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A Review of eHealth Initiatives: Implications for Improving Health Service Delivery in Nepal

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ABSTRACT

The aim of this paper is to take stock of the use of information and communication technologies in delivering health services in Nepal and identify bottlenecks in implementation for improving delivery of health services. A descriptive review was conducted from May to September 2016. Data were collected from organizations working on the different thematic areas in health where information and communication technologies was used. Fifteen ongoing eHealth projects were identified in the areas of monitoring and surveillance, electronic health records/electronic medical records, health information system, and telemedicine. Common challenges were addressed, including a lack of funding, infrastructure, electricity and network, and national capacity. Most eHealth projects were not integrated into the national system. Working at a national level to address the challenges, centralizing eHealth projects and developing national policies would ensure to adopt eHealth at a right place and to accelerate eHealth initiatives.

Keywords: eHealth; health service delivery;information and communication technologies (ICT); Nepal.

INTRODUCTION

Electronic health (eHealth) is defined by the World Health Organization (WHO) as the use of information and communication technologies (ICT) for health, which can benefit both health officers and general population.[1] With the development and spread of ICT, movements toward using ICT for health services have started in many countries. eHealth has the power to improve health systems in various ways, such as electronic health records, telemedicine, and mobile health (mHealth).[1] Health officers can manage data accurately and efficiently, and better health services will be available to more people through eHealth.

eHealth tools are designed to benefit health systems management, health surveillance, health education, clinical decision making and to support public health action and disease management.[2] eHealth implementation in developing countries have shown to improve communications between institutions, assist in ordering and managing medications and help monitor and detect patients abandoning care.[3]

METHODS

Considering that there is a lot of paper-based work and a lack of access to health facilities in remote areas in Nepal, there is a possibility to take advantage of eHealth. eHealth would contribute to achieve the visions and missions of National Health Policy 2014 and Nepal Health Sector Strategy 2015 – 2020 (Table 1).[4,5] For instance, Nepal Health Sector Strategy 2015 – 2020 aspires to leverage modern technologies for better health information management, increased access to health services, better management of procurement and supply chain, and more effective and efficient construction of health facilities.[5]

Several eHealth projects have been implemented by various organizations at different settings in Nepal.[6] However, some of the problems arethat many programs were conducted separately, and activities, skills, and lessons learned were not shared with each other. There is little information aboutthe current situation of eHealth in Nepal.These make it difficult to implement eHealth initiatives efficiently, and may lead to a duplication of work. Centralizing all projects will help health officers and stakeholders understand the current situation on eHealth and accelerate eHealth initiatives for the next phase.[7] This paper aims to provide the overview of current eHealth projects in Nepal and identify bottlenecks in implementation ICT for improving delivery of health services.

To understand the current situation of eHealth, a

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descriptive review was conducted from organizations working on eHealth. A structured review process was adapted which included identifying organizations working on the different thematic areas in health where ICT was used. This was carried out by following International organizations, international and local non-governmental organizations, identified from experts in eHealth fields (Ama ko Maya, GIZ, Medic Mobile, Possible, Public Health Concern Trust, UNICEF Nepal, and WHO Nepal).

Table 1. National Health Policy and Nepal Health Sector Strategy of Nepal.

	National Health Policy	Nepal Health Sector Strategy
Vision	All Nepali citizens have the physical, mental, social and spiritual health to lead productive and quality lives.	All Nepali citizens have productive and quality lives with highest level of physical, mental, social and emotional health.
Mission	Ensure citizens' fundamental rights to stay healthy by utilizing available resources optimally and through strategic cooperation between service providers, service users and other stakeholders.	

CURRENT eHEALTH PROJECTS IN NEPAL

A total of 15 ongoing eHealth projects were identified. Table 2 summarizes the characteristics of eHealth projects in this study. These were categorized into monitoring and surveillance (n=8), electronic health records/electronic medical records (n=4), health information system (n=2), and telemedicine (n=1).

TYPES OF eHEALTH PROJECTS

MONITORING AND SURVEILLANCE

Eight projects were identified in the area of monitoring and surveillance. A majority of them, seven out of eight, were mHealth projects. 'A low-cost mobile phone system to support community-based maternal and newborn care in rural Nepal' and the 'Best Wishes Program' had Female Community Health Volunteers (FCHV) use mobiles to collect data and monitor the health status of pregnant women. FCHVs reported that mobile phones were useful. However, electricity and network problems were challenging as rural villages lack constant electricity and network coverage although the battery life of feature phones used for mobile reporting last for almost a week. FCHVs and health workers despite their limitations, are ready to learn and accept innovation. With proper supervision and motivation, we can train and encourage them.

'Expanding the reach of eye care services in rural areas of Nepal' was designed to generate evidence on a model for financial sustainability of community eye centres. FCHVs and community health workers conduct a simple eye test and refer potential patients to the eye centres using SMS. The 'Ipas Global Mobile Data Collection Pilot' aimed to monitor and improve the quality of safe reproductive health services using mobile tools. As for the 'Reporting of cancer screening in Far-West region of Nepal', mHealth was used to report monthly screenings and request equipment and supplies. To report timeliness and completeness outbreak weekly, the 'SMS reporting for Vaccine Preventable Disease Surveillance' was conducted nationwide. Lastly, the 'Support to the Health Sector Programme (S2HSP)' was implemented, aiming to ensure timely availability of structured disease surveillance data using DHIS2. Surveillance tool was the outcome measured and reported that it takes time to fully understand DHIS2 and has technical problems including compatibility. It is important to conduct a baseline study before implementing the project.

Electronic Health Records/Electronic Medical Records (EHR/EMR)

Four EHR/EMR projects were identified. Two programs were conducted at the hospitals to implement EHR/EMR, and the other two programs aimed to manage the immunization records of children using ICT at the health facilities at district levels.

At hospital levels, two projects were implemented using open source software.'Designing and deploying a national public sector EHR' has been implemented to create an effective digital system in two districts (*Achham* and *Dolakha*). Improved data quality and increased follow up care were reported as findings while status quo bias (clinicians who are used to doing everything on paper, find it hard to adjust to doing it all on computers)and infrastructure problems (unreliable power, lack of proper earthing, access to repair facilities) were reported as challenges. Patient health literacy, lack of national eHealth policy and a perceived value to and buy-in from providers (If clinicians don't see immediate benefits for the system, they are less likely to be bought in. Initially, benefits might not be obvious) were other challenges reported. This project measured many outcomes such

Table 2. The characteristics of the current eHealth projects in Nepal.

SN	Title	Objective	Duration	Type	Location	Activities
1	A low-cost mobile phone system to support community-based maternal and newborn care in rural Nepal	• To strengthen the Safe motherhood program using mHealth technology. • Involvement of FCHVs for data collection and follow ups with pregnant women until delivery. • To provide delivery and danger sign alerts to SBAs.	2013 ongoing	Monitoring	Baglung	The FCHVs use a SMS-based system to provide counselling and follow ups with the women during pregnancy regarding ANC visits and safe delivery.
2	A low-cost mobile phone system to support community-based maternal and newborn care in rural Nepal • To strengthen the Safe motherhood program using mHealth technology. • Involvement of FCHVs for data collection and follow ups with pregnant women until delivery. • To provide delivery and danger sign alerts to SBAs.		2016-2017	Monitoring	Gorkha	Care coordination and service reporting.
3	Best Wishes Program	• To strengthen the Safe motherhood program using mHealth technology. • Involvement of FCHVs for data collection and follow ups with pregnant women until delivery. • To provide delivery and danger sign alerts to SBAs.	2016-2020	Monitoring	Ilam	FCHVs track pregnancies in their VDCs and counsel and follow up with pregnant women for regular ANC visits, institutional delivery, postnatal visits and immunizations, and report their progress to the respective health posts.
4	Expanding the reach of eye care services in rural areas of Nepal	To establish evidence on a model for financial sustainability of Community Eye Centers.	2016-2017	Monitoring	Rolpa	•Design and provide training to the FCHVs and CHWs to do a simple eye test and refer potential patients to the nearest community eye centre by sending structured SMS through their feature phones. The referral system will generate a profile for each patient in a password protected dashboard. •Each potential patient will be assigned a unique ID and a referral slip that they will present at the community health centre. •Staff at the community eye centre will then track and follow up with the patients.
5	Ipas Global Mobile Data Collection Pilot	To monitor and improve the quality of safe reproductive health services offered by public and private providers in order to decrease preventable deaths and disabilities from unsafe abortions.	2016 - 2017	Monitoring	•Rupandehi •Bara	Report on reproductive health services using mobile tools.
6	Reporting of cancer screening in Far-West region of Nepal	Use Medic Reporter to report monthly screenings, referrals, and treatment data at participating facilities, request equipment and supplies, and document issues that arise in service provision.	2016 - 2017	Surveillance	Selected sites of Kailali	Service reporting (monthly)

7	SMS reporting for Vaccine Preventable Disease (VPD) surveillance	Report timeliness, completeness, and outbreaks from weekly reporting sites of 75 districts.	2016	Surveillance	Nationwide	Weekly reporting
8	Support to the Health Sector Programme (S2HSP)	To ensure the timely availability of structured disease surveillance data, allowing for prompt alerts and other data visualizations.	2016 - 2018	Surveillance	Nationwide	• Use the DHIS2 for EWARS • Customize the DHIS2 for collecting and analysing surveillance data • Train sentinel sites on the use of the new system • Start using the DHIS2 based EWARS
9	Designing and deploying a national public sector EHR	• The goal of an EHR is to create an affordable, effective, and comprehensive digital system. • Low cost and high-quality care are accessible to all.	2014 - ongoing	EHR	•Achham (Bayalpata Hospital) •Dolakha (Charikot Hospital)	• Deployed an EHR • Integration with Nepal's CHW network and our home-visits program. CHW's live and work in the surrounding villages performing triages, providing referrals, and managing follow-up care. • Use open source software - Bahmni at the facility level: registration, outpatient/inpatient medical records, inpatient bed management, lab orders &fulfilment, PACS/Radiology orders &fulfilment, drug order &fulfilment, inventory tracking, and reporting - Compare at the household level: continuous surveillance for maternal and child health, tracking of pregnant women, chronic disease patient follow-up, and so on.
10	Introduction of a Medical Record System in Trishuli Hospital, Nuwakot	To introduce a medical record system to help in the patient level information management of the district hospital in Nuwakot.	2016 - 2018	EMR	Nuwakot	• Introduce an EMR • Understand the workflows within the hospital. • Select one distribution of OpenMRS to be used (Bahmni/OpenMRS+ etc.). • Customize the selected distribution to meet the workflow needs. • Design a phased implementation plan for introducing the EMR. • Provide training to relevant hospital staff. • Implement.
11	Electronic Immunization Registration System	Register a child coming for immunization, make the record available from health facilities and track immunization status of the child.	2014	EHR	Palpa Kanchanpur Bhaktapur Kaski Chitwan	
12	Vial to Child	To implement technology-based vaccine management system and evaluate the effectiveness to improve vaccine delivery.	2016 - 2017	EHR	Dadeldhura Nawalparasi	The project uses innovation in technology for vaccine delivery through an android-based application. Health workers use the application installed on tablets to manage children's immunization records. Vaccine information including lot numbers and expiry dates is collected using Optical Character Recognition, and fingerprints ofparents/ caregivers are collected to manage children's immunization records.

13	District Health Information Software2 (DHIS2) Technical Support	• To upgrade the existing Health Management Information System to be based on the Open-Source DHIS2 platform to allow for more robust reporting and data analytics • To support release of the DHIS2 version 1.0 and enhancements for version 2.0.	2016 - 2018	Health system	Nationwide	• Customize the DHIS2 to Nepal specific requirements. • Migrate old HMIS data to new system. • Train D(P)HO staff of all 75 districts on using new system. • Start using new DHIS2 based HMIS. • Use the DHIS2's data analytics engine for better analysis/visualization of data. • Advocate the use of analyzed data for evidence-based decision making at policy level.
14	Insurance Management Information System (IMIS)	To manage the following data: • Membership (Enrolment, Renewal, etc) of families • Claims from health facilities for health services provided under the insurance schemes • User satisfaction feedbackof the Social Health Security Programme of the Government of Nepal	2014 - 2018	Health system	Ilam Baglung Kailali Plan to be nationwide	• Develop/Customize a web-based system for Insurance Data Management • Choose appropriate system • Customize IMIS for Nepalese context • Build capacities of SHSDC to use IMIS • Support the maintenance and day to day operations of IMIS • Advice SHSDC and developers on further development of IMIS
15	Rural Healthcare and Telemedicine Service	•Provide health service to the rural population, especially those in remote areas, through use of information technology • Empower the local health workers through demystification of knowledge and skills • Create models of healthcare in sparsely populated remote areas	2007 - ongoing	Telemedi-cine	Myagdi Parbat Gorkha	• Provide health service to the rural population, especially those in remote areas, through use of information technology • Empower the local health workers through demystification of knowledge and skills • Create models of healthcare in sparsely populated remote areas

as outpatient utilization rate, equitable access metric, institutional birth rate, chronic illness follow-up rate, contraceptive prevalence rate, surgical services availability ratio and under 2 mortality rates. It was learnt that there is a need for an eHealth champion from amongst the clinicians/users, regular refresher trainings and Murphy's law applies so need contingency plans for IT (network will go down, lightning strike will take out the server, power backup will fail etc.), paper has its place even in a fully digital system.

Another project called the 'Introduction of a Medical Record System in Trishuli Hospital, Nuwakot' has been implemented to introduce a medical record system to improve information management. This measured the implementation and patient's waiting time as its outcome.

Regarding immunization, the 'Electronic Immunization Registration System' project has been running since 2014. The project is being conducted in five districts. Health workers register children coming for immunizations and track the immunization status of the children using computers.

Another program called 'Vial to Child' is being conducted in two districts with the purpose of implementing a technology-based vaccine management system. Health workers use the application installed on tablets to manage children's immunization records. Outcomes such as Usability to assess how easy or difficult it was for health workers to use the software and Data quality to compare the number of doses recorded in the system to those on paper were measured.

Health Information System

Two projects were identified regarding health information systems. The 'District Health Information Software2(DHIS2) Technical Support' aimed to upgrade the existing Health Management Information System for more robust reporting and data analysis.The DHIS2 was found as an appropriate platform of the aggregated public health data, but limited national capacity and technical problems like customization (Nepali calendar, etc.) were challenging issues. Improved data availability and timeliness, better monitoring of public health programmes were measured. Collaboration with University of Oslo and the DHIS-2 core group is essential to ensure that country specific requirements are addressed on time while in-country capacity building and institutionalization of the system is key for the success of this project.

The 'Insurance Management Information System' was implemented to develop and customize a web-based system for insurance data management. There were technical issues and capacity building was required at various levels of health facilities to use electronic tools. Both projects mentioned that building national capacity would be a key factor for the success.

TELEMEDICINE

The 'Rural Healthcare and Telemedicine Service' has been operating since 2007. The objectives were to provide health services to the rural population and empower the local health workers through real-time video conferences and sharing information. Technical problems, such as a lack of electricity, bad weather, gadgets related and non-technical problems such as unstable funding, training, retention of human resource and political issues were identified as challenges. Reliable tools were developed for measuring reduction in the unnecessary referrals, retention of health workers in the remote area, prevention of death and other parameters. As lessons learnt, the importance of documentation, cooperation with the government, and a strong maintenance mechanism for networks were addressed.

DISCUSSION

A descriptive analysis was conducted to overview the current eHealth projects in Nepal. Fifteen different projects were identified and these were implemented at different settings for monitoring and surveillance, EHR/EMR, health information systems, and telemedicine.

These projects addressed some challenges such as unstable electricity and network, limited national capacity and funding, and a lack of national policies. Several situation analyses on eHealth were conducted in other countries as well, and similar challenges were identified. In India, the unavailability of suitable human resource was identified as a major challenge, and ensuring financial sustainability and collaborations between the government and non-profit and for-profit organizations were recommended.[8] Besides these, lack of policy and strategic planning, lack of legislation on confidentiality of data and ethics, lack of standards for medical imaging, interoperability, software, and inadequate ICT skills in the health sector were reported as challenges to adopt eHealth.[9] The top five issues regarding eHealth in Ghana were a lack of ICT infrastructure, a lack of basic ICT knowledge and skills, Internet access, financial and sustainability issues, and privacy and security issues.[10] The issues with using ICT in Pakistan were basic such as inadequate infrastructure, unavailability of hardware and poor resource allocation.[11] In Bangladesh, challenges were inadequate ICT infrastructure, financial problems, resistance to change, usability and user acceptance, lack of policy and regulation, and interoperability of systems.[12]

Health workers in this study reported that using ICT for their work was helpful and data quality was improved. ICTs can be used more effectively to improve the health system in the rural hospitals and health centres with access to ICTs, access to supporting communication infrastructure and networks and supportive policy framework.[13-15] In many low-and middle-income countries, ICT is being increasingly employed to address key health system challenges such as toincrease access to healthcare (42%), improve data management (38%), facilitate virtual patient–provider communication (31%), improve diagnosis and treatment (17%), mitigate fraud and abuse (8%), and streamline financial transactions (4%).[16-18] The most commonly used devices were phones (71%) and computers (39%) and donors were the primary funders of almost half of eHealth programs (47%).[16,17]A systematic review conducted in South Africa found out that eHealth within community health facilities in developing countriesprovided promising evidence for the contribution of eHealth to quality of care.[19]

According to the study in Thailand, eHealth applications including EMR/EHR, mHealth, and telemedicine were being implemented, but these services were fragmented and scattered, therefore the country's eHealth experts recommended creating a multi-stakeholder, national-level, eHealth governing authority and eHealth policy.[20] Various developing countries, including Nepal, addressed common challenges to implement eHealth activities, such as inadequate human resource, infrastructure, budget, collaboration, policy, and customization.[21,22] A programme in rural Nepal that aimed to implement a mobile phone system for collecting health surveillance data did not reach its fullest potential due to several programme management challenges during the implementation of the surveillance programme and other reasons such as leadership transitions, poor process design and a lack of consistent vision of how to operationalise the data.[23] Poor initial planning and research design, insufficient computing skills, lack of change management and lack of technology readiness are some of the factors responsible for the failure of eHealth projects in developing countries.[24] It is suggested that policy makers and healthcare managers should undertake adequate planning and make better use of their resources for successful and sustainable

eHealth projects.[25]

Electronic Medical Records (EMR) changes paper-based record keeping system to a computerised modern record keeping system making medical information easily readable and available and thus can be employed to change healthcare.[26-28] However, with adoption of this technology, there are various associated challenges such as interoperability, privacy and confidentiality, organizational and social barriers, limitations of technology, electronic preservation, legal status of EMR and customization.[29-32]

Telemedicine has a potential of becoming means of improving health services. It is commonly used in developed countries, however, this modality is less available in a developing country, like Nepal, because of the high cost of bandwidth and the poor telecommunication infrastructure.[21] Lack of proven large-scale operations, poor evidence base,inadequate implementation, lack of readiness, change management, and many others are reasons for telemedicine not being integrated into existing health care systems globally.[33-35] Various reasons including limited resources, unreliable power, poor connectivity, and high cost are some of the challenges faced with telemedicine in developing countries.[36-40]

The use of mobiles to improve vaccination in low- and middle-income countries has been effectively demonstrated with interventions including appointment reminders, mobile phone apps, and pre-recorded messages.[41,42] A systematic review conducted to study the efficacy, usability and feasibility of mobile based app and SMS reported that they were equally promising interventions for eHealth.[43] The utility of mobile health (mHealth)/Mobile technology is being used within health programs and health systems in both developed and developing countries to support patient care, manage information and change behaviours of both patients and providers. Mobile phones are being popular among thefrontline health workers (community health workers) as an important resource for simplifying emergency, support data collection, decision support, alerts and reminders, and information access tools in the published literature across low resource settings.[44,45]

Documentation and collaboration with other institutes and the government were mentioned as important factors to succeed in eHealth. United Nations agencies and other international bodies dealing with health, telecommunications and trade, government authorities, health and telecommunication decision-makers at the national and regional levels, as well as the regional bodies to which they belong, academic and research institutions, local health professionals and their associations, consumers, patients and their associations, donors, non-governmental organizations, the private sector, including foundations and industries related to health and ICTs and the media are the main players in the field of eHealth.[46,47]

eHealth applications such as Health Information Systems (HIS), Electronic Medical Records (EMR) system, telemedicine, and mobile services are important tools of ICT that improve quality of healthcare delivery, increase patient safety, and reduce healthcare costs.[48,49] Despite the challenges faced by developing countries, studies have shown that a few have successfully adopted and implemented a wide range of eHealth tools and applications in health institutions.[3,50-52]

This paper is not a systematic review so it did not capture all recent eHealth activities in Nepal. Data on summary of findings and lessons learned were not collected from some eHealth projects because these were at early stages or there was scarce information. These limited the scope of this study. Nevertheless, this study was meaningful in that it reviewed recent eHealth projects to understand the current situation and identified common challenges addressed in other developing countries. The draft eHealth national strategy of Nepal is developed by Ministry of Health.[53] The vision is 'eHealth facilitates the delivery of equitable and high-quality healthcare services to enable all Nepali citizens to enjoy productive and quality lives'.[53] To achieve the eHealth vision, several activities including 'capacity enhancement of managers and policy makers in the area of eHealth policy and strategic management', 'strengthening of existing health information systems – electronic record system, e-reporting (web and mobile) and e-monitoring systems, including supply chain monitoring and management system', and 'ensuring availability of electric power to run electronic devices in collaboration with Nepal Electricity Authority and alternate source of energy' were recommended.[53]

CONCLUSIONS

Several eHealth projects were implemented in Nepal, but these were not fully integrated into the national system, and limited documents were available to understand the projects. To ensure the uptake of eHealth and maximise the benefits from eHealth in Nepal, working at a national level to improve infrastructure, human resources and centralize eHealth projects would be recommended.

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