the desk review and consultations undertaken for this assessment, organized per the six thematic areas outlined above. Next, *EHR Experience in Nepal* provides detailed accounts of two EHR implementations that exemplify tangible opportunities and challenges in the Nepali context. The report concludes with an *Assessment of Nepal's Readiness to Implement EHRs*, which includes a preliminary binding constraints analysis, and a *Proposed Action Plan*.

The annexes supplement the report with supporting documentation and resources. These include the resources consulted in preparing the diagnostic questionnaire (Annex 1), a list of individuals and organizations consulted (Annex 2), an overview of Nepal's healthcare delivery structure (Annex 3), key principles from Nepal's National eHealth Strategy (Annex 4), and an overview of international EHR standards (Annex 5).

Introduction

Governments around the world are working to leverage data to make service delivery more efficient, inclusive, and responsive to citizens' needs. To strengthen its support for countries seeking to build a data-informed public sector at the national and sub-national level, the World Bank is implementing a program on “Mainstreaming a Rights-Based Approach to Information and Data in Bank operations”. This work, funded via a grant from the Human Rights, Inclusion and Empowerment Umbrella Trust Fund (HRIETF), seeks to enhance World Bank efforts to mainstream data-related work in operations and strengthen beneficiaries' ability to exercise their rights.

Through the HRIETF-supported program, the Bank has developed a methodology to help task teams and governments develop data-related initiatives, where relevant and feasible, to address development challenges.¹ This methodology (“Data Toolkit”) is now being tested in a few countries by partnering with teams that are preparing or already implementing an operation, with a focus on improving service delivery. Data-related initiatives are defined as activities that involve the actual production, dissemination, and use of data, and/or work to strengthen the “data ecosystem”, which includes the policy and legal framework, skills and institutional capacity, and other factors.

The Government of Nepal, through one component of the World Bank's proposed Nepal Quality Health Systems Program-for-Results (“PforR”; P177389), seeks to implement Electronic Medical Records (EMRs) to improve healthcare delivery. The PforR builds on the support the Bank has provided in recent years to improve governance, accountability, and transparency in the health sector in Nepal, and to contribute to the country's objective of universal health coverage.² The PforR is currently in preparation and presented an opportunity for the HRIETF grant team to partner with the PforR project task team and government counterparts to conduct a rapid readiness assessment and develop concrete strategies to address key challenges. The purpose of this assessment report is therefore to support World Bank operations by helping to inform preparation of the PforR.

As currently planned, the PforR will provide resources (expertise and financing) to develop an EMR system compatible with the existing DHIS2/HMIS system, and interoperable with other existing health management information systems. The initial EMR rollout will cover the network of primary and provincial hospitals in two provinces of Nepal. Under the results area “Improving readiness of healthcare delivery system and quality of care”, outputs and intermediate results include:

¹ The methodology is informed by the 2021 World Development Report, *Data for Better Lives*. See World Bank 2021a.

² For World Bank experience with electronic health records in other countries, refer to the “Supporting Effective Universal Health Coverage in Argentina” project (P163345), and the “Strategic Purchasing and Alignment of Resources & Knowledge in Health Project (SPARK-health)” project in Côte d'Ivoire (P167959).

- EMR standards adopted by MoHP (IRI 1.7/DLR 2.1)
- EMR implemented by Program-Supported Health Facilities (IRI 1.8/ DLR 2.2)

These outputs would enable, as an outcome, that inpatients in program-supported health facilities would have EMRs (PDO 3/ DLR 2.3). This would contribute to the PforR’s proposed long term outcomes, which include improving the quality and equity of health outcomes, and building resilient health systems. The project would include procurement of ICT hardware and software, development and implementation of standards to link data systems, and technical and capacity building support at the federal and subnational levels. The EMR system would also be linked with the insurance management information system.

Koshi and Gandaki have been selected as the two provinces for EMR rollout under the PforR. Together they represent more than 25 percent of the national population, and comprise a wide range of types of facilities and ecological regions. They are also relatively strong in human resources and other factors that are expected to contribute to a successful implementation.

Regarding terminology, for simplicity and to capture the full range of digitization objectives, this report hereafter refers to digital health records as electronic health records (EHRs) rather than EMRs. The terms “Electronic Health Records” (EHRs) and “Electronic Medical Records” (EMRs) are sometimes used interchangeably, but generally EMRs are understood to mean digital versions of a traditional patient record based in a single healthcare facility. EHRs comprise everything that EMRs do and more; EHRs are designed for interoperability (data sharing among all providers and the patient), encompass a broader range of data (e.g., a patient’s health plan as well as history of care), and can contribute to monitoring and analyzing healthcare data at a higher level (e.g., national disease surveillance). The government’s Digital Nepal Framework defines EHRs as a “combination of EMR and the hospital management system”.³ This report uses the term EHR throughout because it is understood to be more comprehensive than EMR and includes the idea of interoperability, a key objective in Nepal. However, the difference is largely semantic and the choice of one term is primarily for readability.

This report presents the findings of the readiness assessment on the barriers and opportunities related to designing and implementing an EMR system in Nepal, to help inform the preparation of the PforR. As an initial, rapid assessment, the report aims to take a broad albeit preliminary view of EMR readiness. It follows an “ecosystem” approach, meaning that it considers the larger environment for “supply” side issues like the policy/legal framework, institutional arrangements, existing data systems and standards, and infrastructure, as well as “demand” side issues like citizen engagement mechanisms and existing demand for EMRs in user communities (hospitals). The approach is user-centric and includes the following components:

- Problem identification
- Assessment of the initial conditions and enabling environment via desk review drawing on existing literature and data

³ MoCIT 2019.

- Preparation of a diagnostic questionnaire based on the draft Data Toolkit and adapted/expanded using inputs from a variety of assessment tools (see Annex 1 for a list)
- Consultations with key stakeholders within and outside government, using diagnostic questionnaire as a guide for discussion (see Annex 2 for list of persons and organizations consulted)
- Analysis of findings and preparation of report

International Experience with EHRs

Electronic health records (EHRs) are digital versions of a patient's medical history and treatment information. They are used to store and manage a patient's health information, including medical history, diagnoses, medications, treatment plans, and test results. EHRs are designed to be accessible to authorized healthcare providers, such as doctors, nurses, and other clinicians, and can be used to support the delivery of patient care. EHRs can help improve the quality and efficiency of healthcare by making it easier for healthcare providers to access and share patient information, coordinate care, and track patient outcomes.⁴ This in turn results in timelier care, as well as a decrease in wasted resources, thus contributing to better service delivery and development outcomes.⁵ In addition to the direct application to individual patient care, anonymized data from EHRs can be used to monitor the performance of service providers, and to monitor public health at the local or national level, such as identification of disease outbreaks.

The international norm ISO/DTR 20514 defines an EHR⁶ as:

a repository of information regarding the health of a subject of care in computer-processable form that is able to be stored and transmitted securely, and is accessible by multiple authorized users.

There are several good practices that a country should consider when implementing EHR systems. One of the most important issues to keep in mind is the imperative to clearly define the goals and objectives of the EHR system.⁷ It is important to have a clear understanding of what the EHR system is intended to achieve and how it will be used to support the delivery of healthcare. In this sense, it is important to take into account that EHR systems can be considered one element of a larger Health Management Information System (HMIS). Yet an HMIS is not only an EHR system, as an HMIS can also incorporate information about budget, human resources, users' satisfaction and so on.

The majority of the literature on EHRs and their impact comes from wealthy countries, but the available evidence on international good practices for lower-income countries highlights the following as key aspects to take into account when designing and implementing EHR systems:

Engagement with all relevant stakeholders and human-centered design. Involvement of all stakeholders is crucial in the design, implementation, and monitoring process to ensure sustainability.⁸ EHR systems can impact a wide range of stakeholders, including healthcare providers (both medical and administrative staff), patients, policy makers, civil society, and other

⁴ Manca 2015.

⁵ Tsai et al. 2020.

⁶ See <https://www.iso.org/standard/39525.html>.

⁷ Office of the National Coordinator for Health Information Technology 2016.

⁸ Odekunle, Odekunle and Shankar 2017.

donors. It is important to involve all relevant stakeholders in the planning and implementation process to ensure that the EHR system meets the needs of all parties. This entails understanding their data and information needs, main current channels for collecting and accessing data, capacities and potential resistance to change. It also implies a strong emphasis on user-centric design. Incorporating user testing into the design process allows the system to “fail fast” and for design and technical flaws to be addressed.

Example: In Thailand, an analysis of a nationwide survey of healthcare personnel found that key success factors enabling EHR adoption fell into two categories, managerial and technical, with the former being more significant. One of the key managerial factors identified was involving clinical staff in the implementation.⁹

Interoperability. This refers to a key feature in EHR systems that allows for patient information and data to be accessed at different healthcare centers and ensure that data gathered in one point is accessible in another point.¹⁰ For this to happen, first, patients’ data must be recorded in a standardized manner, particularly when dealing with clinical terms (this relates to data quality, see below). Second, healthcare providers must be equipped with the right tools, in terms of hardware and software, to access patient data. It is important to take into account that EHR software can vary significantly and healthcare providers in the same country often rely on different systems, thus creating problems for interoperability. In Brazil, by 2021, several experts had mentioned that the main challenge for the EHR system was limited interoperability.¹¹ Countries that are about to transition from paper records to EHRs can address this issue from early stages by adopting a health information exchange system with common data definitions and technical standards, thus avoiding problems later during implementation.

Example: In Rwanda, a civil society organization working with the government developed the Rwandan Health Information Exchange System to ensure that the various health information systems in that country could communicate with each other, thus ensuring interoperability.¹² The challenges they faced were significant, as not only the different systems such as OpenMRS¹³, the system from the National Identification Agency, and DHIS2 were not linked, but other data (such as HIV cases) was captured on paper. In this context, the work focused on developing an interoperability layer on OpenHIM¹⁴ (which was developed using open source code and is publicly available) followed by establishing mediators between the different systems. Finally, the team developed the registries for facilities and clients to ensure that these are properly captured through the systems.

⁹ Narattharaksa et al. 2016.

¹⁰ PAHO 2020.

¹¹ Barbalho et al. 2022.

¹² See <https://ohie.org/impact-stories/creating-a-health-information-exchange-system-in-rwanda/>.

¹³ See <https://openmrs.org/>.

¹⁴ See <http://openhim.org/>.

Data quality. Patient EHRs should be complete, timely, accurate, and unified in a single record with a unique ID.¹⁵ As all information and data from patients is entered into the EHR by healthcare professionals, there is always the human element, which at times results in errors and poor quality of data available to other practitioners. Due to this it is important that EHR systems pursue strategies to increase the quality of data. To do so, decision makers can place emphasis on capacity building (see below), as well as relying on international standards such as the International Classification of Diseases by the WHO or the Systematized Nomenclature of Medicine Clinical Terms (SNOMED CT), a standard that was adopted by the Indian government when rolling out their EHR system¹⁶ (see Annex 5 for international standards relevant to EHRs). Also, it is important to avoid digitizing bad data collection and management processes; business process re-engineering of the data workflow should precede digitization.

Example: In Malawi, a quality improvement project for a malaria surveillance system worked in four rural health clinics to increase the quality and use of health data by transitioning from manual to electronic data entry (in XML form on tablet devices).¹⁷ Data audits conducted before and after the project showed measurable improvement in data completeness and consistency. The research highlighted key lessons related to data quality, including: 1) the need for simple processes and systems to minimize workload; 2) the need for ongoing stakeholder engagement and staff training, given high staff turnover; 3) the need to involve healthcare staff in creation of the data entry forms to ensure accuracy of data coding options; 4) risks of incomplete data entry or data loss due to inadequate power/Internet connectivity; 5) risk of theft of electronic devices; and 6) the importance of local data backups when data cannot be transmitted in real time to a central server.

Infrastructure. The effective roll-out of an EHR system requires that the proper tools are available for healthcare providers. This entails hardware, a.k.a. the computers or other electronic devices through which providers will enter and access patients' data. It also requires the proper software to enter and access data, while considering that this software should meet criteria around interoperability (see above) as well as data protection (see below).¹⁸ As mentioned, there are several EHR software solutions, however international experience (including for instance in the US and UK) suggests the desirability of using open-source software.¹⁹ In low-income countries, OpenMRS is the most common. Additionally, when designing an EHR system, connectivity and electricity issues must be considered – e.g., whether the internet connection is reliable. Systems should have offline data entry capability so that providers do not need parallel paper records during an outage, and can simply sync the system when connectivity is restored. Similarly, and in particular when working in rural contexts in low- to middle-income countries, reliable electricity is key for an EHR system to be effective.

¹⁵ Some countries use the national eID as the health ID, which may serve to reinforce the strength and coverage of the identification system overall. This requires strong measures in place to protect health data privacy, which in some cases may suggest that a separate health ID would be more appropriate.

¹⁶ See EHR Standards for India, National Resource Center for EHR Standards, at <https://nrces.in/>.

¹⁷ Tizifa et al. 2021.

¹⁸ Akwaowo et al. 2022.

¹⁹ Aminpour, Sadoughi, and Ahamdi 2014.

Example: In Nigeria, progress has been made regarding the implementation of EHRs, yet the context remains challenging due to limited resources and infrastructure. For example, connectivity and power outages are still regular occurrences, particularly in rural areas. This, in tandem with the investments required in equipment, software, etc., prompted stakeholders in Nigeria to follow a phased approach for the rollout of their EHR system.²⁰ A phased approach allows government to focus on specific areas, ensure proper operation, learn from that experience and then move on to the next areas, all of this without the need for extensive resources at once.

Policies and regulations. Establishing clear policies and procedures for the use of EHRs is also important. Guidelines should be in place to ensure that EHRs are used appropriately and in compliance with the relevant regulatory framework. This entails different levels of policies and guidelines, depending on the prevailing regulatory framework. For instance, there could be data protection legislation already enacted in the country which would provide a clear framework as to how patients' data must be handled. The policy and regulatory framework encompasses a number of topics including access to and ownership of data, security of clinical information systems, privacy and confidentiality, informed consent by patients for data use, secure transmission of health data, and data standards. At a lower level, policies and guidelines will provide healthcare providers with specific actions depending on the situation regarding the use of the EHR system. These guidelines should include the roles and responsibilities of all relevant healthcare providers when using the EHR system, including when to enter and update information, how to access patient records, and how to protect the confidentiality of patient information. With the aim of ensuring that the wide range of healthcare providers rely on common policies, Denmark created the Danish Health Data Authority, a government agency that oversees these issues. India created a similar agency in 2015, the National eHealth Authority.²¹

Example: The Government of India's multiyear effort to enact a personal data protection legal and regulatory framework illustrates the complex issues and debates involved in ensuring data privacy. The lack of a data privacy framework, for example, has made India's national biometric-based digital ID system, known as Aadhaar, controversial at times,²² and the Indian media has played an important role in finding weaknesses in the Aadhaar system.²³ In 2017, the Supreme Court of India ruled that the right to privacy is protected by the Constitution. A Personal Data Protection Bill was published in 2018 covering not only the identification system, but all kinds of personal data. This bill was dropped in 2022 after domestic critics expressed concerns about the power it gave government agencies with respect to personal data, and pushback from global tech giants regarding proposed restrictions on cross-border data flows.²⁴ The government issued a new Digital Personal Data Protection Bill in late 2022 amid continued discussion of the

²⁰ Meribole, Makinde, and Oyemakinde et al. 2018.

²¹ Wadhwa 2020.

²² World Bank 2018.

²³ World Bank 2017.

²⁴ Singh and Singh 2022.

appropriate extent of government exceptions to the law.²⁵ Meanwhile, international dialogue is still evolving on the best ways to balance individual privacy and the benefits of technology.

Data protection. Ensuring the security and confidentiality of patient information is a critical step in EHR implementation. EHR systems handle sensitive patient information, so it is important to have strong security measures in place to protect this information from unauthorized access. These measures could include firewalls, secure login protocols, data encryption and other mechanisms to guarantee that only the required healthcare professionals will access personal data. Training of healthcare professionals in data protection procedures is also essential. Furthermore, citizens may have privacy concerns about their healthcare providers relying on EHRs. Communications strategies should be developed to showcase the security measures to guarantee data protection, while highlighting the benefits of EHRs. The degree of trust in the data protection framework can affect the rate of system adoption. From a policy standpoint, data protection legislation and policies must also provide institutional underpinnings (such as an independent oversight entity) to ensure confidentiality of patients' information (see policies and regulations above). The MEASURE Evaluation Project developed a checklist on data security, privacy, and confidentiality that can be used in the planning stage.²⁶

Example: mHealth Kenya's mLab application (Mobile Laboratory) enables data exchange between laboratories and healthcare facilities so that health providers for people living with HIV get patient lab results more quickly.²⁷ mHealth paid close attention to data security, privacy, and confidentiality in planning and implementation of the app, beginning with mapping security risks during the design phase. This exercise considered, for example, whether facilities had secure places to keep devices, and mapped all electronic access points (APIs, forms) to the app to enable prevention of unauthorized access by third party systems. Viewing lab results requires a login and password and can only be done on a single facility-owned device, though multiple users can receive SMS notifications that results are ready for viewing. Data access levels are defined for different user groups, messages containing test results are SSL-encrypted and can only be viewed within the app itself, and app user training includes coverage of emerging security trends.

Capacity building. A WHO global health survey indicated that capacity constraints are considered the most significant barrier to implementing EHRs.²⁸ Experience has shown that resistance to use of EHR systems by healthcare professionals, due to resistance to change or to limited capacity in the use of electronic tools, can curtail implementation of these systems. Whether healthcare professionals consider that the system helps them do their job better also is a major factor in adoption.²⁹ Providing training and support for healthcare providers is essential to ensure that they are able to effectively use the EHR system and understand how it can support the delivery of patient care.

²⁵ Vengattil and Kalra 2022.

²⁶ The checklist was designed for mHealth applications but could be used for EHRs in general. Available at: <https://www.measureevaluation.org/resources/publications/ms-17-125b.html>.

²⁷ Spigel, Wambugu, and Vilella 2018.

²⁸ WHO 2016.

²⁹ Akwaowo, Sabi, and Ekpenyong 2022.

Example: In Uganda, an EHR demonstration project implemented OpenMRS in HIV clinics at three hospitals.³⁰ A survey of system users (clinicians, clinical support staff, and medical record clerks) revealed a high level of satisfaction with OpenMRS, finding on average that it increased productivity and improved the quality of care. Implementation was most successful at one of the three sites, which the researchers attributed to a number of key factors, several of which were: 1) prior use of IT (an MS-Access research database) at that site, which meant a higher level of pre-existing IT infrastructure and expertise among personnel, including a highly skilled data manager; 2) technical support from consultants from Makerere University in Kampala; 3) a pre-existing partnership with a university in the U.S., and other research programs, that created incentives for gathering the highest quality data possible; and 4) taking advantage of training available through the global OpenMRS developer community. Multi-stakeholder partnerships thus seem a fruitful strategy for addressing capacity issues in EHR implementation (while noting that a national EHR implementation would not require the same degree of on-site customization needed in this example, where each site had different requirements).

Box 1. India and its National Health Portal³¹

The National Health Portal of India³² is a comprehensive online platform that provides access to information about healthcare facilities and services, health education materials, and an EHR system. The portal was launched by the government of India in 2013 with the goal of improving healthcare accessibility and quality.

The EHR system accessed via the National Health Portal is used by authorized healthcare providers throughout India to store and manage patient health information. One of the key features is the ability to securely share patient information among healthcare providers. This can help improve the coordination of care and reduce the risk of errors or duplications.

The government has created a universal health ID known as the ABHA (Ayushman Bharat Health Account) Number³³ to facilitate record sharing among providers, labs, and other health professionals. Patients can also download an ABHA mobile app, which serves as a Personal Health Record (PHR). A PHR is distinct from an EHR in that it is controlled by the patient rather than the health system, while conforming to national health information interoperability standards.

³⁰ Tierney, Acheing, and Baker et al. 2010.

³¹ Healthy India Chronicle 2023.

³² See <https://www.nhp.gov.in/>.

³³ See <https://abdm.gov.in/>.

Box 2. Brazil's DATASUS supporting health data³⁴

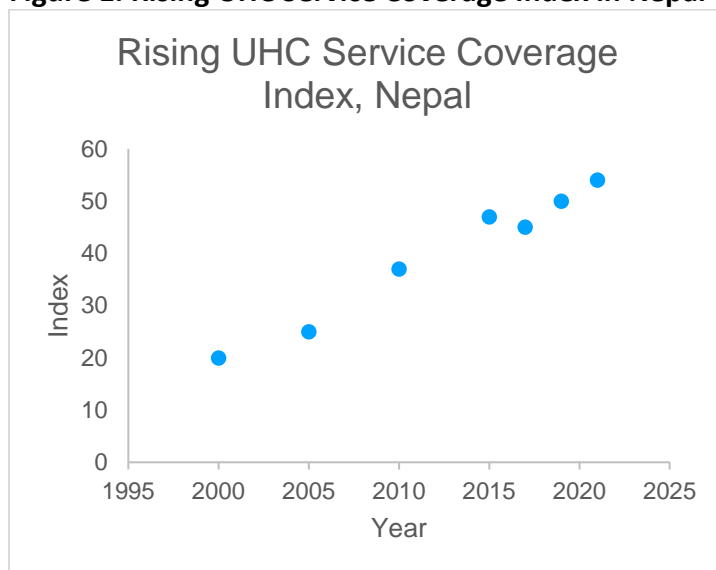
Brazil's Informatic Department of the Single Health System, DATASUS, was created in 1991 with the mission to control and process health data; with the rapid increase in the use of information technologies, this role has expanded. Now it is a key agency within the health system, having developed important applications related to data management. It has played a critical role in the implementation of Brazil's HMIS and its EHRs, as well as in coordinating with all different stakeholders relevant in this area. Furthermore, DATASUS is an important agency in the implementation of the Digital Health Strategy 2020-2028. Agencies like DATASUS provide the institutional underpinnings to ensure coordination among all stakeholders when implementing EHRs and other HMIS-related initiatives.

³⁴ See <https://datasus.saude.gov.br/>.

Problem Identification: The Case for EHRs in Nepal

In recent years, health indicators in Nepal have significantly improved, but challenges remain with respect to ensuring quality healthcare for all. Nepal’s 2015 Constitution stipulates that “every citizen shall have the right to free basic health services from the State.”³⁵ The government has been making progress toward realizing this aspiration of universal health coverage (UHC) (Figure 1), along with major improvements in vital health statistics. The decline in under-5 child mortality is striking, for example, falling from 70 to 28 per 1,000 live births from 2002 to 2020.³⁶ Though progress has been made in making health services more available, access and outcomes vary considerably along geographic, gender, wealth, educational attainment, rural-urban, and other lines.

Figure 1. Rising UHC Service Coverage Index in Nepal



Data source: WHO. See <https://apps.who.int/gho/data/node.main.INDEXOFESSENTIALSERVICECOVERAGE>.

Fragmented data systems and a limited use of data in the health sector contribute to weaknesses in healthcare delivery overall. Nepal has more than 6,000 healthcare facilities across three levels of public healthcare plus private facilities (Table 1), and an additional 11,589 Primary Health Care Outreach Clinic (PHCORC) sites (see Annex 3 for a diagram of the health service delivery structure). According to the National eHealth Strategy, the current norm of paper-based health recordkeeping is error-prone, cumbersome, difficult to leverage for analysis, and expensive (due to paper and printing costs, but also to the cost of physical transportation of reports across difficult geographical terrain). EHRs have shown potential to generate improvement in some aspects of healthcare delivery and administration (for an early example, see Box 3).

³⁵ Available at https://ag.gov.np/files/Constitution-of-Nepal_2072_Eng_www.moljpa.gov_.npDate-72_11_16.pdf.

³⁶ World Bank World Development Indicators. Available at <https://databank.worldbank.org/source/world-development-indicators>.

Table 1. Number of Healthcare Facilities in Nepal by Type, 2019-20

Type of Healthcare Facility	Number of Facilities
Public hospitals	134
Primary health care centers	194
Health Posts	3767
Non-public facilities	2277
<i>Total</i>	<i>6372</i>

Data source: DoHS 2021.

Box 3. A Promising Early Example of EMR use in Nepal

In 2010, the NGO PHASE Worldwide, a primary healthcare provider at the local level in Nepal, adopted a stand-alone EMR system. An evaluation later found that the system generated some “immediate and observable benefits”, in that it was well used and user-friendly, and had sped up data reporting and improved drug inventory management. There were some process issues that meant healthcare staff continued some parallel paper-based recordkeeping, as well as other challenges, particularly related to inadequate infrastructure and technical support. Despite the improvement in patient recordkeeping, the study also noted that staff generally did not look back at the records, underscoring the importance of change management. Overall, however, the study concluded based on this case that an EMR system “can function well in a remote, resource-poor setting by tailoring the design to the intended context”.

Source: Watkinson-Powell and Lee 2021.

The Digital Nepal Framework³⁷ outlines the goal and objectives for its Electronic Health Records 2.0 initiative. It states that EHRs aim to be “a miniature warehouse of medical records where the prescriptions, test reports, medical history, physical and psychological examinations, medication prescribed, diagnosis and prognosis, result of treatment and procedure implemented, allergies and other risk factors, disabilities and many more are accumulated in one folder without letting patients carry away those details.” It also specifies the following objectives for EHRs, emphasizing improvement in frontline service delivery:

- Providing accurate, up-to-date, and complete information about patients at the point of care
- Reducing costs through decreased paperwork, improved safety, reduced duplication of testing, and improved health
- Enabling quick access to patient records for more coordinated, efficient care
- Securely sharing electronic information with patients and other clinicians
- Helping providers more effectively diagnose patients, reduce medical errors, and provide safer care

³⁷ MoCIT 2019.

These stated objectives do not include improvement of data for disease surveillance and decision making at the subnational or national level, or data availability for health research, which are presumably also potential long-term benefits of an EHR system. Nepal's disease surveillance system is currently inadequate, for example, but it is probably unrealistic to expect EHRs to fill this gap in the short to medium term. EHRs would, however, help the government to pivot toward a Green, Inclusive and Resilient Development (GRID) approach by reducing paper use and increasing resilience by strengthening health systems. Additionally, the Constitution states that "every person shall have the right to get information about his or her medical treatment"; EHRs could help the government deliver on this promise.

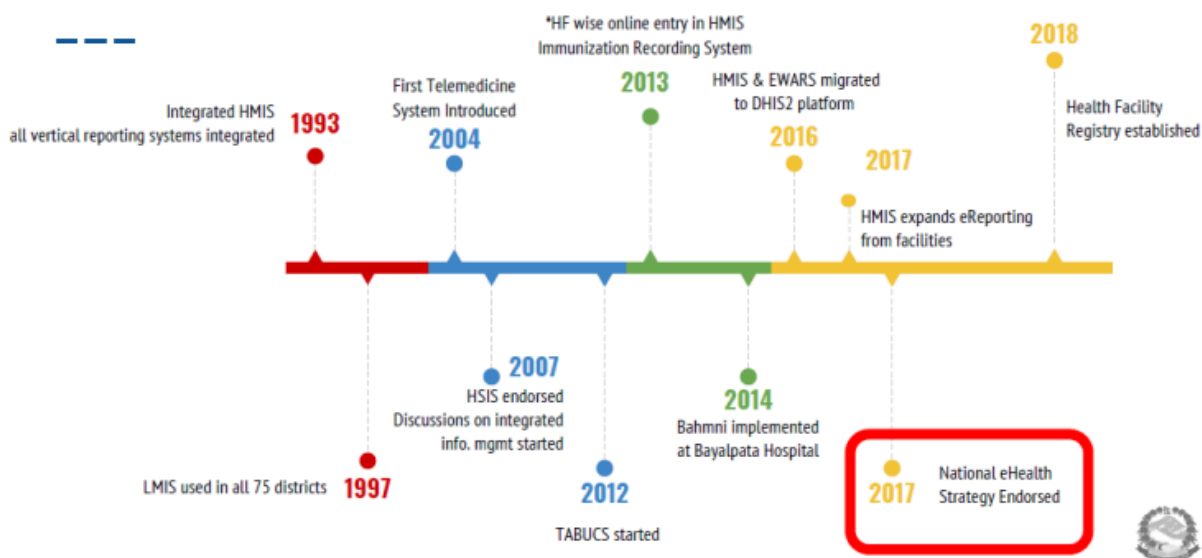
EHR Diagnostic

Strategic and governance framework

The Government of Nepal has been working toward universal health coverage through successive sectoral strategies, with the new Nepal Health Sector Strategic Plan (2022-2030) building on the Nepal Health Sector Strategy (NHSS 2015-2020), and has made significant investments in e-Health (Figure 2). The strategic framework emphasizes improving the coverage and quality of care, and seeks to employ technology to increase access to health information, while ensuring interoperability of data systems. The 2015-2020 plan included “improved availability and use of evidence in decision-making processes at all levels” as one of nine desired outcomes.

The Digital Nepal Framework, under the Ministry of Communication and Information Technology, aims “to contribute to economic growth, find innovative ways to solve major challenges facing society in a shorter period with fewer resources, and identify opportunities for Nepal to participate in the global economy”.³⁸ The Framework includes health as one of eight sectors of focus, and mentions seven specific digital health initiatives, including EHRs and a National Digital Health Platform (see Box 4). Moreover, a top priority it mentions in the context of reducing the stark urban-rural divide in healthcare access is equipping all healthcare centers in rural areas with high-speed Internet, which will be important for EHR rollout.

Figure 2. e-Health Interventions of the Ministry of Health and Population



Source: Reproduced from MoCIT 2019.

³⁸ MoCIT 2019.

Box 4. Nepal’s Ambition to build a National Digital Health Platform/Mobile App

The [digital health] platform should provide all information pertaining to public sector healthcare facilities to citizens and enable easier access to healthcare services. The platform/app could offer the following facilities:

- Information on public healthcare systems and programs
- Information of all nearby healthcare hospitals and centers
- Online booking of appointments with healthcare professionals
- Tracking patients’ healthcare records

The platform should be linked to existing eHealth systems such as the Health Management Information System (HMIS), Electronic Health Records (EHR) Systems, and Health Facility Registry (HFR).

Nepal should emulate the Telangana Ministry of Health and Population (India) app that allows its citizens to access services at over 800 public health facilities; the app was developed by the Government of Telangana in partnership with Mahindra Comviva.

Source: Excerpted from the Digital Nepal Framework (MoCIT 2019).

Under this umbrella, the government’s 2017 National eHealth Strategy aims to provide a comprehensive framework for mainstreaming the use of technology to strengthen health services, governance, and management.³⁹ One of the six intended outcomes of the strategy is “enhanced access to data and information for effective planning, management, governance and evidence-based decision making” (see Annex 4 for the strategy’s guiding principles and strategic pillars). The strategy points to the fact that while e-health systems and tools have increasingly been adopted in Nepal, these investments have generally been ad hoc and uncoordinated. Because of the lack of interoperability or standards-based integration into the national health system, it has been difficult to leverage the increasing amount of health data to inform policymaking or frontline service delivery. With support from GIZ, the government has been working on setting up an Interoperability Lab that will “demonstrate how digital technologies can be deployed to solve larger and more complex health challenges, bringing data from different systems seamlessly together to help decision-makers see the bigger picture”.⁴⁰

The eHealth Strategy and the accompanying Implementation Roadmap include the aspiration to implement EHRs in hospitals, and an electronic health database for recording and reporting at lower-level facilities. The strategy also aims to “establish a national health data bank and ensure security of data establishing multiple backups in different locations”. Nepal has decided to adopt the Open Health Information Exchange (OpenHIE) framework⁴¹ to facilitate

³⁹ MoHP 2017.

⁴⁰ GIZ 2018; see also <http://sil-asia.org/sil-asia-supports-health-interoperability-lab-set-up-in-nepal/>.

⁴¹ See <https://ohie.org/>.

implementation of the strategy. It will serve as the overarching structure for Nepal's digital health sector and as a guiding framework for implementing the National eHealth Strategy, an early aspect of which has been developing key health registries, such as a health facility registry that makes it possible for all health systems to use the same identifying code for a certain facility. Other registries include a terms and standards registry, DHIS2 indicator registry, and a human resources registry. An interoperability layer and Application Programming Interfaces (APIs) will link the registries with the different IT systems in use by the MoHP, hospitals, laboratories, health centers, and other entities.⁴² The diagnostic team was unable to ascertain to what extent the eHealth strategy has been funded thus far.

Turning to the policy and regulatory environment, key rights relevant to health information are stipulated in the Constitution and bolstered through legislation. The right to information is enshrined in Nepal's Constitution, which states that "every citizen shall have the right to demand and receive information on any matter of his or her interest or of public interest, provided that no one shall be compelled to provide information on any matter of which confidentiality must be maintained in accordance with law". The right to privacy is likewise guaranteed by the Constitution. These rights are further outlined in Nepal's Right to Information Act (2007) and Privacy Act (2018). The Electronic Transaction Act (2008) is also relevant as it provides for legal recognition of electronic documents, signatures, and transactions, and includes some provisions related to cybercrimes.

Also, the Nepal Medical Council established "Telemedicine Guidelines for Registered Medical Practitioners" in 2020. The guidelines include some provisions on informed consent, privacy and confidentiality, but further research is needed to understand to what extent this "code of conduct" is followed in practice.⁴³ The guidelines note that providers must comply with the Nepal Medical Council Act 2020 and Consumer Protection Act 1998, but mention that "providers will not be held responsible for breach of confidentiality if there is a reasonable evidence to believe that patient's privacy and confidentiality has been compromised by a technology breach."

Yet, data protection and cybersecurity are major challenges. Nepal's National Information and Communication Technology Policy (2015) committed the government to developing a "legal/regulatory and ethical framework... for effective use of health information, and security measures to safeguard the privacy of patient information inherent in digitized health care records".⁴⁴ The government has been working, in part through engagement with the World Bank, to strengthen the data regulation and cybersecurity legal and policy frameworks, but some gaps remain.

Weaknesses relative to international good practices are illuminated by the Global Data Regulation Diagnostic Survey conducted as background research for the 2021 World

⁴² GIZ 2018.

⁴³ [Nepal](#) Medical Council 2020.

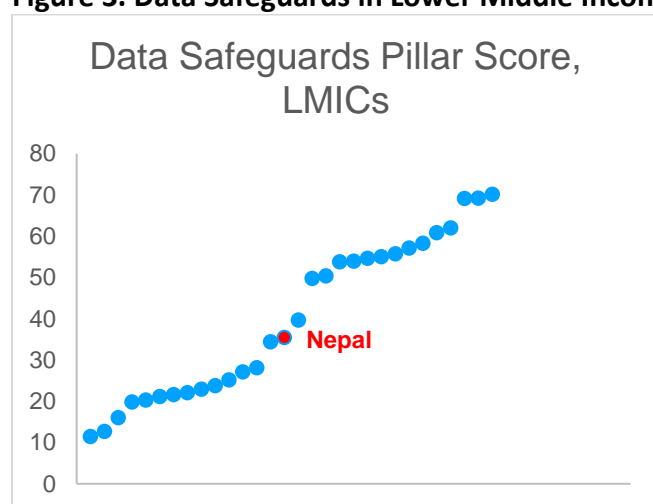
⁴⁴ MoCIT 2015.

Development Report, *Data for Better Lives*.⁴⁵ According to the survey, some of these weaknesses could be remedied with adoption of the following data safeguards:

- Privacy by design
- Limitation on data collection and processing by the government
- Data storage limitation
- Limitation on algorithmic decision-making
- Regulations on cross-border flows of personal data

An analysis by Chen (2021) created an overall score for the questions in the survey pertaining to data safeguards by assigning weights to each question. Overall, Nepal's score on the safeguards pillar of the survey falls roughly in the middle range for lower middle income countries (Figure 3).

Figure 3. Data Safeguards in Lower Middle Income Countries (LMICs)



Data Source: Chen 2021.

In terms of cybersecurity, Nepal has adopted some key regulations, a CERT, and a cybersecurity plan, but the survey identifies a number of issues in the regulatory environment. Nepal's score of 50 on the cybersecurity dimension of the survey is just below the LMICs average of 55.⁴⁶ Weaknesses include a lack of safeguards around processing of personal data (e.g., requirements for data encryption and integrity of systems, including ongoing evaluation of systems that use or generate personal data). Nepal also lacks regulations that require data processors to ensure confidentiality of personal data and to adopt internal policies and other controls for preventing and detecting violations. Additional insight comes from an assessment of Nepal's digital ecosystem that USAID conducted in 2022. This assessment observed that officials tend to

⁴⁵ World Bank 2021b.

⁴⁶ Chen 2021.

understand cybersecurity more as an issue of protecting the government's image, rather than protecting its digital assets and infrastructure.⁴⁷

Through the Digital Nepal Acceleration (DNA) Project (P176543), approved in 2022, the World Bank is supporting Nepal to enhance the broader digital trust ecosystem. Elements include 1) acquiring global certification and promoting the use of digital signatures; 2) establishing a global standard national cyber security center (NCSC); and 3) legal and regulatory measures to improve personal data protection, cybersecurity, and online safety of specific social groups. The World Bank is also engaging with the government through related advisory activities and engagements to support broader improvements and updates to the digital policy and regulatory framework. The Government has presented a draft Cyber Security Policy, conducted a feasibility study for the establishment of a Cyber Security and ICT Research Center, and launched a government cloud service.⁴⁸

Senior leadership and key stakeholders

As discussed in the previous section, the Government of Nepal's senior leadership has conveyed its intent to strengthen healthcare delivery through digital technology. The strategic and policy framework that has been put into place suggests a significant amount of commitment to moving forward on improving the health information ecosystem. The Prime Minister endorses the Digital Nepal Framework and a budget has been allocated for it. Regarding EHRs in particular, resources are not a major obstacle, as there are a number of development partners willing to support implementation.

At the same time, thus far the level of investment in EHR development and implementation has lagged behind the government's ambitions. The drive to implement EHRs has been largely top-down thus far, rather than emerging from the bottom up (from healthcare professionals). The MoHP has an HIS/M&E technical working group⁴⁹, but in general, insufficient coordination has stymied progress. Uniformity in terms of policies across levels of government, and stronger government ownership and coordination under the leadership of MoHP, will be critical to national EHR implementation. There is also a need to strengthen planning to ensure an aligned and integrated approach, and a need for much stronger emphasis on stakeholder engagement.

Table 2 provides an overview of key EHR stakeholders.⁵⁰ MoHP, with which the World Bank has a good working relationship, is the central player. Madan Upadhya, Chief of the Quality Standards and Monitoring Division, has shown leadership around moving the EHR agenda forward. In terms

⁴⁷ USAID 2022.

⁴⁸ World Bank 2022.

⁴⁹ HDC and UNICEF 2022.

⁵⁰ For a more comprehensive survey of healthcare partners and stakeholders, see Annex 1 in HDC and UNICEF 2022.

of non-government stakeholders, medical and physician associations may play a role – these institutions tend to be shaped by active individuals rather than having strong institutional views. The section below on “Demand for EHRs at the hospital level” discusses the views of healthcare professionals in various types of health facilities.

Table 2. EHR Stakeholder Map

National Government	Provincial and Local Governments	Implementing Partners and Other Stakeholders	Users
<ul style="list-style-type: none"> - MoPH: <i>Management Division</i> - <i>Curative Service Division</i> - <i>Policy Planning and Monitoring Division</i> - MoCIT - MoF - Nepal Information Technology Centre - DONIDCR – Department of Civil Registration 	<ul style="list-style-type: none"> - Provincial Health Directorate - District Health Office / District Public Health Office - Hospitals (and eventually other healthcare facilities) 	<ul style="list-style-type: none"> - Private sector - digital service providers, software developers - Medical association, physician association - International organizations, especially the World Bank, WHO, and UNICEF - Bilateral donors, especially GIZ - NGOs in the health sector - Academic partners (potentially) 	<ul style="list-style-type: none"> - Doctors and other healthcare workers - Patients - Data analysts - Decision makers

There have been significant efforts to coordinate and harmonize development partner interventions related to the health information system in Nepal. Since 2004, a group of donors has been supporting the health system in Nepal through a joint program to decrease transaction costs to the government and promote coordinated investments. A study⁵¹ commissioned by UNICEF for the Health Data Collaborative (HDC)⁵² and published in September 2022 assessed partner alignment and found a high degree of alignment with the national strategic plan. It noted that positive contributing factors included the sector-wide approach (SWAp) and pooled funding mechanism for development partners in the health sector, and government-led coordination at the federal level. There is also a technical working group for the health information system, and a national HIS M&E framework, “Health Sector Monitoring and Evaluation in Federal Context” (in draft, 2018). On the other hand, the study argued that the decentralization of healthcare delivery, and a lack of NGO representation in federal coordination mechanisms, are key challenges to effective donor alignment.

There are several ongoing initiatives that should be considered in terms of coordinating an EHR implementation on the donor side. According to the MoHP, the primary EHR stakeholders from

⁵¹ HDC and UNICEF 2022.

⁵² The study states that the Health Data Collaborative was formed in 2016 “with the aim of strengthening national and subnational systems for integrated monitoring of health programmes and performance”.

the donor community include UNICEF, GIZ, and the WHO.⁵³ GIZ has been a key partner in the digital health area, and is actively working to support interoperability in the health information system.⁵⁴ The WHO provides support for strengthening the Early Warning, Alert, and Response System (EWARS) in Nepal. USAID is also currently planning a \$25m digital health project. Within the World Bank, the “Strengthening Systems for Social Protection and Civil Registration Project” (P154548) was approved in 2016 to improve the coverage of civil registration (online registration of civil events), among other objectives.⁵⁵

Institutional structures, responsibilities, and capabilities

On the institutional side, Nepal is in the process of transitioning from a highly centralized system of government to a decentralized, federal structure, with major implications for the health sector. A digital ecosystem assessment conducted by USAID in 2022 found that although the government has had good intentions in developing various strategies, policies and initiatives to strengthen the digital ecosystem overall, limited coordination among government agencies is still a major challenge.⁵⁶ With respect to the health sector specifically, intergovernmental coordination and accountability, and subnational capacity, must all be strengthened to realize the desired benefits of federalism. There is a recognized need “to clarify roles and responsibilities and strengthen the vertical and horizontal coordination and cooperation among public health professionals and other stakeholders in all three tiers of government”.⁵⁷ This underscores the importance of integrated data systems so that information can be shared across levels and enable evidence-based decision making. Overall, there is also a general lack of in-depth understanding around EHRs and digital solutions within senior leadership and the civil service.

While recognizing the challenges inherent in implementing a federal structure, which requires reorganizing the entire health sector into three tiers (federal, provincial, and local), the National eHealth Strategy proposes that this transition represents an opportunity to make the sector more efficient and effective in tackling health challenges. Under the federal system (see Box 5), the central government provides “logistical, financial, supervisory, and technical support” to the lower levels.⁵⁸ The role of the federal Ministry of Health and Population (MoHP) is to define policies and standards and coordinate health delivery at all levels, finance basic healthcare services, and provide tertiary level services. Provincial governments are responsible for similar functions within their jurisdictions but within the framework set by the federal government, and “provincial health directorates provide technical backstopping and program monitoring to district health offices”.⁵⁹ Basic healthcare services are provided at the local level, which is responsible for overseeing health facility operations. While there are significant institutional weaknesses at the federal level, capacity at the provincial and local levels is still lower.

⁵³ MoHP undated. “Data and Digital Priorities: Addressing Equity.”

⁵⁴ GIZ 2023.

⁵⁵ See <https://projects.worldbank.org/en/projects-operations/document-detail/P154548?type=projects>.

⁵⁶ USAID 2022.

⁵⁷ Sapkota, Paday, Wasti et al. 2002. p. 4.

⁵⁸ MoHP, New ERA, and ICF 2022.

⁵⁹ MoHP, New ERA, and ICF 2022.

Box 5. Nepal’s Healthcare Delivery Structure

Health posts are the first institutional contact point for basic health services. These lowest-level health facilities monitor the activities of female community health volunteers (FCHVs) and the community-based activities of primary health care outreach clinics (PHC-ORCs) and Expanded Program on Immunization (EPI) clinics. In addition, they are the referral centers for FCHVs as well as community-based venues such as PHC-ORCs and EPI clinics. Each level above the health post level is a referral point in a network ranging from primary health care centers (PHCCs) to primary- and secondary-level hospitals and, finally, tertiary-level hospitals. Community health units are gradually increasing at the ward level. In addition, Nepal has established urban health centers (UHCs) to ensure that the urban poor can receive treatment in accessible places.

Source: Excerpted from Nepal Health Facilities Survey 2021. See MoHP, New ERA, and ICF 2022.

Within the MoHP, the Department of Health Services (DoHS) is one of three departments responsible for designing and implementing programs. The Management Division falls under the DoHS and is responsible for “informational management, planning, coordination, supervision, and the monitoring and evaluation of health programmes,” which includes the Health Management Information System (HMIS).⁶⁰ It is therefore the most likely institutional home for a national EHR system. As there is no general Data Protection Authority in Nepal, the diagnostic team was unable to confirm which government entity would have responsibility and oversight for ensuring protection of personal health data. On the technical side, IT implementation capacity within MoHP is limited, with only one IT engineer in the IT department. Given these limitations, coordination of a new digital initiative such as EHR implementation would seem to require additional staffing at the central level.

There are also other units within the MoHP that may be relevant to EHR implementation. One of these is the Quality Standards and Monitoring Division. Also, in response to COVID-19, the MoHP created an Information Management Unit (IMU) to design an integrated information management system to strengthen monitoring and decision making in the context of the pandemic. According to the DOHS Annual Report, the IMU comprises a “skill-mixed team of statisticians, demographers, epidemiologists, health workers, ICT experts and public health professionals,” and has been effective in monitoring the COVID-19 caseload.⁶¹ Its work will continue post-pandemic to support emergency response. There may be lessons emerging from this experience related to information sharing and data analytics that could help inform the design of a national EHR system. Also, the National Health Education, Information and Communication Centre (NHEICC) is responsible for public-facing health promotion, education and communication programs, which could be important during an eventual national EHR rollout.

⁶⁰ DoHS 2022.

⁶¹ DoHS 2021.

In terms of current practices and capacity at the provider level, the Nepal Health Facility Survey (2021) offers a wealth of data. Table 3 shows some information about quality assurance and management practices at different levels, including whether patient feedback mechanisms exist and whether management practices are supportive of quality healthcare delivery. The data are self-reported by the facilities. They suggest relatively widespread staff training activities, at least among hospitals, with 80 percent of federal and provincial level hospitals providing staff with some sort of in-service training. They also reveal a lack of emphasis on feedback from patients, with only 17 percent of federal or provincial hospitals and 3 percent of Basic Health Care Centers (BHCCs) having some system to solicit client opinion. There is also significant room to bolster quality assurance and management practices, which may suggest potential challenges in implementing a major new initiative such as an EHR system.

Table 3. Management practices and quality assurance

	Federal/Provincial-Level Hospitals	Local-level hospitals	Private Hospitals	PHCCs	BHCCs
Regular quality assurance activities and observed documentation of such activities*	43.3%	37.6%	18.9%	23.5%	23.0%
System for determining client opinion, procedure for reviewing client opinion, and report of a recent review of client opinion	16.5%	11.2%	14.1%	3.8%	2.5%
Staff management meeting at least once every 6 months and observed documentation of a recent meeting	68.1%	58.9%	38.2%	65.6%	50.9%
Routine staff training**	80.3%	85.7%	28.3%	83.6%	83.5%
Routine supportive management practices***	20.7%	43.7%	6.8%	41.5%	59.3%

Data source: MoHP, New ERA, and ICF 2022.

*Facility reports that it routinely carries out quality assurance activities and had documentation of a recent quality assurance activity.

**At least half of all interviewed providers reported that they had received some sort of structured in-service training in the last 24 months.

***Facility had an external supervisory visit during the 6 months before the survey and staff have received routine training and supervision.

[Government data management policies, procedures and data availability](#)

Building on the previous sections, which focused on the strategic and institutional context for health-related data, this section focuses on the implementation level, including the generation,

collection, processing, and use of data, as well as data availability and gaps. As discussed earlier, Nepal’s new Constitution and the devolution process it triggered generated coordination challenges among the three levels of government. Data sharing is one of these challenges, since different systems and mechanisms are used at different levels to collect, record and process information and data.

The National Integrated Health Information Management System (IHIMS) Roadmap (2021–2030)⁶² lays out the plan for Nepal’s health information system, with a focus on **interoperability**. The Roadmap builds on significant efforts that have gone into planning for interoperability, including a MEASURE Evaluation assessment in 2019 and a Health Metrics Network (HMN) self-assessment tool in 2020.⁶³ There are already HMIS guidelines and an HMIS Tool Book, but standard operating procedures have not been finalized, and the government does not have an explicit data sharing and data use strategy.⁶⁴ Meanwhile, in terms of nationally representative data, the government does conduct the National Health Facilities Survey, the National Demographic and Health Survey (NDHS), and the Nepal Multiple Indicator Cluster Survey (NMICS) on a regular schedule.

To further formalize data reporting, the government has developed a document outlining the “Minimum Standards and Guidelines for Reporting from Health Facilities”. Its primary purpose is to “ensure timely availability and use of quality data in planning, monitoring and decision making at different levels; particularly at the point of data generation”.⁶⁵ It sets out technical requirements in terms of physical infrastructure, electricity, software, connectivity, temperature control, fire safety, security, human resources, and maintenance. It also notes a preference for e-reporting software to be based on free and open-source standards, with user-friendly interfaces. The guidelines aim to improve data quality and standardization, while making it easier for health facilities to report. It also notes the need for a strong monitoring mechanism to ensure compliance with the guidelines. The diagnostic team was unable to ascertain to what extent these guidelines have been implemented or enforced.

Currently, all health facilities are required to report certain types of data in prescribed formats to their local governing authorities. The health facility registry⁶⁶ is available to all, and “has an interface that allows other information systems to connect to it in order to keep their individual lists of health facilities up to date and synchronized with the MoHP.”⁶⁷ Hospitals report monthly via DHIS2, and overall, the MEASURE Evaluation found that 90 percent of public health facilities and 53 percent of private facilities are represented in national HMIS information.⁶⁸ According to the 2021 DOHS Annual Report, in FY 2020/21 “all 753 local governments reported health facility-

⁶² Available in Nepali at <https://www.nhssp.org.np/E&A-Report.html>.

⁶³ HDC and UNICEF 2022, which includes much more detail – see for example Table 2 for the results of the MEASURE Evaluation.

⁶⁴ HDC and UNICEF 2022.

⁶⁵ MoHP undated. “Minimum Standards and Guideline for e-Reporting from Health Facilities.”

⁶⁶ Available at <https://nhfr.mohp.gov.np/>.

⁶⁷ DOHS 2021.

⁶⁸ HDC and UNICEF 2022.

based service statistics electronically to the national database (HMIS).⁶⁹ The 2021 Nepal Health Facility Survey also includes data showing HMIS reporting status, and indicates that for the country’s 27 federal and provincial level hospitals, compliance is fairly high. Of these facilities, 97 percent have a designated HMIS focal person, 95 percent have staff trained on DHIS2, 91 percent compile HMIS reports regularly, and 86 percent report online.⁷⁰

While significant steps have been taken to increase data availability and reporting, data utilization at the health facility level varies. Overall, “it is unclear what proportion of local and provincial health facilities have the capacity to utilize data being generated”⁷¹, and consultations for this assessment also indicated that the use of data for evidence-based decision making remains limited. An MoHP report on addressing equity in the data and digital realm noted that “the coverage and quality of hospital information systems needs improvement in many areas; complete service recording, compliance to standards, quality assurance, use of technology and data use”.⁷²

The 2021 Nepal Health Facility Survey provides additional insight regarding data quality and use at the facility level. Table 4 shows the share of providers that are complying with various recording standards. Compliance is generally much greater at public hospitals than private, and at hospitals relative to PHCCs and BHCCs. Still, even in hospitals, there are major gaps in data – for example, only 68 percent of providers wrote on client health cards for family planning services. Data privacy is an even bigger concern: privacy regarding family planning services was maintained only 23 percent of the time.

Table 4. Providers observed complying with service delivery standard protocols/guidelines for tracer services

	Federal/Provincial-Level Hospitals	Local-level hospitals	Private Hospitals	PHCCs	BHCCs
Provider wrote on the client health card (Antenatal care)	84.2%	81.1%	32.5%	67.2%	26.5%
Provider wrote on the client health card (IMNCI services*)	67.4%	81.6%	25.7%	53.6%	23.4%
Provider wrote on the client health card (family planning services)	67.5%	62.3%	1.4%	51.9%	26.1%
Privacy/confidentiality maintained (family planning services)**	23.1%	36.4%	1.0%	8.7%	3.6%

Data source: MOHP, New ERA, and ICF 2022.

*IMNCI - integrated management of neonatal and childhood illness

⁶⁹ DOHS 2021.

⁷⁰ MoHP, New ERA, and ICF 2022.

⁷¹ HDC and UNICEF 2022.

⁷² MoHP undated. “Data and Digital Priorities: Addressing Equity.”

**Privacy/confidentiality includes ensuring visual privacy, ensuring auditory privacy, and assuring the client orally of confidentiality.

Demand for EHRs at hospital level

There have been a number of attempts to implement EHRs at healthcare facilities in Nepal, but for the most part, these have been isolated efforts. Two exceptions are detailed in the section below on “EHR Experience in Nepal: Two Case Studies”. These two case studies describe implementations undertaken with the aim of informing an eventual nationwide system rollout. Interoperability with the broader national health information system was a key priority. To an extent, the experience of these two implementations has created space for a dialogue in Nepal around the need for such systems and their potential benefits. In general, however, although there is demand for EHRs from the government and from health facilities, EHRs are largely used by hospitals at present for billing purposes rather than to facilitate clinical care. It is also important to note that even in places where EHRs have been implemented, digital processes tend to coexist alongside manual steps for various reasons (for example, some departments of a facility use EHRs while others do not, or certain steps of a process have not been fully digitized).

Some examples of EHRs in Nepal include the following:

- Birendara Sainik Hospital, a hospital run by the Nepali Army, has an EHR system; Taplejung and Ilam Hospitals also have EHR systems
- Janakpur Medical Care and Janaki Academy have digitized service entry and discharge using EMR software from an Indian company; the current focus of system use is billing and revenue tracking
- Koshi Province has a smart hospital policy and has implemented electronic records in 7 hospitals across 14 districts; for example, Hamro Hospital uses the Medic Pro system, but not for patient care

As part of this readiness assessment, a series of consultations was held with a range of healthcare administrators, staff, and providers and other stakeholders in Nepal (see Annex 2 for complete list of persons and organizations consulted). The consultations aimed to shed light on the demand for and use of EHRs in Nepal, including main access channels, the type of data collected and used, challenges in using data, user capacity, and on the enabling environment as perceived by healthcare professionals.

Some recurrent themes emerged from the consultations, which suggested that both public and private facilities face some or all of these common challenges to EHR implementation:

1. **IT skills among healthcare providers and staff** – The challenge of staff skills and capacity was cited repeatedly by EHR stakeholders. Inadequate IT skills among healthcare workers pose a major challenge, especially given high employee turnover in health facilities, which means a need for continual (re)training. Often, doctors and other staff are not used to working extensively with a keyboard. Medical colleges and other healthcare training programs need to be better equipped to provide students with digital skills and

experience. As one case in point, Janaki Health Care adopted an EHR system last year, but it failed because data entry was too much of a burden for doctors and staff. Simplicity and user-friendliness of any system are essential.

2. **Stakeholder buy-in** – Successful EHR implementation requires that doctors and staff believe in the value of these systems. Some providers voice doubts about the priority that should be accorded to EHRs – they wonder how concretely it will benefit patients, and muse that other pressing needs also demand attention.
3. **Healthcare workload** – Doctors may see more than 100 patients per day, and therefore have very limited time per patient. In Nepal there is just about one physician per 1,000 people.⁷³ Some facilities have only one or several doctors, and in public hospitals there is no cap on the number of patients they may need to see per day. If use of EHRs takes longer or is more difficult, they may prefer handwritten records. If processes require that staff enter data multiple times, as is sometimes the case, using EHRs can become impractical. Feasibility may vary by department, with one person consulted saying that while EHRs may work for the inpatient department (or the pharmacy for example), it would be difficult to implement in the emergency department, as the daily workload and pace fluctuates. Ideally, EHRs would reduce the administrative burden on healthcare providers, rather than add to it.
4. **Infrastructure and sustainability** – IT infrastructure is inadequate for EHRs in many healthcare facilities. Moreover, EHR budgets must allow for ongoing system maintenance, backups, technical support, training, and other recurrent costs.
5. **Ownership and coordination** – One person consulted felt that there is a lack of a defined goal, vision, or policy to promote EHRs. There seems to be a need for more ownership and leadership around the EHR agenda, and a more cohesive approach to implementation. There is also a need for clear guidelines and standards to ensure that data is being recorded consistently and accurately across all healthcare departments and facilities.

Despite these challenges, most stakeholders consulted believe in the promise of EHRs to facilitate their work in various ways. The degree of buy-in varies, with one stakeholder calling EHRs “essential for us to improve our services” and another calling it “urgent”, while others are more ambivalent. According to a stakeholder from Nyaya Health Nepal, a senior executive from another facility visited Bayalpata Hospital, where an EHR is in place (see case study), and said “I want the exact same thing in my hospital.” One person consulted said that there is a need for more qualitative information on patients, which could be better collected with a digital system. Another mentioned that EHRs could help efforts to control the number of unnecessary duplicate medical tests doctors have to prescribe as records of previous tests are often not readily available or patients might have lost them. Patients are also increasingly demanding more effective and efficient care, which is putting pressure on providers. Some stakeholders see the potential for digital records to enable healthcare research. One person consulted noted that the use of EHRs for HMIS and DHIS entry has helped to improve data collection and reporting.

⁷³ See <https://data.worldbank.org/indicator/SH.MED.PHYS.ZS?locations=NP>.

Technology and skills infrastructure

Weaknesses in technical infrastructure and digital skills pose key challenges to nationwide EHR implementation. One literature review⁷⁴ of challenges and opportunities for digital health initiatives in Nepal identified inadequate infrastructure (electricity and Internet) and difficult geographical terrain as the most significant barriers, followed by IT skills shortages and enabling policies. This literature review covered health delivery-related interventions only (e.g., telehealth), rather than digital recordkeeping or administration, but the challenges identified would seem to apply equally for EHRs. This section looks first at physical infrastructure and then at digital skills of the healthcare workforce as they relate to a potential nationwide EHR rollout.

In terms of physical infrastructure, Nepal ranks among less technologically advanced countries worldwide. Approximately 38 percent of the population uses the Internet in Nepal, relative to a lower middle income country (LMIC) average of 45 percent, and there are 208 secure servers per 1 million inhabitants, compared to a LMIC average of 671 servers per million.⁷⁵ The 2022 update of the World Bank’s GovTech Maturity Index placed Nepal in the “C” category of countries (with “A” being the strongest and “D” being the weakest) in terms of overall progress toward a digitally-enabled public sector.⁷⁶ This indicates that there is “some focus” on digital transformation of government in Nepal.

Practical problems relevant to EHR implementation include inadequate bandwidth and network or electricity outages in healthcare facilities, as well as insufficient hardware (such as laptops). Many hospitals do not have reliable power or high-speed network access around the clock, and rural areas in particular⁷⁷ often have slow or unstable connections. As shown in Figure 4, there have been significant improvements in infrastructure and amenities since 2015, but still only 55 percent of health facilities nationwide have computers with Internet access. There is also a need for stronger digital infrastructure including storage servers and cloud storage, with adequate security measures and standard operating procedures, to facilitate data use for planning, monitoring and analysis at the national level.

One of the main government efforts to foster effective coordination around the digitalization process is the creation of the Nepal Government Integrated Data Center (GIDC). Located at the National Information Technology Center in Kathmandu, the GIDC aims to centralize and better coordinate digitalization efforts. It provides Internet and a reliable power supply to institutions including the Health Insurance Board (HIB) and the Health Management Information System (HMIS), and has also built a backup data center further south for emergencies.⁷⁸ When fully operational, the GIDC will provide data storage and sharing, as well as email and website hosting

⁷⁴ Parajuli, Bohara, and KC et al. 2022.

⁷⁵ 2020 World Development Indicators. See <https://databank.worldbank.org/source/world-development-indicators>.

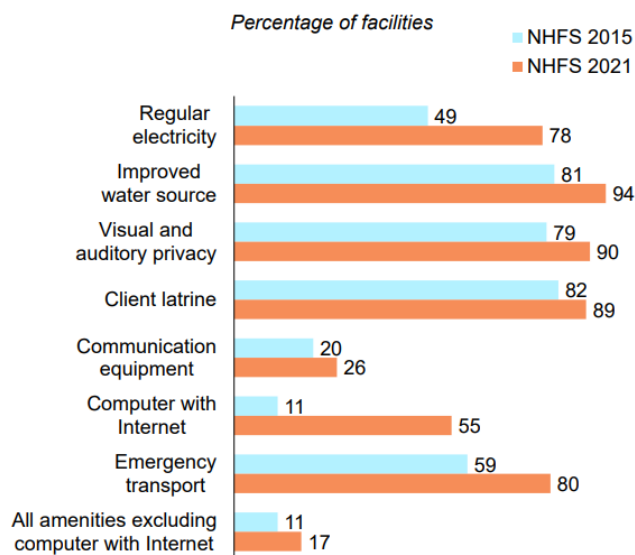
⁷⁶ See <https://www.worldbank.org/en/data/interactive/2022/10/21/govtech-maturity-index-gtmi-data-dashboard>.

⁷⁷ HDC and UNICEF 2022.

⁷⁸ GIZ 2018.

for all government agencies in Nepal. Regulations, policies, and procedures stemming from the GIDC will have an impact on the health sector and potentially over EHR systems.

Figure 4. Available amenities in health facilities



Source: Reproduced from MoHP, New ERA, and ICF 2022.

It is clear from the relevant literature and from the consultations undertaken for this diagnostic that skills shortages create a significant barrier to EHR implementation, as discussed in other sections of this report. Training and subsequent retention of qualified personnel is an ongoing challenge.⁷⁹ Worker shortages are clear from the 2021 National Health Facilities Survey, which includes data on the percentage of MoHP-sanctioned healthcare positions that are filled for different types of facilities. It shows that in federal and provincial-level hospitals, only 42 percent of physician positions are filled, and 78 percent of nursing positions are filled.⁸⁰

Newly trained doctors are more digitally savvy than their predecessors in general, but stakeholders articulated the urgent need to add a digital health course to the Bachelor of Medicine and Bachelor of Surgery (MBBS) curriculum. Kathmandu University plans to launch a Master’s program in Health Document Informatics.⁸¹ Agencies such as the National Health Training Centre can be crucial in building broad digital health capacity, as it is the key national institution for training healthcare workers, and the national health training network “co-ordinates seven Provincial Health Training Centers and 49 hospital-based clinical training sites throughout the country.”⁸²

⁷⁹ HDC and UNICEF 2022.

⁸⁰ MoHP, New ERA, and ICF 2022.

⁸¹ See <https://soe.ku.edu.np/program/hims>.

⁸² DoHS 2021.

The private sector may be able to help fill some technology and personnel gaps. One person consulted noted that Indian firms have provided EHRs in Nepal in the past, but several years ago new government regulations created barriers for international firms, so that now only one or two foreign companies operate in the sector. “Brain drain” is also a problem, with many highly skilled workers having left the country. This situation is not unique to Nepal, and there is potential as in other countries for the government to collaborate with the private sector (and with academia) to bridge the skills shortages in the health sector. Ongoing non-government initiatives, some of which have already been mentioned, provide an indication of the potential to tap into skills and experience from other sectors. Another example is the Integrated Rural Development Project / Nepal Technology Innovation Center (KU-IRDP/NTIC), a project funded by the government of the Republic of Korea and implemented by Kathmandu University. Through this project, the University is working to develop a “smart health platform” that would enable storage of health data in a standardized format and promote the use of data for research by interacting with existing digital health tools in Nepal.

EHR Experience in Nepal: Two Case Studies

Bahmni Implementation at Bayalpata Hospital⁸³

As part of the process of decentralization of healthcare in Nepal, the government has in some cases entered into public-private partnerships (PPPs) at the local level to strengthen frontline service delivery. Possible Health, an NGO, operates a district-level public teaching hospital, Bayalpata Hospital, in the remote rural district of Achham through a PPP with the MoHP. At Bayalpata Hospital, “mid-level providers, including paramedics, nurses and medical assistants, make up the hospital’s core clinical staff, supervised by staff physicians and general practitioner physicians”⁸⁴. Management uses a hub-and-spoke model, with the hospital at the center, clinics that offer primary and follow-up care closer to patients’ homes, and a cadre of community healthcare workers (CHWs) who provide home healthcare visits and conduct disease surveillance. Over the decade preceding 2016, Possible provided healthcare to more than 350,000 people at an average cost of less than \$20 per patient.⁸⁵

In 2014, in partnership with the government, Possible decided to implement an EHR system at Bayalpata Hospital, which at the time had 25 beds and saw up to 600 outpatients per day.⁸⁶ The implementation’s success demonstrated that EHRs can be leveraged effectively to support management and delivery of healthcare in resource-constrained environments. In selecting a system and designing the implementation, the following were priorities:^{87,88}

- Affordability, reliability, simplicity, and suitability for resource-poor settings, including offline work capability and accessibility via mobile app for off-site CHWs
- Scalability and modularity, so that it could ultimately be deployed at a national level
- Patient tracking and performance monitoring features
- Integration across sites of care (e.g., hospital inpatient, outpatient, clinic, emergency, laboratory, pharmacy, home visit)
- Usefulness for quality improvement, impact evaluation, and public health monitoring

The team selected the Bahmni system, developed by Thoughtworks,⁸⁹ as an EHR system for low-resource settings. Bahmni incorporates the widely-used OpenMRS system and other open source components (such as OpenERP) into a single integrated solution, and provides a simplified, user-friendly interface for basic OpenMRS functionality. The system was deployed at

⁸³ This case study summary largely draws on Raut, Yarbrough, and Singh et al., 2017; and Citrin, Thapa, and Nirola et al., 2018. Another writeup of the case is available at <https://www.improvingphc.org/nepal-information-technology>.

⁸⁴ Mehanni, Jha, and Kumar et al., 2019.

⁸⁵ Maru, Basnett, and Citrin, et al. 2016.

⁸⁶ Raut, Yarbrough, and Singh et al., 2017. An entirely new hospital complex was built in 2019, with significantly increased capacity (70 beds). See <https://sharondavisdesign.com/project/bayalpata-community-hospital-nepal/>.

⁸⁷ Raut, Yarbrough, and Singh et al., 2017.

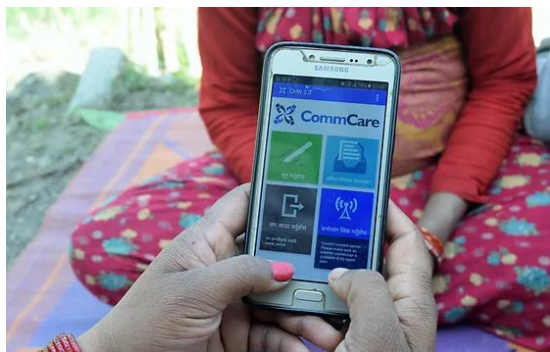
⁸⁸ Citrin, Thapa, and Nirola et al., 2018.

⁸⁹ See <https://www.bahmni.org/>.

Bayalpata Hospital in February 2015 after roughly eight months of planning and system customization, and subsequently completed a second rollout at its primary health center in Dolakha District. An IT team from India was hired to do the technical implementation at Bayalpata, working alongside Nepali staff, which was a successful partnership.

The implementation process at Bayalpata Hospital was carefully phased. It began with training for healthcare staff, then deployment to hospital departments in a phased manner so that each could receive dedicated support from the implementation team, and gradual adoption of functionality (starting with entering diagnoses, and progressing to other system features). Staff use the EHR in the “inpatient department for bed management, drug administration, laboratory orders and results review, progress notes documentation, and discharge planning and documentation” as well as in operating theaters.⁹⁰ Providers use Chromebooks to access the system because they are inexpensive and offer both full keyboard and touchscreen capabilities to facilitate data entry. CHWs use the mobile app CommCare, which is integrated with the EHR system, when visiting patients in their homes.⁹¹ Data from the EHR can be viewed alongside DHIS2 data in an integrated dashboard.⁹² Work has also been underway to integrate the EHR system with openIMIS, the software used by the government to operate its national health insurance system.⁹³

In addition to routine use by providers, the system has been studied by researchers. One research project aimed to enable continuous surveillance of infant mortality in the region.⁹⁴ Another study⁹⁵ compared gathering data on vital events (births) via a birth history census versus via the CommCare app by CHWs in the course of their daily work (“programmatic data”). It found that while neither method was perfect, the programmatic data collected using the app was more complete; the authors of the study attributed some of the relative success of the app to its built-in data validation methods, which help reduce errors in data entry.



⁹⁰ Raut, Yarbrough, and Singh et al., 2017.

⁹¹ Citrin, Thapa, and Nirola et al., 2018.

⁹² Citrin, Thapa, and Nirola et al., 2018.

⁹³ Further investigation would be needed to determine if this is now operational. The idea was to facilitate processing of insurance claims and reimbursing providers. See <https://www.improvingphc.org/nepal-information-technology>.

⁹⁴ Bangura, Ozonoff, and Citrin, et al., 2016.

⁹⁵ Choudhury, Tiwari, and Wu, et al., 2022.

Image source: <https://www.nyayahealthnepal.org/what-we-do>

Three months after implementation, focus groups and surveys were conducted with three user categories – doctors, mid-level providers, and nurses. Overall, the participants were quite satisfied with the system. On a scale of one to ten, the average response to the statement “how useful is the EHR for you right now?” was 7.9, and the average response to “The EHR is good for Bayalpata Hospital” was 9.4.⁹⁶ The concerns that surfaced included:

- The computer is distracting during patient-provider interactions
- When electricity goes out, staff have to re-enter data
- Lack of clarity on who is responsible for documentation
- System downtime caused by difficulty of keeping server room cool enough in summer, which requires ongoing infrastructure investments and a great deal of patience from system users

The following passage provides more insight into the strong emphasis on stakeholder engagement throughout the implementation process:

“Possible's Community Advisory Board (CAB), comprised of local community members and public officials from the districts where we work... convened bi-annually to provide independent advice and critical feedback. Secondly, we engaged district level administrators and political leaders during the development and deployment of the system, which was essential to hearing and addressing their concerns along the way. Thirdly, CHWs have continued to serve as the drivers of new ideas and adaptive thinking, critically informing the PPP around what is working well, and what needs to be changed... Fourthly, Possible has engaged with the central (federal) level government, including supporting the creation of both an eHealth Unit and an Implementation Research Unit within the MoH.”⁹⁷

In a 2019 quality improvement initiative at Bayalpata Hospital, a team designed a way to improve treatment of chronic obstructive pulmonary disease (COPD); this effort is documented in detail in Mehanni, Jha, and Kumar et al. (2019). For this initiative, the team used a feature within the EHR system to create a custom template for COPD diagnoses, and used this as a mechanism to increase adherence to evidence-based practices – specifically, prescribing an oral corticosteroid for COPD. Data analysis and EHR use were an integral part of the plan. Guided by a systems thinking approach, “an overarching aim of the initiative was to demonstrate that small-scale quality improvement initiatives can serve as powerful tools to catalyze systems-level improvements thereby ensuring more effective, higher quality healthcare delivery”.⁹⁸

Several characteristics of Bayalpata Hospital helped make the COPD initiative a success. For example, “multidisciplinary continuing medical education lectures are held daily, which provided

⁹⁶ Raut, Yarbrough, and Singh et al., 2017.

⁹⁷ Citrin, Thapa, and Nirola et al., 2018.

⁹⁸ Mehanni, Jha, and Kumar et al., 2019.

a dedicated time and space to deliver quality improvement-related training and feedback”; there were also a range of other factors related to the high quality of leadership and management at the hospital that facilitated implementation. The results measure, use of oral corticosteroids, increased from a starting point of 14 percent, to more than 60 percent after seven months, and other positive system-level changes were observed.

There are also some key lessons learned from the COPD initiative. The authors of the study note that in retrospect the project design would have benefited from integration with the CHW program, to better link the initiative with home-based and follow-up care. Moreover, uptake of the EHR template itself remained lower than expected. As the authors of the study explain:

“We had not fully appreciated the barriers to EHR template uptake during project design and would have made other considerations in hindsight. Specifically, high staff turnover, English language formatting and low prior exposure to EHRs were likely key drivers of low EHR template uptake. New providers were continuously learning how to use the EHR and would often leave prior to or just after mastery. As documented elsewhere in Nepal, our mid-level providers reported that the template helped with diagnostic accuracy, but it did not address the nuances of patient presentations and was often time consuming. Limited EHR team capacity prohibited dynamic, real-time EHR modifications to meet these provider needs, which led to informal workarounds, rather than systematic EHR changes, which in turn limited the scope of this EHR-based quality improvement initiative. Thus, the second lesson is that the use of technology requires commensurate investments around functionality and system integration.”⁹⁹

Overall, implementation of the Bahmni system seems to have improved health record completeness, and has enabled data to be used for public health monitoring and service delivery improvement. At the same time, the success is qualified, with Citrin, Thapa, and Nirola et al. (2018) noting that “the automated, digital integration of community-level and facility-based EHR data has not been fully achieved”.¹⁰⁰ This EHR proof-of-concept caught the attention of national authorities at the MoHP, who were interested in scaling the idea to the national level. However, many of the key factors that contributed to the success of the implementation may be somewhat unique to these specific health facilities, such as the management approach and institutional strengths, which seem to have been considerable.¹⁰¹ It would be important to determine, for potential implementations elsewhere, the extent to which the preconditions are comparable.

The implementation suggests the following lessons learned:¹⁰²

- Local leadership, ownership, and capacity building have been key

⁹⁹ Mehanni, Jha, and Kumar et al., 2019.

¹⁰⁰ Citrin, Thapa, and Nirola et al., 2018.

¹⁰¹ For additional context, see Maru, Basnett, and Citrin, et al. 2016.

¹⁰² These primarily draw on Raut, Yarbrough, and Singh et al., 2017; and Citrin, Thapa, and Nirola et al., 2018.

- Significant attention to training was essential to system uptake and ongoing training is important due to staff turnover
- Change management was handled skillfully: a staff physician was selected to “coordinate trainings, make announcements on system changes, and gather feedback and suggestions from the care delivery”¹⁰³, and having this champion within the clinical staff was very helpful; also, an interdepartmental team at the hospital was formed to meet quarterly to discuss ways to improve the system
- Results, and stakeholder feedback on the design, implementation, and monitoring of the system, have guided ongoing iterative improvements; this approach started with the initial rollout and has continued with subsequent initiatives
- Stakeholders have deep concerns about data security and privacy risks
- Attention to data quality has been important via daily “data quality sweeps” and constant monitoring of EMR use

Bahmni Implementation at Trishuli District Hospital

Building on the experience of Bahmni implementation in Bayalpata Hospital and in Dolakha District, in 2018 MoHP decided to introduce the system at a public facility, Trishuli District Hospital.¹⁰⁴ Trishuli Hospital is located in the Nuwakot District of Bagmati Province (the province that includes Kathmandu), and is a 50-bed provincial hospital that was devastated by the 2015 earthquake. GIZ and KOICA provided funds for rebuilding, and along with the Global Fund to Fight AIDS, Tuberculosis and Malaria, also supported the introduction of Bahmni. The Bahmni implementation was intended to serve as a pilot that would inform an eventual nationwide rollout.

Bahmni has now enabled digital management of patient registration and record keeping at Trishuli Hospital. Data are backed up to servers off-site, and if patients lose or damage their hospital cards, they can easily be reprinted. Also, “the EHR system links data on the medicines coming into and out of the pharmacy with the number and type of services provided to clients as well as reported stock-outs of medicines, shining a light on inefficient practices and possible malpractice”.¹⁰⁵

When the implementation team customized Bahmni for Trishuli Hospital’s needs, it ensured compliance with the national interoperability plan, using data from the registries. This commitment to interoperability means that monthly aggregate service delivery statistics can be compiled by the EHR system and sent electronically to DHIS2, a process that was previously done manually.¹⁰⁶ There are also custom dashboards that display data to be used for decision making. The introduction of Bahmni “quickly highlighted gaps in management decision-making, leading

¹⁰³ Raut, Yarbrough, and Singh et al., 2017.

¹⁰⁴ See <https://trishulihospital.gov.np/>.

¹⁰⁵ GIZ 2018.

¹⁰⁶ GIZ 2018.

to the introduction of a new (non-clinical) hospital manager, trained in the use of the information and analysis provided by the digital applications”.¹⁰⁷

The Nepal Health Research Council conducted a study of the Bahmni implementation at Trishuli Hospital in 2018, and found that overall, the system had improved data quality, the use of data for decision making, and hospital efficiency.¹⁰⁸ The study used qualitative methods (key informant interviews and focus group discussions, plus review of documentation at the hospital) as well as a quantitative survey of the staff involved in the implementation. According to this study, some sort of digital recordkeeping had already been partially implemented in three hospital departments prior to Bahmni. After a phased Bahmni rollout (including significant attention to staff training), there was full implementation of electronic recordkeeping in two departments (registration/billing and outpatient), partial implementation in three departments (inpatient, emergency, and laboratory), and four departments still relied on paper-based methods. The study found that the time needed to prepare the daily summary of patients and to report to the HMIS had significantly decreased as a result of the new system, and that data was increasingly used in decision making. It also found a “drastic reduction in the percentage of missing information in patient’s records on ethnicity, age, gender, district, VDC/Municipality and ward”, but noted that “the proportion of missing information seems to have increased in the case of other variables like... provisional diagnosis”.¹⁰⁹

The study identified a number of factors that had contributed positively to the implementation, as well as factors that posed key challenges, and noted that many study participants had serious concerns about the long-term sustainability of the system. Positive factors included good teamwork and willingness among the staff to embrace the new system, and strong government commitment to making it work. Challenges included a high level of staff turnover, lack of IT skills among staff, infrastructure issues (power outages, slow server, inadequate system backup), and insufficient technical support for repair and maintenance. The high volume of patients, particularly during disasters, made it difficult to keep up with use of the system, according to staff. Study participants suggested that it would be helpful to create a Nepali language version of the system (it is currently in English). As in other EHR implementations around the world, healthcare staff also expressed the concern that use of the system during patient interactions is distracting and results in less focused attention on the patient. The lack of a permanent IT officer at the hospital was a key sustainability concern; some study participants expressed uncertainty about what would happen once the external project funding ended.

Consultations in 2023 as part of this EHR diagnostic assessment corroborated the sustainability concerns expressed by hospital staff at the time of implementation, and the system does not seem to be fully utilized at the moment. In the several years since the system was established, parallel paper-based and electronic processes have persisted, according to stakeholders consulted for this assessment. While the system has been useful in streamlining billing processes,

¹⁰⁷ GIZ 2018.

¹⁰⁸ NHRC 2018.

¹⁰⁹ NHRC 2018.

the desired benefits in terms of improving the quality of healthcare delivery have been more difficult to achieve. The rollout may have benefited from additional technical support, change management and capacity building. Stakeholders consulted emphasized the need for sustainable technical and change management support to ensure EHRs are successfully implemented and become a critical part of the hospital, and that hospital staff see EHRs as a tool that can help them conduct their duties more easily and improve the overall experience of patients.



Electronic patient registration at Trishuli Hospital.

Image source: <https://www.giz.de/en/downloads/giz2018-en-digitalising-nepals-health-sector.pdf>

Assessment of Nepal's Readiness to Implement EHRs

The Government of Nepal has taken significant steps to lay the groundwork for a nationwide EHR system. It has laid out a vision for digitally-enabled healthcare to support its UHC goal, including via the Digital Nepal Framework and the National eHealth Strategy. Key policies and plans, such as a cybersecurity plan and Privacy Act, have been adopted. The government is committed to addressing infrastructure challenges by connecting rural health facilities to high-speed Internet, and has built a primary and backup data center and a CERT. At the implementation level, the government has adopted a system interoperability framework to guide the development of digital health information systems so that they can “talk to” each other, to enable providers to access patients’ records regardless of location, and to facilitate the analytical use of data. There have been impressive strides in digital health data reporting. The government has invested in a number of health information systems and in strengthening health data reporting for use in policymaking and public health management.

However, weaknesses in the digital health ecosystem mean that continued investment in the enabling environment will be critical. Institutionally, the ongoing process of decentralization makes coordination of EHRs across jurisdictions more difficult, and infrastructure and human resource capacity issues pose key challenges. The quality and completeness of patient health records under existing data management processes in hospitals are lacking in some cases, and digitization is not necessarily a panacea. Also, despite the Privacy Act and other steps taken, the legal framework for data protection still needs to be strengthened, and privacy protections at the health facility level are a significant concern. Cybersecurity is also a remaining issue (work on this is underway via the Digital Nepal Acceleration Project). Evidence of demand for EHRs from healthcare providers and patients is mixed, with some stakeholders voicing enthusiastic support, and others ambivalent or opposed to the idea. Overall, EHR readiness seems to be significantly higher at some health facilities compared to others.

Clear leadership and policy-setting around EHRs from a high level of government would create a more cohesive national approach, and help to build awareness and buy-in among stakeholders at all levels. The strategic framework needs to be fleshed out with implementation details, especially because at present private companies and facilities are often taking ad-hoc steps. As noted in an MoHP report, “sporadic and siloed development [of EHRs is] causing compromise to standards and interoperability basics”.¹¹⁰ There is a need for stronger coordination and partnership with the private sector to more effectively leverage its technology and skills, and for a stronger focus on engagement of key EHR stakeholders in general, such as working with healthcare providers to analyze pros and cons of different options going forward. Some persons consulted for this assessment also voiced concerns about instability in government, and the idea that leadership changes can prompt changes in plans, potentially slowing momentum toward an ambitious objective like an EHR system.

¹¹⁰ MoHP undated. “Data and Digital Priorities: Addressing Equity.”

The two EHR case studies (Bayalpata Hospital and Trishuli District Hospital) provide valuable insights into key factors for success. At Trishuli, the emphasis on end-to-end support does not seem to have been as strong. It appears that differences in the initial environment related to facility management and staffing, which potentially impacted the degree of local ownership and commitment, and differences in the level of investment in support and training, contributed to differential outcomes, with the former having been more successful. These cases suggest the need for significant and ongoing investment for system use to be sustainable (and to continue to increase its impact by becoming increasingly embedded in additional aspects of patient care and healthcare management) after the initial implementation. A strong focus on quality improvement also seems to help shape the EHR implementation process.

Lessons from other digital health undertakings can also provide some lessons. For example, building a culture of data sharing and reuse may take time. Nepal began using OpenIMIS in 2017 with support from GIZ. Certain stakeholders in public and private hospitals were reluctant to share data, however, which meant that an API was not implemented and the overall implementation suffered. Also, implementation of the National Health Insurance Scheme has been slow and has faced many challenges, including lack of supportive institutional arrangements in the HIB, lack of staff capacity, and problems identifying the poorest households.

Finally, it is worth noting that a significant part of the EHR value proposition is based on the idea of consistent use of EHRs across the care continuum. If implemented only in the hospital setting, the impact of EHRs will be limited to some extent because they will not facilitate preventive or follow-up care at clinics or via CHWs. Once feasible, expansion of the EHR system to other levels of healthcare should be considered, but in the meantime, it is important to temper expectations about their potential impact on managing patient health – although an EHR could perhaps help with continuity of care via automated reminders to providers within the hospital system, prompting them to follow up with a patient.

Binding constraints analysis

The assessment suggests that while many preconditions for EHRs are in place in Nepal, personnel capacity may be the single most significant binding constraint to an implementation that succeeds in positively impacting health outcomes. This includes weaknesses in the digital skills base among healthcare workers, as well as their heavy workload, which limits time for adopting new practices for data recording and use. Addressing this constraint will require significant investment in stakeholder engagement to ensure that new processes are as simple and user-friendly as possible, and that healthcare staff feel that EHRs enhance and facilitate their work rather than creating a new burden. Recruitment and hiring of additional staff (including IT support staff within MoHP and at the facility level) will likely be necessary.

Implementing a national EHR system is a complex undertaking involving many challenges that need to be met with clear and detailed planning, sufficient resources, and stakeholder engagement. Strong leadership will be required not only at the national level, to ensure a

coordinated approach, but also at the level of each individual healthcare facility adopting EHRs. Health administrators will need to work with their staff to build collective will and buy-in to make EHRs work for them and for their patients. This means designing a carefully phased approach to implementation, creating and sticking with a training and IT support plan, and holding regular discussions about progress, challenges, and impact to continue to refine business processes and examine how best to leverage the system to achieve tangible impact on health delivery.

Proposed Action Plan

Based on this assessment, the following EHR Action Plan is proposed for consideration:

1. Create an institutional home in MoHP for the national EHR system

- Identify an individual to be the national EHR champion, who can provide strong leadership on the rollout and also build awareness and support for EHRs within MoHP and federal/provincial hospitals
- Confirm which MoHP department (existing or new) the EHR champion will lead, and that will be the EHR institutional home; ensure that it has adequate staff capacity both from a managerial and technical standpoint, and give it a clear mandate for EHR leadership (both on paper, via an official declaration of policy, and in terms of support from the highest level of government)
- Leverage the existing HIS/M&E technical working group to serve as a multistakeholder forum to advance EHR implementation, and invite civil society representatives to participate in this and any other relevant digital health coordination mechanisms

2. Define the scope of the envisioned national EHR system

- Prepare an EHR strategy that clearly defines the strategic objective and theory of change, scope and limitations of the proposed national EHR system; defines the short and medium term outputs; and defines the desired outcomes
- Adopt a digital health information policy and data management plan that addresses patient rights and data protection, data collection, data sharing, and use of data for analytics and decision making; the plan should include clear EHR data guidelines and standards to ensure that data is recorded consistently across facilities and departments
- Prepare a budget and workplan for the EHR pilot phase
- Develop a monitoring and evaluation framework for EHR pilots with provisions for assessing the following, with the understanding that it will take time to fully leverage the data and all the system's capabilities:
 - System use (are records complete, up to date, accurate, etc.)
 - Patient rights (data privacy protection), gender equity concerns, and social inclusion
 - The degree to which EHR data is actually used to improve healthcare delivery at the point of care; data analytics at the healthcare facility level to improve management; and data use at the regional/national level to inform health policy, monitoring, and decision making

3. Adopt minimum Technical Standards for EHRs: See Annex 5 for relevant international standards

4. Start with one to three pilot hospitals rather than implementation across the two provinces as currently envisioned, and select pilot location(s) based on readiness, using criteria such as:

- Commitment to health informatics as demonstrated by current level and quality of data recordkeeping and data reporting (DHIS2)
- Technical infrastructure, with a preference for well-connected urban hospitals over rural hospitals
- Commitment of hospital management to EHRs, and willingness to provide strong leadership and be personally involved in every step of implementation
- Digital skills/capacity of staff
- Potential partnerships, such as with private firms or with universities that can help with technical troubleshooting, process design, or using data in health delivery

5. For each pilot hospital:

- Identify the EHR leader from among hospital management
- Establish a technical working group with representatives from all key functions/departments to oversee the implementation, starting with a facility-specific Technical and Data Assessment – this would be an assessment of technical/infrastructure availability and needs, and an inventory of current data recording, data use, and data protection practices in the hospital
- Develop a change management plan including business process reengineering, stakeholder engagement, and training
- Develop a communication plan for patients and the broader community explaining patients’ rights regarding data privacy, and explaining EHRs and their benefits in healthcare delivery; design stakeholder engagement and feedback mechanisms for patients (some of this can be coordinated at the national level to avoid duplication of effort – e.g., patient education materials)
- Invest in the pilots to experiment with business process reengineering and to establish a proof of concept for public hospitals, building on past experiences, and then expand EHR support from there by demonstrating tangible impact on healthcare delivery

6. Prioritize user-friendliness and simplicity, and patient protections and rights, in software design and processes

- Start with the Bahmni system already in use in Nepal and customize it for the pilot hospital(s), engaging users meaningfully in the design and testing process (can include surveys of healthcare workers, surveys of patients, focus groups and interviews, and moderated usability testing); also include users and stakeholders from the two Bahmni case studies to incorporate their lessons learned on usability
- Ensure compatibility with the OpenHIE and relevant registries that have already been developed
- Ensure attention to patient rights and data privacy, including differential concerns in data collection, recording and use related to patient identity (including gender, persons living with disabilities or sensitive medical conditions, vulnerable groups, etc.)
- Create simple and useful visualizations (dashboards)
- Translate system into Nepali
- Prepare staff training materials

- Ensure that user testing and engagement continues throughout implementation and as part of monitoring and evaluation

7. Invest in capacity and the enabling environment

- Build awareness and understanding of the benefits of EHRs among leadership and stakeholders within the Government of Nepal, and the health sector more generally
- Strengthen digital health implementation capacity within MoHP
- Establish digital health training programs at the university level and within the National Health Training Centre
- Create a PPP model to strengthen partnership and coordination with the private sector
- Consider undertaking a cybersecurity/data privacy and protection assessment (the World Bank’s Digital Development practice has piloted a tool), perhaps under the umbrella of the Digital Nepal Acceleration Project
- Conduct a more detailed review of the data privacy and protection framework and develop concrete steps to align with international best practices

8. Increase emphasis on data quality and data analytics

- Map linkages between EHR data and the national HMIS, identify gaps in current data reporting and clarify plans for data reporting via EHRs, informed by the prior Bahmni pilot experiences
- Identify data users in MoHP and elsewhere in the federal and subnational government, and involve them in discussions of data needs and usage
- Investigate the potential for a long-term partnership with an academic institution(s) to develop health informatics and relevant courses, develop a pipeline of talent, and strengthen the use of data and work on data-informed health policy; investigate possible collaboration on this with the Digital Nepal Acceleration Project (P176543)¹¹¹

9. Regarding preparation of the World Bank Nepal Quality Health Systems PforR, an additional DLI is proposed, as follows:

Proposed additional DLI	Responsibility for achieving results	Implementing agencies	
		National	PLGs
Adopt a digital health information policy and data management plan including data sharing, data use, patient rights and data protections	MoHP	- MoHP	- Provincial Health Directorate - District Health Office / District

¹¹¹ Per the Project Document, it plans to “undertake a study to define a roadmap to develop the [digital] startup ecosystem in Nepal; and implement a pilot program in partnership with a university, training center, or other similar organizations”

(yes/no) [note: this would incorporate existing DLR 2.1, "EMR standards adopted by MoHP"]			Public Health Office - Hospitals
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Annexes

Annex 1. Resources consulted in preparation of the diagnostic questionnaire for EHRs in Nepal

- Draft data assessment methodology created under the “Mainstreaming a Rights-Based Approach to Information and Data in Bank operations” Program
- [Open Data Readiness Assessment \(ODRA\) questionnaire](#)
- [WB Digital Health Assessment Toolkit Guide](#)
- [Health Information Systems Interoperability Maturity Toolkit: Assessment Tool](#)
- [Global Digital Health Index Indicator Guide](#)
- [Measurement of Access to and Use of ICTs in the Health Sector: Questionnaire](#)
- [EHR Manual for Developing Countries](#)

Annex 2. Persons and organizations consulted

Dr. Shankar Prasad Adhikari, Director, Hamro Hospital, Biratagar, Koshi Province; and General Secretariat, Association of Private Health Institute, Koshi Province

SP Kalune, Executive Director, Nyaya Health Nepal, Kathmandu

Aarju Khanal, Medical Record Department, HOD, Birat Medical College

Dr. Raman Mishra, Janaki Medical Care, Janakpur

Yubraj Parajuli, Chief Business Officer, Danfe Care

Sanjaya Poudel, Director, SunyaEk, Kathmandu

Dr. Ankur Sah, Rector, Madesh Institute of Health Science, Janakpur

Sujit Kumar Sah, M&E Officer, ADRA Nepal, Lalitpur

Sabitri Sapkota, MPH, PhD, Executive Director, Possible Health

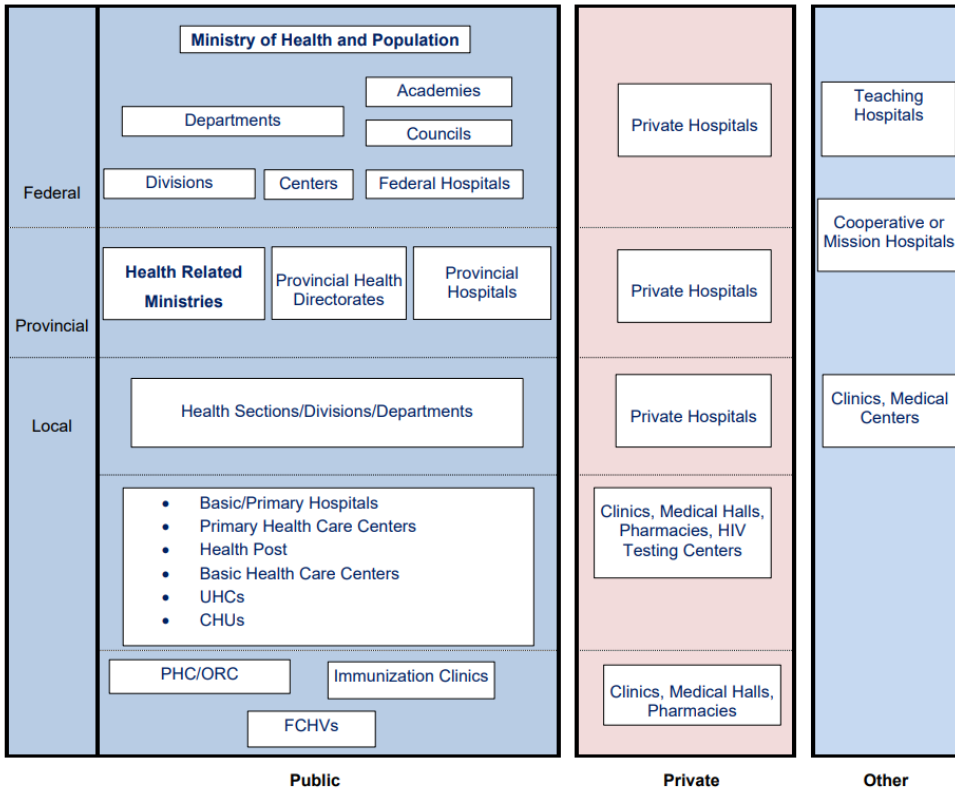
Aastha Thapa, Nursing Officer, Public Health Department, Social Development Ministry, Province One

Dr. Madan Upadhya, Chief, Quality Standards and Monitoring Division, MOHP, Kathmandu

Harish Chandra Yadav, Managing Director, Janakpur Medical Care

Dr. Pramod Kumar Yadav, Medical Director, Madesh Provincial Hospital, Janakpur

Annex 3. Health service delivery organizational structure in Nepal



Source: MoHP, New ERA, and ICF 2022.

Annex 4. Guiding principles and strategic pillars – Excerpt from the National eHealth Strategy

The National eHealth Strategy is guided by the following four overarching principles:

1. Respects people's right to health information
2. Ensures that e-Health approaches and solutions are centered around: population at large, health clients, service providers and health workers, and public health managers and decision makers.
3. Fosters collaboration and partnership with state and non-state actors
4. Strives for cost-effective, standardized, efficient, interoperable and user-friendly e-Health solutions and applications

The National eHealth Strategy stands on the following three strategic pillars:

1. **GOVERNANCE AND FOUNDATION** This pillar covers basic infrastructure required to enable the effective electronic sharing of information across the health sector which includes standards and interoperability, legislation, policy and compliance, leadership, coordination mechanism to ensure successful implementation of e-Health initiatives. This also includes investments for the different eHealth initiatives.
2. **CHANGE AND ADOPTION (HUMAN RESOURCE AND CAPACITY)** This pillar covers actions that need to be carried out to encourage and enable participants in the healthcare system to adopt e-Health solutions and change their work practices to be able to use these solutions effectively.
3. **SOLUTIONS (SERVICES AND APPLICATIONS)** This pillar covers ICT systems and tools to address the high-priority needs of population, health clients, service providers and health workforce, and healthcare managers and decision makers.

Source: Excerpted from MoHP 2017.

Annex 5: EHR international standards

Every EHR system must be capable of capturing, storing, retrieving, and exchanging data and information related to a patient's medical history. This includes information in various formats such as images, clinical codes and data. Given the scope and complexity of these functions, standards to ensure that they are fulfilled effectively can be grouped into the following categories of standards¹¹²: health records, data ownership, data privacy and security, and infrastructure required. Each of these areas can be then subdivided into more specific issues, as described below.

1.- Health Record Standards:

1.1.- Identification and Demographic Information of Patients: these standards focus on basic information about patients, such as national ID number and photo, name, gender, age, and so on.

International standard:

- ISO/TS 22220:2011, Health Informatics - Identification of Subjects Health Care

1.2.- Architecture Requirements and Functional Specifications: the records themselves must be designed in a way that eases access, and guarantees validity, accuracy and timeliness, for practitioners relying on them, while meeting legal and ethical requirements.

International standards:

- ISO 18308:2011, Health Informatics - Requirements for an Electronic Health Record Architecture
- ISO/HL7 10781:2015, Health Informatics - HL7 Electronic Health Records System Functional Model Release 2

1.3.- Logical Information Reference and Structural Composition: This refers to the need to have common semantic and syntactic structures, otherwise confusion may arise.

International standards:

- ISO 13940, Health Informatics - System of Concepts to Support Continuity of Care
- ISO 13606, Health Informatics - Electronic Health Record Communication
- OpenEHR Foundation Models

1.4.- Medical Terminology and Coding Standards: in addition to having a common semantic and syntactic structure, it is important that EHRs use the same medical terminology to avoid confusion, as this may vary from region to region.

International Standards:

- SNOMED CT, for primary terminology

¹¹² See India's National Resource Center for EHR Standards at <https://www.nrces.in/standards/ehr-standards-for-india#introduction>.

- Logical Observation Identifiers Names and Codes (LOINC) by the Regenstrief Institute, for test, measuring and observation codes
- WHO Family of International Classifications, for coding diseases, functioning, disability and health, health interventions, and diseases for oncology

1.5.- Data Standards for Image, Multimedia, Waveform and Document: all EHRs must include data in various formats, thus it is key to have standards for these formats.

International Standards:

- NEMA Digital Imaging and Communications in Medicine, for multimedia formats, including images, audio and video
- ISO/IEC 14496, Coding of Audiovisual Objects, for multimedia formats
- ISO 19005-2, Document Management - Electronic Document File Format for Long-term Preservation

1.6.- Data Exchange Standards: one of the main advantages of EHRs is their ability to be accessed at different healthcare points. However, in order for this to be possible data must have certain characteristics that allow it to be exchanged.

International Standards:

- ANSI/HL7 V.2.8.2.2015 - this is an application protocol for electronic data exchange in healthcare environments
- ASTM/HL7 CCD Release 1, for summary records exchange
- ISO 13606-5:2010, Health Informatics - Electronic Health Record Communication
- NEMA DICOM PS3.0-2015, for images and audiovisual data

Other areas that are relevant to health record standards, yet for which there are no international standards at the moment, include discharge and treatment formats, e-prescriptions, personal health and medical devices interfacing. In this case, policy makers in the health sector, together with other key stakeholders, can develop country specific standards as needed.

2.- Data Ownership Standards

With regards to data ownership, as well as data privacy and security and infrastructure, there are very limited international standards. However, these areas remain critical for well-functioning EHR systems. Furthermore, oftentimes specific country regulatory frameworks must be taken into account, for example with respect to data privacy and security legislation, tech regulations for governments, and so on. The case of India and its EHR Standards provides an illustration of how governments can tackle this lack of international standards.

2.1.- Ethical, Legal and Social Issues: these are linked to privacy, who gives authorization to access, and who can access EHRs. India established the following guidelines.

- Privacy refers to authorization by the owner of the data (patient)
- Security must include private and public encryption methods
- Users of EHRs (healthcare practitioners and institutions) must confirm their identity to have access to information

2.2.- Protected Health Information: it refers to information that can identify the patient and sensitive information. The government of India determined the following as Protected Health Information based on their own regulations.

- Passwords
- Financial information
- Physical, physiological or mental health conditions
- Sexual orientation
- Medical records and history
- Biometric information

2.3.- Data Ownership of Health Records: these are guidelines provided by the government of India regarding data ownership.

- The patient is the owner of the information in their EHR
- Healthcare providers hold this information on behalf of the patient
- Healthcare providers own the media for storage and exchange of EHRs

2.4.- Data Access and Confidentiality: in India, the EHR standards also provide guidance on the conditions under which EHRs can be accessed and what practitioners can do with said information.

- There must be regulations to guarantee confidentiality of data in EHRs, and the patient should have control over these
- Patients can access their EHR at their convenience, and they can make amends only to correct errors
- Patients can restrict access to and disclosure of personal identifiers (personal health information)
- Data will be available to healthcare providers as required on demand

2.5.- Disclosure of protected and sensitive information: as this information in EHRs might be relevant in certain situations, these are the guides in India for disclosure:

- When it is relevant for treatment, payments or other healthcare operations. This must be disclosed with consent from patients.

- For national priority activities, such as communicable and notifiable diseases, EHRs can be disclosed without consent, as long as the data is anonymized; or in court-mandated instances.

2.6.- Responsibilities of a Healthcare Provider: as the holders of EHR data on behalf of patients, providers must ensure the following:

- Protect and secure EHRs
- Remove patient identifier information when required
- Inform patients about policies related to their health information
- Develop and guarantee the implementation of internal privacy policies, and provide training to staff on these

2.7.- Privileges of Patients or Personal Representatives: with regards to the information held by providers - patients, as established in the case of India, can demand the following:

- A copy of their medical records
- The registry of instance where their EHR was shared with other stakeholders
- That the provider withholds specific information in their EHRs temporarily or permanently from other stakeholders

2.8.- Denial of Information: there are cases where providers can deny information requests. These cases are the following:

- Information obtained anonymously under a promise of confidentiality
- Psychotherapy notes
- Information compiled for civil, criminal or administrative action

2.9.- Records Preservation: this are the guidelines in India:

- Records must be preserved during the lifespan of the patient
- Upon the passing of a patient, providers are strongly encouraged to keep the records indefinitely, yet under an inactive status

3.- Data Privacy and Security Standards

3.1.- Security Technical Standards: these refer to the control of access to EHRs and the personal information contained in them, including the technological means to safeguard said access and information. The following standards focus on diverse aspects of access control, including authentication of users, automatic log-off, access control and privileges, audits, integrity, encryption, and digital certificates.

International Standards:

- ISO/TS 14441:2013, Health Informatics - Security and Privacy Requirements of EHR Systems for Use in Conformity Assessment

- ISO 27799, Health Informatics - Information Security in Health
- ISO 22600:2014, Health Informatics - Privilege Management and Access Control.
- ISO 27789:2013, Health Informatics - Audit Trails for EHRs
- ISO 17090, Health Informatics - Public Key Infrastructure
- HTTPS, SSL v3.0 and TLS v1.2 standards for secure transmission

3.2.- Administrative Safeguard Standards: this refers to administrative measures that providers must develop to ensure the security of data and information, and includes the following aspects:

- Security management processes to prevent violations
- Assign responsibilities regarding security (i.e., a security officer)
- Clearly determine access privileges to personal health information and who grants these privileges
- Training and contingency plans in case of violations

3.3.- Physical Safeguard Standards: this focuses on the preservation and maintenance of physical equipment used to store, access and exchange EHRs. Recommendations by the government of India include the following:

- Limit accessibility to facilities where EHRs are stored
- Control of access at workstations to deter unauthorized users
- Control over movement of equipment that contains EHRs

4.- Infrastructure Standards

The Government of India also included standards for the equipment required for a well-functioning EHR, including hardware, networks, and software.

4.1.- Hardware:

- Hardware should exceed the minimal requirements for the software
- Hardware must meet certain requirements in line with industry standards such as BIS, NEMA, IEEE, EnergyStar and others
- Backup storage and system redundancies should be considered
- Hardware should be checked constantly and maintained as necessary
- Updates should take place; for this, capacity assessments should be conducted

4.2.- Network and Connectivity:

- Equipment must possess connectivity capabilities such as Internet, LAN, etc., and even cloud computing
- The connectivity medium should be reliable and fast enough

- The connective medium should ensure security and integrity of data transferred

4.3.- Software:

- It must satisfy required standards on the various issues previously mentioned
- It must be interoperable
- It must possess searchable capabilities
- It must support digital archiving
- It should support rapid data capture, sharing and access

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