

Public health information systems for primary health care in India: A situational analysis study

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ABSTRACT

Introduction: Information communication technology (ICT) based health information systems (HISs) are expected to transform health system functionality. The present study was aimed to evaluate HISs in India with a focus on primary health care (PHC). **Methodology:** The study used a qualitative method to evaluate and understand various ICT-based HIS implemented at the state/union territory (UT) level in India. After initial scoping research on HIS through literature search and observation, in-depth interviews of key informants at various levels (programme managers, analysts, co-ordinators, data entry operator and health care providers) was carried out to have an insight on the user experience of these systems. An inductive applied thematic coding of qualitative data was done for analysing the data. **Results:** Multiple applications have been developed under national health programmes to meet the health information needs, but at present, there is a limited role of these HISs in enhancing the effectiveness of comprehensive PHC. Many of these systems are proprietary-based, and the long-term sustainability and integration of these systems remain a challenge. **Conclusion:** A change is required in the approach to design a HIS that will cater to the needs of PHC. Moreover, HIS should be people-centred rather than technology-centric with focus on integration and sustainability.

Keywords: Health information system, India, information communication technology, primary health care

Introduction

Universal health coverage (UHC) endorses equity, improving efficiency and provision of quality healthcare. It is believed that the use of information technology (IT) in healthcare can be a key enabler for achieving UHC.^[1] The use of IT in health was first advocated at the World Health Assembly (WHA) in 2005.^[2] Globally, information and communication technology (ICT) based health information systems (HISs) have been developed. These systems capture, store, manage, analyse and transmit required information related to the health for planning, decision

makings and resource allocation.^[3] Furthermore, ICT can build a transparent system, bring accountability and responsibility among people involved in healthcare service delivery.^[4]

However, despite the obvious potential, many researchers have argued that ICT-based HISs have not delivered optimally.^[1,5] The focus of ICT systems in health has been largely on aggregate systems for national-level reporting, while their application for primary health care (PHC) management has been very limited.^[6,7] PHC is a critical foundation of the health services that can provide a roadmap to achieve UHC.^[8] Arguably a stronger PHC focus can contribute to better health outcomes, with greater equity and lower costs of care.^[9] Limited information is available on HISs, which are people-centred and community-based with an orientation towards PHC. Hence, this study aimed to evaluate the HISs that were developed in India for generating information

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for surveillance, monitoring, and resource allocation at the PHC level. The evaluation was done in terms of the effectiveness of a HIS and challenges during implementation.

Methodology

This study evaluated HIS based on the following factors:

- a. Literature search
- b. World Wide Web (WWW) search
- c. Observations
- d. In-depth interview of key staff.

The public-owned HISs that were oriented to improve health care were included in the study. The identified systems were evaluated to understand the role of ICTs in supporting the healthcare system, and whether such systems helped in improving PHC.

A scoping search was carried out on reviews of HIS used in the public sector in India from PubMed, Scopus, Medline and Google Scholar. The search was limited only to studies published after the year 2000. Our search keywords included, “Health Information Systems AND India”, “Integrated Disease Surveillance Project AND India”, “NIKSHAY AND India”, “Mother and Child Tracking System AND India” and “Strategic Management Information System AND India”, “District Health Information System AND India” in Title/Abstract and limited to the medical field. After removing the duplicates from various searches, we identified 900 articles with the above keywords. Keeping the relevance with the aim of the study, we found only 16 articles suitable for our study.

The HISs that were used at the primary health centre, community health centres (CHC) and district hospital (DH) from four states/ union territories (UTs) included Chandigarh, Punjab, Haryana and Himachal Pradesh. To assess the flow of information under various national health programmes using HIS, the State TB Cell, State AIDS Control Society, State National Health Mission Office and Regional National Informatics Centre in Chandigarh were visited.

In-depth interviews of purposively selected key informants were conducted by the investigator to collect the qualitative data on user experience on the implementation and functioning of ICT systems at the state level. At the time of the interview, only investigator and respective participant were present to ensure privacy and confidentiality at the time of data collection. Programme managers and analysts at the National Health Mission (NHM) office of Punjab and UT Chandigarh and the programme co-ordinator at the State TB Cell, State AIDS Control Society and Regional National Informatics Centre at UT Chandigarh were interviewed. The information was also collected from the doctors, health staff and data entry operators working at various levels of health care (primary health centre, CHC and DH). Before the start of the in-depth interview, an overview was elicited first by the interviewers on broader topics in question.

Analysis

The notes made from the in-depth interviews were qualitatively

analysed using inductive applied thematic coding. Based on the web research, observations, interviews and qualitative analysis, the brief overview narratives of each system were developed, analysed and interpreted with a focus on the role of ICTs and how it has influenced PHC. The HIS evaluation was based on criteria used in planning commission, Government of India report^[10] and HIS evaluation criteria developed by Hanmer.^[11] The ethical approval for the study was taken from the Institutional Ethics Committee of PGIMER, Chandigarh vide their letter no. INT/IEC/2017/195 dated 23/08/2017.

Results

We were able to identify five important HISs, including National Health Mission Health Management Information System (NHM-HMIS), Integrated Disease Surveillance Programme (IDSP), NIKSHAY, Mother and Child Tracking System (MCTS), Strategic Information Management System (SIMS) and District Health Information System 2 (DHIS2), which were used by the states for information generation under various National Health Programmes in India. The findings are presented in two parts, namely, features of HIS and appraisal of HIS.

Features of health information systems

The main features related to these systems are summarised in Table 1 and their characteristics are presented below.

National Health Mission Health Management Information System (NHM-HMIS)

The National HMIS portal was launched in 2008 as a part of the national reform process. Initially, it was planned as a repository to collect district-level aggregate integrated reports, but gradually over time, it has gone right down to the sub-district level, and today around 1,80,000 health facilities in the country are reporting to this portal.^[12] In addition to the aggregate reports, there is a degree of individual data comprising of line lists of deaths.

The programme managers and analysts pointed out that, initially, the portal was lacking in many basic functionalities, but these have been gradually enhanced over time. For strengthening analysis, the functionalities were provided to move the data into proprietary software (SAS software) and the central monitoring and evaluation department under NHM conducts analysis and places reports on the portal to be downloaded by the states. Similarly, for spatial analysis, third-party proprietary software (ArcGIS) is used. The primary analysis of data is not carried out by the district or facility level staff. Regarding the utility of HIS data, a respondent stated,

‘Very often there is mismatch in the HMIS data and it is difficult to rely upon the available data for making a ground assessment of health condition and use it for resource allocation’

District Health Information System (DHIS2)

DHIS2 is a free and open-source platform that has currently developed into a global de-facto global standard for building HISs in low- and middle-income countries (LMICs).^[13]

Table 1: IT-based HISs in India

HISs	Purpose	Open/Proprietary Source	Developer	State*
HMIS	Providing facility-based health information for planning and resource allocation	Proprietary system	Vyam Technologies	Punjab and Chandigarh
DHIS2	Tool for collection, management, visualisation and generation of health information data	Open-source platform	HISP	Haryana and HISP, Noida
MCTS	To improve maternal and child health services	Open-source platform	NIC	Punjab and Chandigarh
NIKSHAY**	To create a database of all TB patients and use this database for monitoring and research purposes	Open-source platform	NIC	State TB cell, Chandigarh
IDSP	Strengthening of the disease surveillance system for epidemic-prone diseases to detect and respond to outbreaks	Open-source platform	NIC	Chandigarh
SIMS	For strategic planning, monitoring, evaluation, surveillance and research in the effective tracking of and response to HIV cases	Proprietary system	Vyam Technologies	State AIDS Control Society, Chandigarh

* States where reviews were done. **A combination of Hindi words 'Ni' and 'kshay' meaning 'no' 'tuberculosis'. IT=Information technology, HISs=Health information systems, HMIS=Health Management Information System, HISP=Health Information Systems Programme, DHIS2=District Health Information System, NIC=National Informatics Centre, MCTS=Mother and Child Tracking System, IDSP=Integrated Disease Surveillance Programme, SIMS=Strategic Information Management System

The project co-coordinator from the HISs Programme (HISP), India informed that DHIS2 has been in operation in India since 2006 and is presently being used in nine states as a state data warehouse, where states enter all their facility-based data into the DHIS2, and from there the reports are further submitted to the national HMIS portal in the required format. Further, the system is used to conduct a state-level analysis of data and provide feedback to peripheral units to support action. Many states have also carried out specific customisations, such as for accredited social health activist (ASHA) monitoring, supportive supervision and others. One of the respondent stated,

'Over and above the information available from Government Portals, DHIS2 gives flexibility to analyze data as per the local health needs and generate indicators for local decision making'

Mother and Child Tracking System

The MCTS system was launched by the Union Ministry of Health and Family Welfare in 2009, primarily driven by the logic of improving the veracity of data. It has modules for registering pregnant mothers and following them for their antenatal care (ANC) visits and registering children over the immunisation cycle.

About the various functionalities in MCTS, a respondent stated,

'the data is analysed at central monitoring and evaluation and SMS are sent to all the states every day on number of registrations achieved. Initially, the system was not able to generate follow-up reports or work plan for the health workers, but gradually over time this functionality was developed'

The peripheral healthcare providers using the system stated that timeliness was an issue with the system as there were delays in registration of data going up to the national level, where work plans are generated and then sent back to them. The data entry is made at the primary health centre/block level by a data entry operator, for which auxiliary nurse midwives (ANMs) from sub-centres have to make a weekly visit to the primary health centre/block office to get their sub-centre data entered.

It was observed that this system was more focused towards monitoring of the health staff rather than monitoring maternal and child health indicators. This system added a huge workload on the health staff, as they had to enter name-based data into the system and, at the same time, aggregate numbers were also being entered into the HMIS portal. At a later stage, it was realised that a large portion of reproductive and child health care remains out of the ambit of this system, therefore, it was decided to switch over to a Reproductive and Child Health (RCH) portal and close the MCTS.

The health worker using the work-plans generated from MCTS stated,

'The delays in getting the workplans generated from MCTS make them useless as by the time the workplans are received they already have their due visits completed'

NIKSHAY: Tuberculosis case tracking and surveillance

Following the introduction of a policy of mandatory notification of tuberculosis (TB) cases in May 2012, India launched a new web-based TB surveillance system called NIKSHAY.^[14] This application was developed for aggregate management reporting and also for the tracking of TB patients, including multi-drug resistant (MDR) and extensively drug-resistant (XDR) TB patients.

The programme co-ordinator at the State TB cell stated that the system sends daily SMS alerts to district and state TB officers on patients registered under the Revised National Tuberculosis Control Programme (RNTCP). In case a patient migrates to a new place, the patient details can be easily transferred to that centre to avoid a loss to follow-up. The system is being improved to make it more patient-centric by building mechanisms for alerts and reminders for both the patient and directly observed treatment (DOTS) provider if the patient misses the medicine. During the interview, programme co-ordinator stated,

'the application does not offer offline data entry functionalities which is often a requirement in peripheral areas and remains a major drawback of the application'.

At the lowest unit, i.e. the designated microscopy centre, data recording is done manually in registers and the patient card, which is later entered into the system through data entry operators at the primary health centre/block level. Another limitation of the system stated by the respondent was,

'the application does not support the automatic generation of indicators, and data needs to be taken out into spread sheet to generate the indicator'.

Integrated Disease Surveillance Programme

The IDSP portal was launched in November 2004. The portal has facilities of data entry, viewing of reports, outbreak reporting, data analysis, training modules and resources related to disease surveillance.^[15] The IDSP portal is under the management of the National Centre for Disease Control (NCDC), Ministry of Health and Family Welfare, which is also supported by CDC USA.

In the existing information flow, the health care providers from the most peripheral unit, i.e. sub-centres and the primary health centres/hospitals, fill up three set of forms (S, P and L—syndromic, presumptive and laboratory confirmed), and send them manually to the sub-districts/districts where online entries are done. The L form contains a line list of positive cases, while the others represent aggregates.^[16]

The respondent stated,

'to get access to their own data, state officials need to request the IDSP office at national level which often leads to great delays, where time is of essence in disease surveillance. Outputs are weak, not supporting strong response and action. Some of these diseases being reported on are also reported by other systems, causing ambiguity for decision makers on what data to use'.

Strategic Information Management System (SIMS)

SIMS was developed over the existing computerised management information system (CMIS) used by the National AIDS Control Organisation (NACO). IT was officially launched in August 2010. It is a web-based centralised application that has integrated all programme components of NACO into one system.^[17]

It was observed that the vendor who has developed this system is the same who has built the national HMIS portal, and many design limitations seen with HMIS were also there in this portal. The system supports data entry at various levels, including reporting units (RU) and district and state levels. Data collected are primarily aggregate in nature, though there is a demand felt for case-based data, especially for HIV-positive cases to strengthen the follow-up. The application generates output reports using third-party analytic tools (SAS, GIS). SIMS captures monthly programme monitoring data of over 30,000 users.

The respondent stated,

'a key limitation of the application was that the application is geared primarily towards upward national reporting, and provides very little feedback to users on the ground to guide action taking. Further, there is little to no flexibility given to state users and below to do any modifications and all have to report only to stipulated national standards'.

Appraisal of health information systems

The abovementioned HISs have been developed in the public sector under vertical health programmes using different technologies, these are mostly oriented towards health management for providing programme specific inputs to policy-makers. The evaluation details are given in Table 2.

Discussion

Historically, HISs have been based on aggregate data, provided by public health facilities in their monthly reports. In 2008, following national reform efforts in India, the forms were standardised and computer-based reporting was initiated. Today, all public facilities are reporting data into national health portals. Some name-based systems, including use of mobiles, were introduced for the health workers at the community level to counsel pregnant women, postpartum mothers and their families and to schedule a vaccination, ANC and postpartum care services.^[18]

The HMIS is a facility-based programme, and it does not give full information about the health status of the area served by a facility, as these services are not entered. The national HMIS system has a rigid structure with very less scope of flexibility to meet additional health information requirements, which may vary from state to state. Many states, such as Gujarat, Jharkhand, Kerala, Madhya Pradesh, etc., have adopted DHIS2 to redesign HMIS. This is being done to make it architecturally more flexible and allow customisation as per the needs of the states through the incorporation of various reporting formats and monitoring indicators.^[19]

Studies conducted to review the MCTS system have highlighted issues of the limited utility of data generated through MCTS, as it is only used for generating the work plan and does not contribute to any health information reports. The studies on the implementation of MCTS in peripheral areas have reported challenges related to irregular electricity supply, inconsistent Internet connectivity and the slow speed of the MCTS web portal, leading to delays and time wastage.^[20,21]

The MCTS system is currently replaced by the RCH Portal, which has been developed by the National Informatics Centre (NIC). The RCH Portal is also expected to support voice calls.

By launching NIKSHAY and reaching out to the private sector, it is claimed that India has achieved a 29% increase in case of notifications in 2014 compared with 2013,^[22] but still, case reporting is only 63% of the expected cases.^[23] In a study on challenges faced by primary healthcare providers, it has been stated that there is a lot of duplication and gaps in the details available

Table 2: Evaluation of IT-based HISs in India

HIS	Functionality	Management and Data Entry	Data Authentication	Offline Data Collection Capability	Up-to-date Information	User/Patient Interaction	Local Use of Data
NHM-HMIS	Aggregate System Validations Offline Excel Import Analysis at District level and above	Block level and above	No	Partial	No	No	No
DHIS2	Aggregate system Validations Inputs to HMIS Basic analytics	At PHC level	No	Yes	Yes	No	Yes
MCTS	Name-based Validations Generates work plans	At block level	Yes	No	No	No	Yes
NIKSHAY*	Name-based Notification Allows Monitoring and follow-up	At block level	Yes	No	No	No	No
IDSP	Aggregate system Validations and alerts Analytics	DH	No	No	One week lag	No	No
SIMS	Aggregate system Validations and alerts Multiple modules Advanced analytics	ICTC/FICTC	No	Partial	No	No	No

*A combination of Hindi words 'Ni' and 'kshay' meaning 'no' 'tuberculosis'. DH=District hospital, CHC=Community health centre, PHC=Primary health centre, ICTC=Integrated Counselling and Testing Centre, FICTC=Facility Integrated Counselling and Testing Centre, HISs=Health information systems, NHM-HMIS=National Health Mission Health Management Information System, DHIS2=District Health Information System, MCTS=Mother and Child Tracking System, IDSP=Integrated Disease Surveillance Programme, SIMS=Strategic Information Management System

with the portal and it exposed the lacunae in software to fulfil the information needed for ensuring smooth implementation of TB notification at primary care level.^[24]

At present, about 90% of the 707 districts in India are reporting disease surveillance data in the IDSP portal related to notifiable diseases on a weekly basis. The IDSP data are collected on epidemic-prone diseases on a weekly basis (Monday to Sunday) that give information on disease trends.^[14] However, studies have reported that surveillance system is not very effective in achieving its objectives, very often the cases are detected at a time when the damage because of the outbreak has already occurred and the control measure initiation usually gets delayed.^[25]

SIMS was developed to generate information for information required for planning, management and monitoring purposes and strengthen programme management at various

levels.^[26,27] However, being proprietary software, managing and improving software features remain a challenge. At primary level, it has just remained a tool for data entry with very limited access.

Some common characteristics identified in HIS implemented in India include:

- Focus on centralisation: Most systems have focused on central reporting; thus, they have favoured centralisation.
- Limited focus on supporting local action: Typically, the systems were seen to have limited functionalities on feedback and promotion of local use.
- Systems developed in silos: Most of the systems lack interoperability, so it is difficult integrating components of various programs to give a holistic picture of the patient enrolled in various programmes at one point of care.
- Use of proprietary platforms: Many of the large systems (such as HMIS and SIMS) are based on proprietary systems. While

such software contributes to high costs, they also create vendor lock-ins, which put at risk the future sustainability of systems.

Presently, the existing public HISs at primary care level in India are not aligned with the patient's needs and interests and mostly cater to higher-ups in vertical programmes. Studies have emphasised on integrating HIS with PHC so that they act as a link between the patient, community health worker and physician and support PHC for its strengthening.^[28,29]

Conclusion

While multiple IT systems have been utilised in the public health sector, they have not really contributed to enhancing the PHC, and they have been unable to demonstrate evidence of impacting health outcomes. The HISs have not been optimised to the organisational needs, which require them to be sustainable and able to integrate various components of PHC.

There is a need to design an integrated system that covers all essential services provided at PHC level, improve access to services and provide reliable health information for use at the local level so as to increase the efficiency of PHC providers and increase the confidence of administrators and users.

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Conflicts of interest

There are no conflicts of interest.

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