



A Quiet Revolution

Strengthening the Routine Health Information System in Bangladesh

A publication in the German Health Practice Collection

German Health Practice Collection

Showcasing health and social protection for development

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More information can be obtained from the Managing Editor at ghpc@giz.de.

■ **Front cover photo:** Staff at the Management Information Systems (MIS) unit of the Directorate General of Health Services at the Ministry of Health and Family Welfare in Dhaka use the District Health Information System (DHIS2) software to monitor the status of health reporting from public facilities nationwide. As part of efforts to strengthen Bangladesh's health information system, the Ministry has provided computers, wireless modems and training in DHIS2 to health workers at all levels of the public health system. More than 7,000 facilities – including some 3,500 community clinics – now report routine data electronically, which enables real time monitoring of population health.

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Acronyms

ABDC	Addressing Bangladesh's Demographic Challenges
BMZ	Federal Ministry for Economic Cooperation and Development, Germany
DHIS	District Health Information System
DMIS	Data Management and Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
HIS	Health Information System
HISP	Health Information Systems Programme
IT	Information Technology
MDG	Millennium Development Goal
MIS	Management Information System
MOHFW	Ministry of Health and Family Welfare, Bangladesh
MOLGRDC	Ministry of Local Government, Rural Development and Cooperatives
NGO	Non-Government Organisation
UHC	Universal Health Coverage

A Quiet Revolution

Strengthening the Routine Health Information System in Bangladesh

Executive summary

This publication describes efforts by Bangladesh's Ministry of Health and Family Welfare, with support from the German Federal Ministry for Economic Cooperation and Development (BMZ), to strengthen the country's routine health information system (HIS).

Situation

Despite significant health achievements in recent years, the absence of a well-functioning HIS has prevented policy makers in Bangladesh from monitoring population health in real time and targeting interventions accordingly. Reflecting the country's pluralistic health service delivery arrangements, Bangladesh's HIS is highly fragmented. Data generated by private and public sector providers are not linked and, within the public sector, data from urban and rural areas, and from family planning programmes, are handled separately. Multiple overlapping reporting systems result in heavy paperwork burdens and poor data quality.

Approach

Since 2009, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), on behalf of BMZ, has been supporting the Management Information Systems (MIS) unit in the ministry's Directorate General of Health Services, which has emerged as a champion in efforts to strengthen and modernise Bangladesh's HIS. The comprehensive approach to HIS strengthening promoted by GIZ focuses not only on improving systems and software, but also on building local capacity to maintain and use the HIS infrastructure, promoting a culture of information use at all levels of the health system, and strengthening HIS governance.

GIZ facilitated the establishment of a so-called National Data Warehouse which made existing electronic health datasets from different directorates and vertical programmes interoperable for the first time. It also supported the introduction of two open source software products developed specifically for the collection and management of health information in developing countries.

The District Health Information System (DHIS2) software is used to collect and analyse aggregate data from health facilities; it also includes an individual record function which helps health workers to track pregnant women and children. OpenMRS is an electronic medical record system for use in hospitals.

Technical advisors from GIZ supported the customisation of DHIS2 and OpenMRS for use in public health facilities in Bangladesh and worked with the MIS unit to train health personnel at all levels to submit routine data electronically, via DHIS2. Through on-the-job capacity building, technical staff at the MIS unit have learned to manage the servers, maintain and update the software, and address hardware and software queries from thousands of users.

The MIS unit makes routine data collected via DHIS2 available through a public access server (www.dghs.gov.bd), uses it as the basis for the annual Health Bulletin and more than 500 local health bulletins, and has established a short course on health informatics for mid-career professionals, offered jointly by BRAC University in Dhaka and the University of Oslo. It also advocates the adoption of DHIS2 among departments and programmes both within and outside the ministry as a way of harmonising the country's HIS through use of a common platform.

Results

Two independent reviewers have confirmed that the comprehensive approach to HIS strengthening in Bangladesh has generated valuable results. These include:

- **Dramatically reduced administrative burdens – and more time for patients – through digitisation of routine reporting.** The ministry has distributed laptops and wireless modems to almost 15,000 government-run health facilities countrywide. Some 7,000 facilities now report routine information electronically, using DHIS2; the remainder should be doing so by the end of 2015.
- **A national electronic data repository signals the end of information silos.** Thirty-three previously separate electronic datasets are now linked together in the National Data Warehouse, which uses the DHIS2 platform. The steady adoption of DHIS2 by vertical programmes inside the ministry – and growing interest from health providers outside it – is leading to a more harmonised information environment.

■ Use of individual health records improves patient care.

Health workers at community clinics are using individual electronic records in DHIS2 to capture health information about pregnant women and children and to track them over time. Along with hospital records created with OpenMRS, these records support the ministry's goal of creating an electronic shared health record system for the entire population.

■ Better quality and more comprehensive routine information now available from the public sector.

Data collected in DHIS2 at public sector facilities can now be used to monitor the progress of Bangladesh's national health sector reform programme. Better information is enhancing project management, improving local-level health planning and allowing quicker detection of emerging issues, such as outbreaks of food-borne illnesses.

■ Improved capacity at Bangladesh's Ministry of Health and Family Welfare and growing international contributions in eHealth.

As a result of long-term on-the-job capacity building efforts, managers, statisticians and technical staff at all levels of the MIS unit are now better placed to manage HIS systems and infrastructure and to work with the information it generates. Bangladesh has emerged as an active contributor to the global DHIS2 and OpenMRS open source communities and as a leading eHealth innovator internationally.

Lessons learned

The comprehensive and systemic approach to HIS strengthening in Bangladesh has shown that it is possible to bring about a more orderly, harmonised information environment even in the absence of an overarching HIS strategy or policy framework. By adopting a pragmatic and incremental approach to modernising the HIS infrastructure, the MIS unit at the Directorate General of Health Services has catalysed a process of change which is leading to a more effective health information system. The main focus for the future will be on building local capacity to work with routine information in health planning and policymaking.

A simple tool makes a world of difference

Nestled amidst rice paddies and partially shaded by a small grove of trees, the Notun Mahal Community Clinic in the Cox's Bazar District of southern Bangladesh is a tidy three-room structure whose modest exterior belies the quiet revolution which is taking place inside.

Harun-ar Rashid is a Community Health Care Provider who has been based at the clinic for the past two and a half years, providing primary health care services to the residents of four nearby villages. The walls of his cramped office are adorned with brightly-coloured educational posters depicting the warning signs of common childhood illnesses and the correct proportions of salt, sugar and water needed to prepare oral rehydration solution. A hanging spring scale used for weighing infants stands in one corner. A few women and children wait quietly in the hallways, but it is the middle of the morning and the clinic is not busy.

Rashid and his colleagues – a Health Assistant and a Family Welfare Assistant who make household visits three days a week – provide a range of basic services, but antenatal and neonatal care, nutrition counselling, and the treatment of common childhood illnesses are top priorities. Despite its great success in reducing maternal and child mortality, Bangladesh continues to struggle with high levels of maternal and child malnutrition and poor access to and use of maternity services. One of the challenges is getting local residents to visit health facilities: according to Rashid, many

people associate going to the clinic with sickness and are therefore reluctant to come for regular checks. And, because of the absence of an effective civil registration system, the clinic doesn't have reliable information about who lives in its catchment area. But – his eyes gleam – all of this is now changing.

The previous month the clinic received a laptop computer and wireless modem from the Ministry of Health and Family Welfare (MOHFW) in Dhaka as part of a national effort to improve the collection of routine health information. Since then, Rashid has been able to submit the clinic's regular reports – the numbers of patients treated and summary statistics on maternal health, childhood illnesses, accidents and nutrition – electronically, to a central server, instead of compiling them by hand and delivering paper forms to the nearest health complex at the sub-district level, a half-hour drive away.

While this eases his workload, what is even more important to him is the fact that the software which they use to report this routine information – District Health Information System 2 (DHIS2) – also allows for the creation of individual patient records for certain categories of patient. In just one month, the clinic had already established individual records for 189 children under five years of age and 49 pregnant women who live in the catchment area.



■ **Left:** The Notun Mahal Community Clinic is one of 13,000 such clinics spread throughout rural Bangladesh. Each clinic serves a population of approximately 6,000 people.

■ **Right:** Harun-ar Rashid records information about patient visits in thick ledgers, and then submits summary data on a daily, weekly or monthly basis using a laptop and wireless modem.

This makes a huge difference in the way we work,' says Rashid. 'Before, we could capture only very limited information in the paper registers we used and we couldn't track individual patients. Now I have detailed information about the children living in my area, and I can go back and look at a patient's history.' Among other features, DHIS2 issues reminders when patients have missed a scheduled check-up, such as an antenatal visit, or are overdue for an immunisation. This allows the clinic staff to follow up with patients, by mobile phone, to remind them to come to the clinic.

Rashid smiled. 'I can already see that all the pregnant women and children in our area will eventually be registered in this way. And when the pregnant women are registered it means that we will know about the infants being born – we can reach out to them and bring them back in to the clinic as they grow. It means that we at the clinic are much more aware about who is who in our area and about what their needs are. We are in a position to provide much better service to patients now.'

A comprehensive approach to strengthening health information systems

Whether for tracking health services, maintaining individual patient records, monitoring drug stocks or overseeing financial flows, health information systems (HIS) are the invisible backbone of any country's health system. The topic of strengthening health information systems may set few hearts aflutter, but the fact is that no effective health system can survive without a well-functioning information system. The collection and use of routine health information is essential for evidence-based policymaking, for tracking emerging health threats, and for monitoring progress towards health targets, such as the Millennium Development Goals (MDGs). Strong IT-based health information systems can also further progress towards the achievement of Universal Health Coverage (UHC).

Bangladesh has emerged as one of the top health performers in South Asia over the past decades, but a number of challenges, including a fragmented and unreliable health information system, are slowing the country's further progress. The absence of reliable routine health information has meant, among other things, that health planners have been forced to rely heavily upon the findings of periodic surveys, which provide only a snapshot of the population's health, rather than a constant, highly detailed flow of data which can be analysed and acted upon at multiple levels. Ideally, routine and survey data should be used in combination to guide decision-making about health.

Germany's Federal Ministry for Economic Cooperation and Development (BMZ) has been supporting Bangladesh's development for more than 40 years. Since 2009, under the auspices of the Support to the Health Sector Programme, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), commissioned by BMZ, has been working closely with the MOHFW to implement a comprehensive approach to HIS strengthening which will improve the Ministry's ability to monitor progress, in real time, towards the achievement of key health goals. Going beyond a narrow focus on systems and software, the approach being supported by GIZ in Bangladesh also aims to build local capacity to maintain and use the HIS infrastructure, to develop a culture of information use at all levels of the health system, and to strengthen the governance of HIS in the country.

This publication describes the approach to HIS strengthening which has been pursued and the results which it has generated thus far. As with any revolution – including quiet ones which occur behind the scenes – it takes time for changes to become entrenched and for their full effects to be felt. However it is already clear that great progress has been made in harmonising Bangladesh's complicated health information systems – a crucial step for improving the overall management of the health sector.

Health and health care in Bangladesh

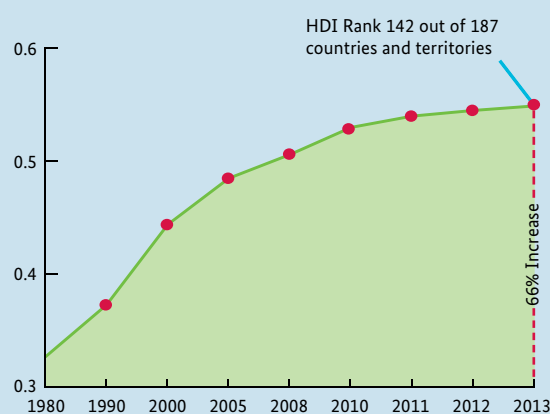
The health challenge in Bangladesh

With an estimated population of 156 million people living in a territory of only 147,000 square kilometres, Bangladesh is one of the most densely populated countries in the world. Nearly a third of the population lives in urban areas, often in crowded slums with poor access to clean water and sanitation.

Although Bangladesh remains one of the world's poorest countries – in 2010, over two-fifths of the population lived on less than USD 1.25 per day (World Bank, 2014) – it has also made remarkable progress in education, poverty reduction and health since independence in 1971. Life expectancy has risen, the fertility rate has dropped, the proportion of fully immunised children has grown, and maternal and child mortality rates have fallen steadily. All of this has been achieved with relatively low total expenditure on health: 3.8% of the country's Gross Domestic Product or USD 27 per capita in 2011 (WHO, 2014).

There have been successes beyond the health sector as well: Bangladesh has experienced steady economic growth since 1996, its net primary school enrolment rate was estimated at 94 per cent among males and 98 per cent among females for the period 2006–2012 (WHO, 2014), and the expansion of roads and electricity have made rural areas more accessible. Poverty reduction initiatives, such as microcredit schemes, and women's empowerment have also had positive impacts (Koehlmoos et al., 2011).

Figure 1: Bangladesh's Human Development Index (HDI), 1980–2013



Despite these gains, however, many pressing challenges remain. Access to antenatal services is low: only 50 per cent of pregnant women in Bangladesh have at least one antenatal visit during the course of their pregnancies, and only 26 per cent have four (WHO, 2014). Most births in Bangladesh continue to take place at home and the level of skilled birth attendance (32 per cent) is much lower than in neighbouring countries (Mushtaque et al., 2013): ensuring skilled attendance at birth is therefore a top priority as it will lower the number of preventable maternal and infant deaths. Malnutrition also remains a major concern, with 37 per cent of children under five years of age estimated to be underweight and 41 per cent estimated to be stunted (WHO, 2014). In addition, Bangladesh, like many developing countries, is undergoing an epidemiological transition with a growing morbidity and mortality linked to non-communicable diseases, such as heart disease and diabetes. Much more will need to be done in the future to prevent and treat such conditions.

A pluralistic and fragmented health system

While the MOHFW is responsible for overseeing, managing and regulating health, family planning and nutrition programmes countrywide, health services are delivered by a complex mix of public and private institutions.

Bangladesh's public health system, which was established during the 1970s, mirrors the country's general administrative pattern. The MOHFW directly oversees a network of health facilities (see Figure 2) which stretches from the national level down through seven divisions, 64 districts, 485 sub-districts (known as *upazilas*), 4,501 unions and 13,503 wards. This includes 593 government-run hospitals (126 at secondary and tertiary level, and 467 at sub-district and union levels), 1,362 union-level outpatient facilities, and 12,527 community clinics which provide primary health care to rural residents on an outpatient basis (MOHFW, 2014). This public system employs more than 100,000 health personnel, including doctors, nurses, paramedics and community health workers, and accounts for 26 per cent of total health expenditure in Bangladesh (Ahmed et al., 2013).

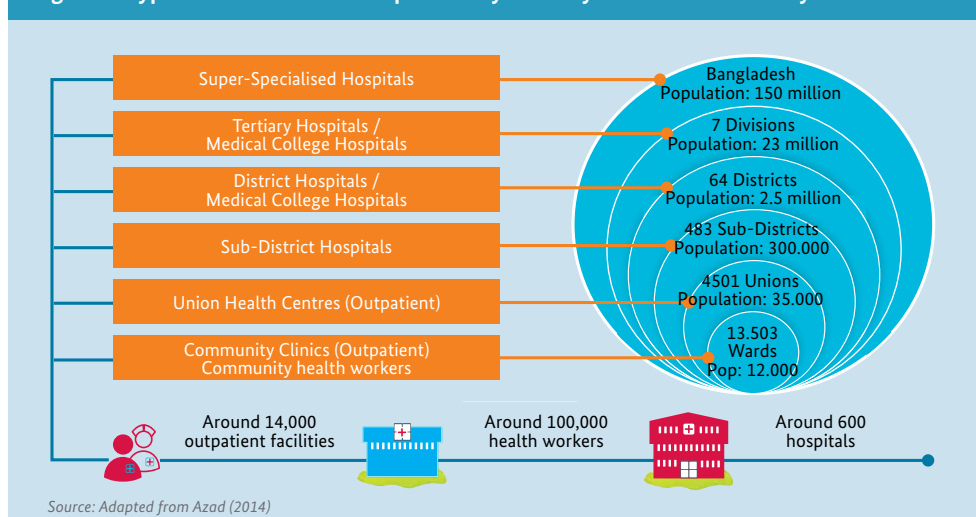
The governance of the public health system is complex. Three aspects of the fragmented landscape should be mentioned:

- **Different ministries are responsible for primary health care in rural and urban areas.** While the MOHFW directly oversees primary healthcare facilities in rural areas, the Ministry of Local Government, Rural Development and Cooperatives (MOLGRDC) is responsible for primary healthcare in urban areas. As the Ministry does not usually have its own network of health care facilities, it subcontracts non-governmental organisations (NGOs) or other private providers to deliver primary health care services to urban residents.
- **Family planning services are managed and delivered separately from other health services** at all levels of the public health system. The decision in 1974 to establish separate health and family planning wings within the MOHFW – led by the Directorate General of Health Services and the Directorate General of Family Planning, respectively – reflects the priority placed upon slowing the country's fertility rate. Despite clear efficiency arguments for re-integrating family planning and other health services, now that the fertility rate has dropped significantly, the two directorates continue to work in parallel using separate facilities and personnel from national down to ward level.

- **There is a strong tradition of project-based health service delivery.** Until the launch of the first sector-wide approach to health in 1998, it was common for priority health interventions such as nutrition services, maternal and child health and tuberculosis control to be funded directly by international development agencies and managed as vertical programmes under the MOHFW. Sometimes the programmes would use the public facilities and personnel to deliver services to the population; other times NGOs would be contracted to deliver services, resulting in duplications, inefficiencies and overlapping initiatives.

Alongside the public system is a large and heterogeneous private sector. The World Health Organization (WHO) estimates that private spending accounts for more than three-fifths of total expenditure on health in Bangladesh (WHO, 2014). The private-for-profit sector has been growing steadily in line with the country's rapid urbanisation. Some 45,000 formally trained doctors and nurses are employed in private secondary and tertiary care facilities, but informal providers far outnumber those with formal qualifications. It is estimated that there are more than 500,000 traditional medical and homeopathic practitioners, village doctors and drug vendors working, largely unregulated, countrywide (Ahmed et al., 2013).

Figure 2: Types of health facilities operated by Ministry of Health and Family Welfare





■ With an estimated 12 million inhabitants, Dhaka is one of the world's great mega-cities.

There is also a substantial private not-for-profit health care sector. Largely enabled by donor funding, NGOs have played an enormous role in Bangladesh since its independence, stepping into the breach to deliver health care services, respond to famine and natural disasters, and fight poverty at a time when the country lacked strong public institutions. There are believed to be more than 2,000 NGOs – both local and international – working on health in Bangladesh (Koehlmoos et al., 2011); many focus on providing primary health care services to the poor, including in urban slums.

As the next chapter describes, the pluralistic and fragmented structure of the health system has made it extremely difficult to collect comprehensive and reliable data about the coverage of health services and the health status of the population.

The evolution of Bangladesh's health information system

The components of a strong health information system

In recent decades massive investments in global health have been accompanied by a growing emphasis on measuring the health of the world's population as a way of tracking progress towards the attainment of key targets, such as the MDGs. Despite this, however, there is still 'a huge gap [...] between what public health professionals know and what they need to know' to improve people's health (WHO, 2008, p.1).

An effective health information system brings together information from a wide range of population- and facility-based data sources – censuses, civil registration systems, population surveys, health service records and health facility surveys, to name but a few – to generate an up-to-date picture of the health of a population. However, only few countries in the world have health information systems capable of gathering data at all levels of the health system, which means

that in most countries decisions about policies, interventions and the allocation of resources are made on the basis of partial or outdated information, or both. The problem is particularly dire in countries which have the greatest health challenges, as these are often contexts characterised by chronic underinvestment in the systems needed for data collection, analysis, dissemination and use (WHO, 2008).

The performance of a country's health information system depends not only on data sources, but also upon certain policy, administrative and organisational prerequisites which allow the institutions which produce and use health information to interact seamlessly with one another (see Box 1). In many countries, including Bangladesh, these prerequisites have been missing, or were only partially present.

Box 1. Frameworks and standards for country health information systems

The Health Metrics Network was established in 2005 under the auspices of the WHO to improve global health by strengthening the systems that generate health-related information in countries worldwide.

To do this, the Network advocates the development of comprehensive national plans created with broad-based inputs from stakeholders both inside and outside of the health sector. The plans should focus on establishing or strengthening the following components:

- **Health information system resources**, including the legislative, regulatory and planning frameworks which underpin the system, and the resources – personnel, financing, logistics support, information and communications technology, and coordinating mechanisms – to allow it to function.
- **A core set of indicators and targets** for monitoring and assessing changes in determinants of health; health system inputs, outputs and outcomes; and health status.
- Both population-based and facility-based **data sources** which allow for tracking of indicators and targets.
- **Data management** processes, ranging from data collection, storage and quality assurance to transfer, processing, compilation and analysis.
- **Information products** which translate data into evidence and knowledge for decision making.
- The **dissemination and use** of health information.

Source: Framework and Standards for Country Health Information Systems (WHO, 2008).

Bangladesh's patchwork HIS

Between January 2007 and June 2008 a group of experts under the MOHFW joined forces with the WHO's Health Metrics Network to assess the status of Bangladesh's health information system – and the context in which it operates – against a set of international standards (see Box 1). The results were sobering: only three of the six main components (i.e. indicators, data sources, information products) were assessed as being 'adequate' or 'highly adequate'; two (i.e. resources, dissemination and use) fell into the category of 'present, but not adequate'; and one component, data management, received a score of 0 – 'not at all adequate' (Munshi et al., 2009).

In the absence of strong central leadership, a supportive regulatory environment, clear policies and a common infrastructure to facilitate the transfer of information among users, Bangladesh's health information system sprang up in a haphazard manner around the specific information needs of dozens of different institutions. And, as the Health Metrics Network assessment showed, data management procedures were the weakest link of the chain.

Historically, each of the various health care providers in Bangladesh has handled routine data collection in its own way: the public sector has multiple routine information systems which map to its various service delivery channels; large NGOs maintain their own information systems, often designed to meet the monitoring and evaluation requirements of donor agencies; and other private providers operate their own systems for managing patient records, drug supplies and human resources.

All of this data remained in its own silos and was never combined. Each system used its own definitions of terms, its own standards for capturing data and its own procedures for collecting and analysing information. The result

was a patchwork – a system composed of miscellaneous and incongruous parts – that may have been of some use to those who ran the individual information systems, but which was of almost no use at all to officials at a national level who required timely, complete and reliable data for decision making. They had no way of knowing which routine data to use or trust: different departments and programmes would collect information on the same things, using their own systems, and come up with different results. In addition, because data from the public and private sector were never comprehensive nor linked, it was impossible to get an overview of the distribution of service coverage by different types of providers for services such as antenatal or delivery care or the treatment of sick children.

As a consequence, policymaking was overly dependent upon the findings of periodic surveys, such as the Bangladesh Demographic and Health Survey, which are expensive and complex to undertake and hence conducted only every three to five years. These robustly designed surveys provide a credible snapshot of health at the national and divisional level and are useful for tracking broad changes in population health. However, the long gaps between surveys and limitations to the analysis which could be undertaken meant that policymakers could not act as quickly as they might like to when monitoring and planning health interventions. Ideally, data derived from surveys and from routine sources should complement one another, with indicator surveys helping to validate facility-based data, to address risk behaviours and to illuminate the equity dimension of health.

Weak routine information systems also hampered the management of health services at a decentralised level. One-way flows of information – where data is collected at the point of delivery, compiled into summary reports and sent upwards through vertical hierarchies – did little to empower facility managers or local health planners to use data to improve outcomes in their facilities.

Box 2. A snapshot of Bangladesh's routine HIS before the digital revolution

Well into the new millennium, the collection of routine health information in the public sector in Bangladesh was done manually, using paper forms which would be completed by health workers at a decentralised level and submitted upwards, through the administrative hierarchy, until they eventually reached Dhaka. The main features of this system included:

- **Parallel systems.** In keeping with its bifurcated structure, the MOHFW had two main management information system (MIS) units – one in the Directorate General of Health Services and one in the Directorate General of Family Planning – each responsible for collecting routine data about the health services it provided, as well as logistics (i.e. equipment and supplies) and personnel. There were also smaller MIS units embedded into vertical programmes. These multiple systems operated independently of one another and the information which they collected was not combined, even at the highest levels.
- **Overlapping reporting requirements.** Facilities and field workers were responsible for collecting certain types of routine data using standardised reporting formats. These forms, however, were not harmonised, with the result that the same information would often be collected multiple times (sometimes according to different definitions) by different departments and programmes. This resulted not only in a heavy paperwork burden, but also in data of questionable quality, as field workers struggled to keep up with the reporting demands of multiple, poorly coordinated sub-systems (Munshi et al., 2009).
- **Paper forms and ledgers.** Data collection systems were paper-based, with aggregate data being captured electronically at certain levels of the system. Hard copies of reports would be sent to the next highest administrative level where they would be combined with similar data from other facilities, sent to the next higher level, and so on, until they reached the national level (Munshi et al., 2009).
- **Slow channels of communication.** Communication between levels of the public health system relied on the postal system, land lines and fax machines. Generating an answer to even a relatively simple data request was extremely time consuming, as letters had to be sent by post from one administrative level to the next and back again. Not only was this inefficient, but there were chances for mistakes at every step, as data was continuously being compiled and forwarded up the chain.
- **Insufficient manpower.** The MIS unit in the Health Services directorate was understaffed (160 out of 660 sanctioned posts were vacant in 2009) and had few personnel with the knowledge and experience needed to modernise the existing paper-based system. Statisticians – the category of employees responsible for gathering, compiling and submitting reports – were overwhelmed by data entry tasks. Beyond this, most did not have statistical training which could be drawn upon in designing research or surveys, undertaking data analysis or preparing reports about various health issues (Munshi et al., 2009).



■ *Data from patient visits to health facilities were recorded in large paper ledgers, such as these. Hard-copy reports were prepared on a daily, weekly or monthly basis using the information contained in the registries.*

Digital Bangladesh

By the late 2000s it was clear to officials in the MOHFW that management information systems desperately needed to be modernised. The new head of the Management Information Systems (MIS) unit, the Directorate General of Health Services, Professor Abul Kalam Azad, began a large-scale effort to distribute computers to health facilities in 2008, but was racing to keep up with the pace of technological change. The team leading the Health Metrics Network assessment observed that the unit was 'building the systems now which needed to be built 10 years ago' (Munshi et al., 2009). They recommended, among others:

- preparing a **comprehensive HIS policy** document;
- ensuring more **coordination between the institutions** producing and using information both inside and outside the health sector;
- **filling vacant statistical posts** throughout the public health sector;
- creating **positions for skilled IT personnel** at the MIS unit;
- promoting a **culture of IT-based communication** and reducing paper-based data handling.

These conclusions were voiced at an opportune time: in December 2008, the Government of Bangladesh introduced the vision of 'Digital Bangladesh by 2021' – a call to action to mainstream information technology (IT) in all realms of society as a way to improve transparency and promote development. Under the rubric of Digital Bangladesh, the government actively encouraged civil servants to leverage IT tools to improve the planning, design and delivery of

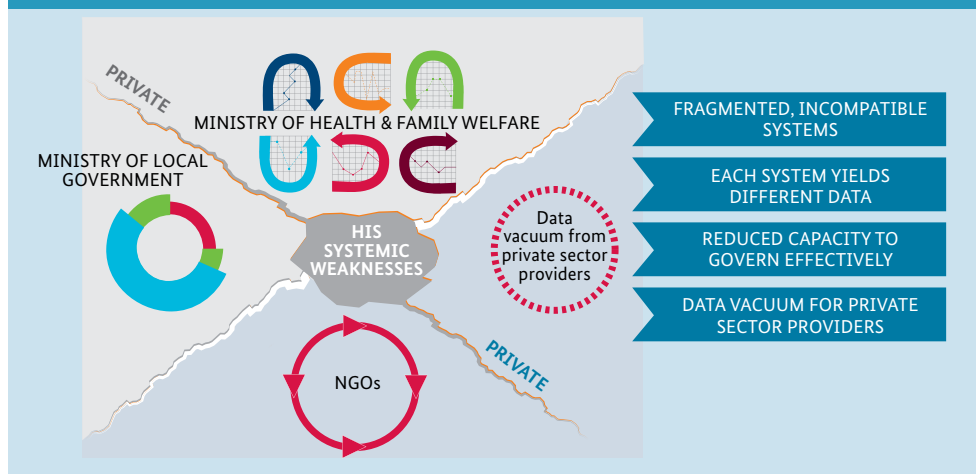
services, particularly for the poor (Access to Information Programme, 2009).

The idea of Digital Bangladesh caught on in a way that earlier efforts to promote IT for development in Bangladesh never had. Innovations and pilot projects abounded across the public sector and the health sector was no exception. Starting in 2009 there was a virtual explosion of eHealth projects within the MOHFW: from telemedicine centres, electronic attendance systems to monitor staff punctuality at health facilities, and mobile phone-based medical consultations for patients at district and sub-district health facilities, to a nationwide patient complaint system using text messaging. Beyond this, efforts also began in earnest to build a digital infrastructure within Ministry structures, extending from the national to decentralised levels. The offices of the MIS unit at the Health Services directorate were renovated, a MIS Data Center – a modern, air-conditioned space with a backup generator – was established to host a new web-based server, and an IT lab was set up to facilitate staff training. The MIS unit also set up a web portal to which content from the entire Health Services directorate could be regularly uploaded, created an Internet mail server with its own domain, and provided each health facility under its jurisdiction with its own unique email address to speed communications. By April 2009, the MIS unit had provided some 800 hospitals and health offices, from national to sub-district level, with computers and wireless modems. The groundwork was being laid for existing health information systems to become digitised.

■ *Professor Abul Kalam Azad in the data center at the MIS unit in the Directorate General of Health Services.*



Figure 3: Extreme fragmentation of routine HIS, 2009



■ Rapid, but uncoordinated digitisation

As a motivating idea Digital Bangladesh was wildly successful, but in the absence of overarching information management strategies and policies within individual sectors, adopting IT became the end, rather than the means to an end. Within the sprawling MOHFW, with its 32 operational programmes, new management information systems appeared everywhere.¹ The apparent benefits of digitising paper record-keeping led many line directors to invest in the creation of custom-made software systems for capturing and transferring data. By late 2009 there were no fewer than seven different electronic MIS systems operating within the Ministry.² Because there was no policy which required these systems to be built according to common standards and to fit into an overarching architecture, each unit went its own way. Data could now be transmitted more quickly through vertical channels, but the individual datasets were not interoperable.

There was another risk to focusing on individual solutions at the expense of the bigger picture: many of the new software products underpinning these systems were developed by private companies. If the companies went out of business – which occurred not infrequently – there was no one capable of providing software support. The commissioning departments were left with software which could not grow with them, and very quickly these systems would have to be scrapped and built anew.

Although the transition to the electronic era occurred relatively quickly within the MOHFW, it happened in a disorganised way. There was little thought given to the benefits of an integrated HIS which could move beyond the well-known limitations of the existing paper system: duplication of information, non-standardisation of data and an inability to work across IT platforms. Nor was the opportunity seized to work towards a more harmonised HIS for the sector as a whole (see Figure 3): while MIS systems were proliferating within the Ministry, other major health providers – including the Urban Primary Health Care Project at the Ministry of Local Government and private for-profit and not-for-profit providers – were developing their own MIS solutions. The information landscape remained fragmented and data from the private sector remained completely disconnected from policymaking, except as it was reflected in periodic population surveys.

¹ Management Information Systems are systems – typically computerised – which provide organisations with the information they need to organise, evaluate and manage their operations.

² While the MIS Unit within the Directorate General of Health Services is responsible for gathering and working with routine data for all services provided under the directorate, it does not have any formal authority over the disease-specific and vertical programmes which, in the directorate's organigram, are all located at the same level.

A new focus on routine information

■ Bangladesh's health sector reform programmes

Beginning in 1998, the Government of Bangladesh and major development partners joined forces to implement a series of five-year strategies to improve population health and strengthen health systems. These sector-wide approaches to health reform are aimed at making development assistance more effective by aligning financial and technical contributions behind an agreed government-led plan, thereby minimising the duplications and wastage associated with multiple, overlapping vertical initiatives.

The Health Population and Nutrition Sector Development Programme, launched in 2011, is the third and largest such effort. Seventeen different development partners are providing a total of USD 1.8 billion in financial and technical contributions (approximately 30 per cent of the total cost) to implement the programme, which is organised into 32 different operational plans, one for each of the MOHFW's operational programmes. Two of the plans are focused on strengthening health information systems and eHealth.

Beyond these specific operational plans, however, improving routine information systems has emerged as a cross-cutting theme within the sector reform programme because of the need for robust data to monitor the programme's results. A Project Monitoring and Management Unit within the MOHFW is responsible for reviewing the performance of

the individual operational plans and the strategy as a whole on an annual basis. While many indicators should ideally be tracked using routine data sources, the absence of reliable data covering the entire population has meant that the unit has to rely heavily upon data from periodic surveys or from specially-commissioned studies to do its job.

■ Germany's contribution

Despite widespread consensus over the need for an effective system for gathering routine health information, the challenges involved in building such a system are daunting. GIZ, working on behalf of Germany's Federal Ministry for Economic Cooperation and Development, is one of the few partners in Bangladesh which has worked directly and consistently on strengthening the country's health information system in recent years.

Through its Support to the Health Sector Programme, GIZ builds management capacities in selected departments of the MOHFW which are critical for strengthening overall sector management. The programme focuses on topics such as health financing, health governance and gender, quality management (with an emphasis on occupational health and safety), and health information systems.

In the area of health information systems, GIZ provides technical assistance and policy advice to the MIS unit of the Directorate General of Health Services, which has emerged as the champion of efforts to modernise and upgrade

Box 3. German Development Cooperation in Bangladesh's Health Sector

Germany has been supporting Bangladesh's social and economic development since the country's independence. Since 2003 it has provided both financial and technical support to the health sector reform programmes led by the Government of Bangladesh, including a commitment of USD 49.5 million to the current Health, Nutrition and Population Sector Development Programme.

The KfW Development Bank administers Germany's financial assistance to the health sector reform programme. Germany is the third largest of the seven development partners contributing to the multi-donor pooled fund, which is managed by the Government of Bangladesh and overseen by the World Bank.

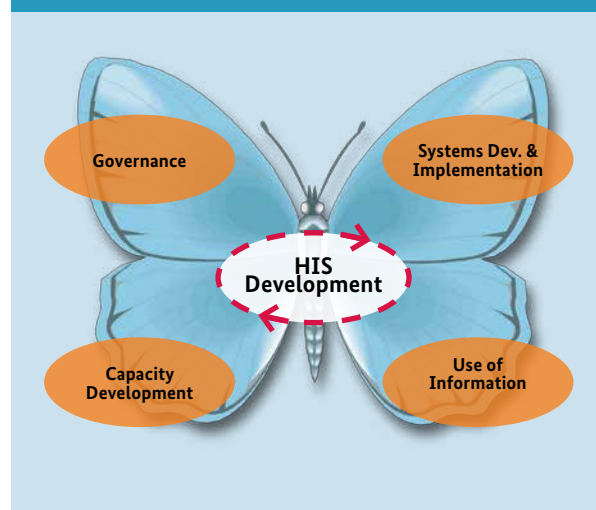
German technical cooperation provided by GIZ supports the strengthening of selected areas of the health system at both the national and sub-national levels. At a national level, the Support to the Health Sector Program builds the institutional and organisational capacity of selected departments within the MOHFW. At the sub-national level, the Addressing Bangladesh's Demographic Challenges (ABDC) programme works to improve urban health in Sylhet City through a combination of governance strengthening initiatives and measures to improve sexual and reproductive health.

existing systems. While aligning support with the goals of the operational plan on HIS and eHealth, which the MIS unit is responsible for implementing, technical advisors with GIZ have also encouraged colleagues at the unit to pursue a comprehensive approach to health information systems strengthening which goes beyond a narrow focus on technology and infrastructure.

The ‘butterfly model for HIS strengthening’ (Figure 4)³ which the GIZ team has elaborated reflects the understanding that a health information system requires four equally strong wings to function successfully:

- **Systems development and implementation:** putting in place appropriate IT software and hardware for data collection and management, and maintaining, managing and further developing these systems;
- **Capacity development:** building local expertise to maintain and manage the health information system, including its technical aspects;
- **Use of information:** making information available, in accessible formats, to all stakeholders, while instilling a culture of evidence-based decision making; and
- **Governance:** systems and processes for managing the country’s HIS, including coordination mechanisms, strategic plans, and policies.

Figure 4: The butterfly model for HIS strengthening



This balanced approach is consistent with the framework endorsed by the Health Metrics Network and with the Regional eHealth Strategy promoted by the Southeast Asia Region Office (SEARO) of the WHO. Yet, as the remainder of this report will show, it has also proven to be a pragmatic and effective choice in a context where efforts to bring about change cannot wait for the political will to be summoned to develop an overarching strategy. While the vision of an orderly, systematic, consensus-based process of reform is the ideal scenario, the reality in Bangladesh, as in many countries, is much more complex.

The next chapter describes the specific measures supported by GIZ, in close collaboration with the MIS unit in the Health Services directorate, and shows how these have played a critical role in nudging Bangladesh’s fragmented HIS into a more harmonised system capable of providing the information which government officials, policymakers and development partners need to improve the population’s health.

³ The butterfly model for HIS strengthening, as well as its graphic representation, are based upon GIZ’s capacity development concept. See GIZ (2011). *Capacity Works: The Management Model for Sustainable Development*. Eschborn, Deutsche Gesellschaft für Technische Zusammenarbeit.

Bringing order to chaos: HIS strengthening in Bangladesh

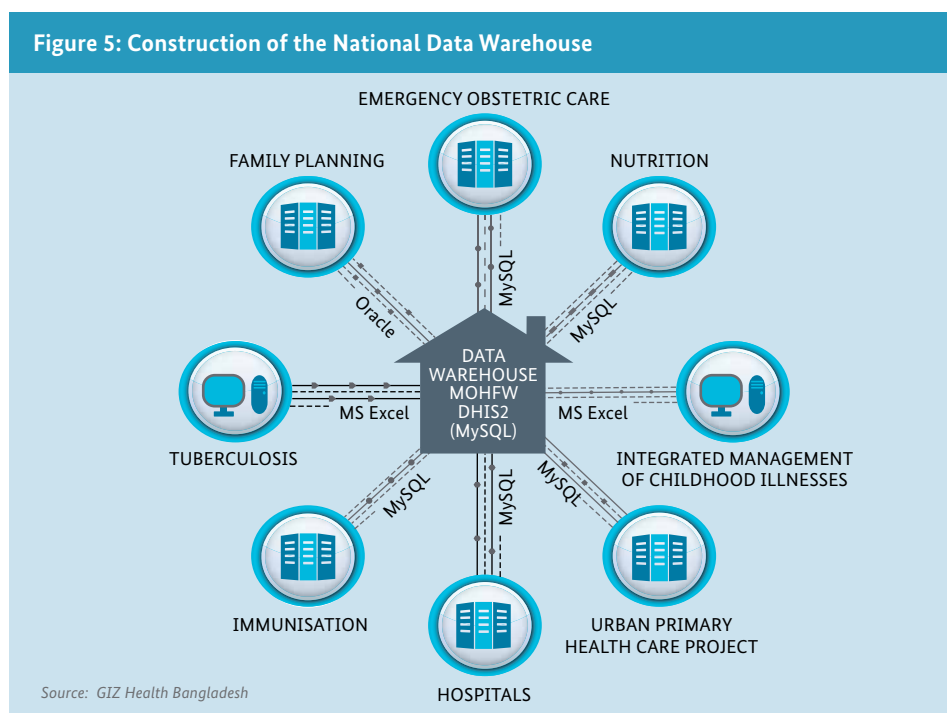
First steps in systems building: the National Data Warehouse

The starting point for efforts to rationalise the fragmented HIS landscape was to bring together data from multiple, parallel management information systems into a useful whole. Beginning in 2009, GIZ supported the MOHFW to create a National Data Warehouse, an electronic data repository which bridged the gaps between the various computerised databases and made them interoperable.

GIZ contracted the consulting firm EPOS Health Management to design and build the National Data Warehouse; the initiative was known as the Data Management and Information System (DMIS) project. Over a two-year period, a team of experts manually mapped and converted the contents of eight separate databases, which had been developed using different platforms, into a standard format (see Figure 5). This involved coming up with a complete inventory of the contents of each dataset, developing an interim translator (a code for standardising data), converting all the datasets so that they could be used by a single software, and integrating the data.

The challenges involved in building the National Data Warehouse were enormous, recalls Muhammad Abdul Hannan Khan, a GIZ senior technical advisor who was involved with the DMIS project. At a technical level, decisions had to be made about how to deal with gaps in data definition, double reporting and databases with fundamentally different structures. Moreover, it took time to convince the owners of the various MIS systems to join the initiative in the first place; many were reluctant to share their data and to release it into the central repository. 'When data goes public, it puts pressure on everyone to look at data quality,' he explains.

Once the existing databases were integrated, it became possible for the first time to access and analyse data from different vertical programmes – and from the health services and family planning directorates – through a single interface. The National Data Warehouse provided rich data mining functions which decision makers could use to plan and monitor health interventions at all levels of the health system.



The District Health Information System (DHIS2) comes to Bangladesh

The DMIS project team explored a variety of technical platforms for the National Data Warehouse before finally landing on a free, open source software called the District Health Information System (DHIS2), which has emerged over the past 15 years as a leading software for managing health information in developing countries (see Box 4). More than 30 countries currently use DHIS2 as the basis for their health information systems.

DHIS2 was specially designed as a flexible, easily adaptable tool for collecting and managing aggregate health data. As two of the main architects of DHIS2 have put it, 'The creation of software to support HIS in countries is so complex and so huge a task, while the requirements in many countries are quite similar, it makes a lot more sense to collaborate as a big virtual team, than to work in isolation and reinvent the wheel' (Braa and Sahay, 2013).

The Health Information Systems Programme (HISP), which has led the development of DHIS2, is a collaborative, global network comprised of regional and country health authorities, open source communities and research institutions all committed to the development, implementation and use of DHIS2 to improve public health decision making. New and improved versions of the software are released regularly. The global DHIS2 community is supported by major development partners and philanthropic organisations, including the Norwegian Agency for Development Cooperation (Norad), the Global Fund to Fight AIDS Tuberculosis and Malaria, and PEPFAR, lending it real sustainability.

■ Taking the leap into open source software

At the same time that the DMIS project was settling upon DHIS2 as the software solution for the National Data Warehouse, technical advisors from GIZ were working closely with Professor Abul Kalam Azad, the director of the MIS unit at the Health Services directorate, to explore different options for the collection of routine data in health facilities. After taking over as head of the unit in 2008, Azad quickly emerged as a champion for the modernisation of information systems in the health sector. When he arrived, no one in the unit had Internet access, even in headquarters. 'Paper registers were being maintained in all facilities and these had to be collected somehow at headquarters. It was impossible to do this efficiently,' he recalled recently. 'People were frustrated. It wasn't clear what they were doing, or why. In order to manage a system countrywide, we needed a digital system.'

'Our goal was to make a digital system where data was entered at source and where people could access their own data, but where data for the whole country also could be seen and analysed at headquarters in real time,' Azad explained. He consulted widely with private service providers, as well as the donor community; GIZ facilitated the introduction to DHIS2 as a software which was flexible, easy to learn, explicitly designed for the decentralised collection of health data in developing countries, and fully compliant with WHO data exchange standards. DHIS2 was also highly scalable: thousands of concurrent users and hundreds of millions of data records could be supported through a single web server.

Not everyone within the MOHFW was convinced about the merits of open source software, and the vested interests of software vendors who supplied government ministries meant that significant advocacy needed to be undertaken by GIZ and Azad to make the case for the suitability of DHIS2. But in 2010, with GIZ's support, Azad's MIS unit installed DHIS2 on its servers and Bangladesh joined the ranks of countries utilising the product.

Box 4. A brief history of DHIS2

The story of the District Health Information System dates back to the immediate post-apartheid period in South Africa when there was an urgent need for an inexpensive, flexible software which could be deployed in support of efforts to both decentralise and integrate a highly fragmented health system. During the apartheid period there were no fewer than 14 departments of health at the central level (designated, among others, for 'white,' 'Asian,' 'coloured' and 'black' populations, as well as for homelands and self-governing states) – and, as in Bangladesh, multiple data collection tools, procedures and data definitions, and no national data collection standards (Braa & Sahay, 2013).

DHIS was initially developed as a free database application by the Health Information Systems Programme (HISP), a project led by the Department of Informatics at the University of Oslo. It was introduced on a pilot basis in a single district of South Africa in 1997 and, following three years of participatory design, was being implemented in every district and province of the country.

DHIS promotes the use of information for improving health services and, as such, is deliberately designed to:

- Give greater control over data and data management to users at local levels;
- Support a flexible data structure (e.g. easy to add and change data elements, health facilities and districts, and organisational boundaries);
- Enable the integration of vertical flows of data;
- Empower local health managers, health workers and community members by granting them access to their own information; and
- Facilitate the horizontal flow of information by allowing users outside the health sector to access aggregated health information.

After the turn of the millennium, DHIS began to be used in more and more countries, including Cuba, India, Mozambique and Viet Nam, but it became difficult for the South Africa-based development team to keep up with the specific requirements of an expanding network of users.

Starting in 2004, the software was fully redeveloped. Version 2 – DHIS2 – is a modular web-based application that uses a distributed development platform to bring software development closer to the contexts where it is used. Software developers in countries using DHIS2 engage with the global source code to customise versions for local implementation (Braa and Sahay, 2013).

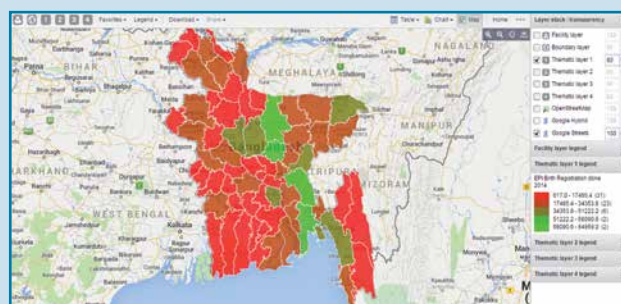
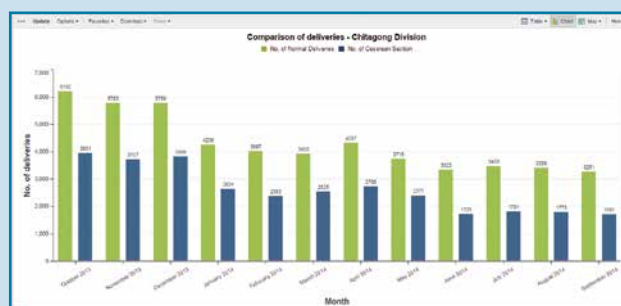
■ Migrating forms: The first three datasets move to DHIS2

Now that the National Data Warehouse was up and running, using DHIS2, the next step was to customise the software so that facilities could begin capturing their data directly at source, in DHIS2, through a web-based interface. The MIS unit began reaching out to different departments and programmes across the directorate, demonstrating the potentials of the software to simplify their work. The Emergency Obstetric Care programme and the team responsible for monthly reporting on Integrated Management of Childhood Illnesses were the first to express interest; a decision was taken to migrate the monthly hospital bed statement as well.

GIZ technical advisors worked closely with the programme managers and with external consultants to customise DHIS2 for use with these three datasets. This process involved lengthy back-and-forth discussions with programme managers, particularly around decisions about what data to collect. While the technical advisors encouraged programmes to streamline their reporting requirements, programme personnel were often reluctant to reduce the breadth and depth of data being collected, not wanting to be held responsible down the road for information which was no longer available. In the end, the individual programmes had the final decision about what data would be collected via DHIS2.

Box 5. Features of DHIS2

DHIS2 is a comprehensive, fully customisable data management system with advanced data visualisation capabilities. Its key features include:



- **Charts:** Users can generate and customise a range of standard chart types by selecting indicators, organisational units (i.e. facilities or administrative levels), time periods and other variables. Charts can be saved, shared and downloaded.
- **Pivot tables:** Data can be arranged and analysed in web-based pivot tables; users can filter columns and rows according to their specific needs. Tables can be saved for future use within DHIS2, or downloaded for offline use in Microsoft Excel.
- **GIS mapping:** Data in DHIS2 can be mapped visually. Users can generate, save and share maps showing everything from the location of different types of health facilities to the proportion of children who are fully immunised in a given administrative unit.
- **Dashboard:** DHIS2 users can configure their own personal 'dashboards' where the charts, maps and reports they use most often are continuously updated for real-time tracking of key indicators. The dashboard feature also allows users to communicate directly with other DHIS2 users through a messaging function, thereby facilitating joint discussions and interpretations of data.

Source: www.dhis2.org; screenshot from Bangladesh's DHIS2.

When the customised system with new forms was ready, it was time to train people to work with DHIS2. For months GIZ's technical advisors had been coaching and providing on-the-job training to the technical personnel at the MIS unit to build their understanding of DHIS2 and to teach them how to manage and maintain the servers. They also supported the unit in preparing staff at a decentralised level. In February 2011, 128 statisticians, two from each of Bangladesh's 64 districts, came to Dhaka for a three-day training programme. GIZ's technical advisors gave the statisticians a basic introduction to DHIS2 and its features, taught them how to log into the reporting server using their facility's unique username, and systematically went through each of the three forms.

Although DHIS2 is an extremely intuitive system for those who are computer literate, it was necessary to allocate sufficient time to the training – 'one day, one form,' as Muhammad Abdul Hannan Khan, the GIZ technical advisor, described it – to ensure that the district statisticians went away confident not only in their ability to work with DHIS2 themselves, but also to explain it to others. In order to minimise costs and to accelerate the roll-out process, the MIS unit chose to use a 'cascade' method to extend training down to the lowest levels of the health system. The trained district-level statisticians were responsible for repeating the training for statisticians at the health facilities at sub-district level.

In March 2011, with little fanfare, data started to flow into DHIS2 from facilities country-wide.

■ More and more datasets migrate to DHIS2

After the first three datasets came on line, interest in DHIS2 began to build. Programmes and departments within the MOHFW saw the benefits of having their data integrated into the National Data Warehouse and were attracted to the simplicity and functionality of DHIS2. By early 2014, there were 33 datasets being managed in DHIS2, representing the vast majority of services being provided in the Health Services Directorate. In June 2014 the MIS unit of the Directorate General of Family Planning also signalled its decision to use DHIS2 as an integrated platform to collect routine data – an important step towards bridging the information divide which had historically existed between the MOHFW's two main directorates.

'DHIS2 is a mature and functioning system which has low obstacles to adoption,' explains Kelvin Hui, the GIZ technical advisor responsible for health information systems strengthening. 'Rather than calling for a tender – with its lengthy processes, costs and inherent lobbying and corruption problems – departments simply need to ask the MIS unit for support in building data collection forms in DHIS2 and can have it rolled out immediately.' After DHIS2 was first introduced at facility level, there was no need for a lot of additional training, since personnel already knew how to log on and navigate the system. When new reporting formats were ready, the MIS unit would circulate brief instructions via email to all statisticians updating them on reporting requirements. Data would begin to flow almost immediately.

Box 6. National Nutrition Services: 'Now we are part of something larger than ourselves'

Pointing to a stack of monitoring reports on the desk in front of her, Nasreen Khan, the deputy programme manager of the National Nutrition Services, can still hardly believe her eyes. In mid-2013 key nutrition-related indicators were integrated into the standard reporting format for the Integrated Management of Childhood Illnesses programme in DHIS2. As a result, Khan and her staff are now able to generate regular reports about the number of women and children receiving nutritional advice, infants being exclusively breastfed, or cases of underweight and stunting among children under the age of five at health facilities countrywide.



■ *Dr Nasreen Khan*

The National Nutrition Services programme was created in 2011 with the goal of mainstreaming nutrition into the existing services being provided by the Health Services and Family Planning directorates, after years of stand-alone nutrition programmes administered by NGOs. Khan's portfolio included nutrition surveillance. 'It's been incredibly efficient for us to join this approach,' she says, referring to DHIS2. 'When we started, we didn't inherit a health information system. We were basically in a vacuum.' According to Khan, various approaches to nutrition surveillance have been used in Bangladesh since the 1990s, but because the structure of nutrition service provision kept changing, no single, lasting surveillance system ever emerged. As in other areas of health, the history of HIS in nutrition is characterised by gaps, incompatible platforms and obsolete datasets.

'By using DHIS2, we are now part of something larger than ourselves,' explains Khan. 'It would have taken us way more energy and resources to build something new and there's no way at this stage that I'd be able to show you data from 245 sub-districts,' she says, gesturing to the charts in front of her, summarising results from those sub-districts where nutrition services have now been mainstreamed. 'In this case, it took one email from the MIS unit and the next day, 245 sub-districts started reporting.'

Other departments also liked the fact that in-house technical and troubleshooting support was available from technicians at the MIS unit, with backstopping from GIZ. There is an email list, for example, where statisticians can post technical queries; the answers go to the entire list so that everyone can benefit from the advice. There is also a designated staff person in Dhaka who provides technical support to health facilities by telephone. With these functions performed within the Ministry itself, it was no longer necessary for programmes to deal with external consultants and IT companies for software-related problems.

'The most important feature of DHIS2 is not the software itself, but the robust community that stands behind it,' Hui explains. 'Users regularly get new functions and features at no cost via new version releases.' This is because DHIS2 users in countries around the world make modifications to the software based on their needs and submit these for approval to the custodians of DHIS2. Some of the functions within the core software have been contributed by the Bangladesh DHIS2 development efforts.

■ Community clinics come on board

Once all health facilities down to sub-district level were routinely capturing data in DHIS2 across the range of datasets, it was time to 'go deep.' In early 2014, the MIS unit at the Directorate General of Health Services began to extend DHIS2 to the 13,000 community clinics which provide basic primary health care and health promotion services to the country's rural population and to the more than 20,000 Health Assistants affiliated to the clinics who make home visits.

For Professor Azad, the head of the MIS unit, bringing the community clinics online was a critical step on the road to a comprehensive, nationwide health information system. 'We originally focused on data collection in facilities, but we knew that this could never give us the whole picture,' he explained recently. 'We know that many people use private providers; others go to unregistered facilities or to informal

healers. In Bangladesh there is only one way to really know what's happening,' he continued, 'and that is to visit people's homes.'

In April 2014 laptops and wireless modems began to be distributed in phases to community clinics countrywide. At the same time, Health Assistants working from the clinics received tablet computers to use to capture data during household visits. Less than a month after the Ministry started delivering the equipment, 3,500 community clinics were already reporting data using DHIS2.

■ DHIS2 poised to enter urban areas

The MOHFW's decision to adopt open source software for its routine information system has not gone unnoticed by the Ministry of Local Government, Rural Development and Cooperatives. Since 2006, the Urban Primary Health Care

Box 7. A view from the front lines of DHIS2 implementation

How are users experiencing the roll-out of DHIS2 at decentralised levels of the health system? There is perhaps no one who knows the answer to that question better than Usaimong Marma. Since early 2014, Marma has been working in the Cox's Bazar district of southern Bangladesh, helping the civil surgeon's office, the heads of the sub-district health complexes and the staff at the community clinics with data entry, report generation and analysis, and IT troubleshooting.



■ Usaimong Marma

Marma is one of three consultants employed by UNICEF Bangladesh as part of a pilot project to test approaches to strengthening health management information systems at a local level. He and his colleagues have been deployed to three districts with poor development indicators to assess how the roll-out of DHIS2 is taking place under the most challenging circumstances and to explore how local officials can be supported to use routine health information for planning and decision making, particularly in the areas of maternal and child health and immunisation.

What Marma has found in Cox's Bazar is a mixed and fluid picture (Marma, 2014). 'Things are running pretty smoothly at the health complexes at sub-district level,' he observed, 'but there are definitely challenges at the community clinics. 3G isn't yet stable in the area and, as a result, lots of Community Health Care Providers are having trouble with connectivity.'

There are 166 community clinics in the district – about 90 per cent of them have been equipped with laptops and wireless modems and approximately 80 per cent of Community Health Care Providers have received at least basic training on DHIS2 (Marma, 2014). 'The best part of my job is the end of the month when the community clinics have to report,' says Marma. 'If data is missing, I call them up, ask where their data is, and help them to get it submitted correctly.' The roll-out of DHIS2 is well underway, but there is still a long way to go until all the Community Health Care Providers are comfortable with DHIS2 and are able to submit their data regularly and effortlessly.

Project has used its own customised software to collect monthly reports from the providers it contracts, on behalf of the Ministry, to deliver an essential services package to residents of ten city corporations. Last year, however, it was announced that the Urban Primary Health Care Project will, in future partnership agreements with service providers, require that all regular monitoring data be reported in DHIS2 and in OpenMRS (see 'Digitising inpatient records with OpenMRS' below).

Muhammad Ziaul Hoque, a senior programme officer for management information systems with the Urban Primary Health Care Project, welcomes the move. 'We want our data to become available to others,' said Hoque. 'There needs to be cooperation between the ministries in order to get a full picture of health in the country.' The project team anticipates that the migration to the new software will occur at some point during 2015.

Introducing individual medical records

DHIS2 was explicitly designed with the facility-based collection of aggregate data in mind, which made it an obvious choice for the MOHFW when it wanted to digitise its routine data collection. However disaggregated (patient-specific) data allows for improved quality of data – the current system of manual summation of daily records to derive monthly data still has risk of errors – and much more powerful data mining and analysis opportunities. Disaggregated data will lead to better, more accurate information upon which to base health-related decision making.

As part of GIZ's support to HIS strengthening in Bangladesh, it has facilitated two initiatives to bring individual patient records into widespread use. The first was support for the adoption of the 'patient tracker' function under the auspices of DHIS2; the second has involved the introduction of electronic medical records in hospitals through the open source software OpenMRS.

Box 8. A glimpse of the future: NGOs and private providers in Sylhet using DHIS2

Sylhet, a city of approximately 500,000 people located in the north-east of Bangladesh, is one of the country's 11 city corporations. In September 2013 Sylhet broke new ground by becoming the first city in Bangladesh where routine information about urban health is being collected by private providers using DHIS2 and is being integrated into the National Data Warehouse.

Sylhet has become something of a laboratory for testing the potentials of DHIS2 as a streamlining platform for routine health information. Through its Addressing Bangladesh's Demographic Challenges (ABDC) project, which focuses on sexual and reproductive health in Sylhet, GIZ has encouraged the Chief Health Officer of Sylhet to require regular reports from all NGOs and private providers active in the city. As the city official responsible for public health, he recognises that he needs comprehensive and timely data in order to do his job. As a result of his efforts, some NGOs in Sylhet have now begun to enter data directly into DHIS2.

Once the Urban Primary Health Care Project switches over to DHIS2, it will be possible to analyse data about the health of urban populations alongside data from rural areas. Until then, Sylhet offers a glimpse of what the future may hold in store.



■ Thanks to the efforts of Sylhet City's Chief Health Officer, information about all facility-based services provided in the city, including antenatal care and deliveries, is now being captured in DHIS2.



■ **Top:** Health Assistants like Marzia Begum, who works at the Notun Mahal Community Clinic, make regular home visits. They carry out health education and disease prevention activities, administer vaccinations, identify pregnant women and newborns, and make referrals.

■ **Bottom:** The individual record function makes it easy for health workers to know when pregnant women and children have missed a check-up and to encourage them to come to the clinic.

■ Individual records and the 'patient tracker'

One of the main limitations of Bangladesh's previous paper-based system of record-keeping had nothing to do with the inefficiencies of reporting, and everything to do with the quality of care being provided to patients. Information about outpatient visits was recorded in clinic registers, but it was not linked to individual patients so there was no way to track a particular individual's health status over time, to refer back to his or her health history, or to know when a patient was overdue for a check-up. The lack of individual health records was particularly problematic in the case of pregnant women and young children, for whom continuity of care is critical.

Early versions of DHIS2 did not support individual records, but this function was eventually added after it became clear that it could help to improve the effectiveness of many countries' maternal and child health programmes. The so-called 'patient tracker' function, designed specifically for use with pregnant women and young children, allows for the creation of case-based records in which details from patients' appointments can be captured and subsequently retrieved. Patients can also be tracked over time. When health workers run an overview report of individual records affiliated to their clinic, they can see a list of patients who have missed scheduled appointments and can send automatic text message reminders to their mobile phones encouraging them to come to the clinic, much like an appointment management system.

Figure 9: Screenshot of DHIS2 individual record

The screenshot displays the DHIS2 'Individual Records' interface for a patient named 'Almora CC, Basail'. The interface includes a sidebar with a list of locations, a main area showing a timeline of services, and a detailed form for the current service.

Timeline of Services:

- Reproductive Health Services: 2014-07-23
- Reproductive Health Services: 2014-08-05
- Reproductive Health Services: 2014-09-04

Service Details (2014-07-23):

ANC Services			
Number of ANC	ANC-2	ANC provided by	CHC
Anemia	1+	Danger sign	
Blood Pressure	Systolic: 110 Diastolic: 70	Edema positive	
Weight in Kg	61	Urine Sugar	Positive
Height in Cm	155	Urine Albumin	Positive
Immunization Status	TT-5 completed	Counseling (husband)	
		Number of IFA provided	10

Individual patient records are established on the basis of name, identification number and/or mobile phone number. They are linked to specific clinics, but are portable in the sense that they can be accessed by the system without geographical barriers. If a patient moves, the electronic record can be reassigned to a different facility. After giving birth, pregnant women's records are immediately linked to those of their newborn children, further enhancing continuity of care.

In Bangladesh, the introduction of the patient tracker function in DHIS2 was the first major innovation which took place after the software was already in widespread use. In late 2013 the GIZ technical advisors began working with the technical team at the MIS unit at the Health Services directorate to develop the necessary forms in DHIS2 and helped to train district-level statisticians at a series of workshops held at divisional level.

To date, three different types of individual records have been rolled out: a maternal register, containing information from pregnant women's antenatal visits; a registry for child health checks; and a registry for under-5 child health. As of May 2014, individual records were being maintained at community clinics in 20 districts (approximately one-third of the country), and were also being used for inpatients at hospitals and district and sub-district levels.

Once the individual records are well established at community clinics countrywide, it will become possible to automatically generate many of the aggregate reports which are currently prepared manually by compiling data from the paper registers and entering them into DHIS2. The monthly maternal health report, for example, will be able to be automatically populated with data from the individual maternal records with the click of a mouse.

Box 9. A view from the Ramu Upazila Health Complex

Akterul Islam is the Health and Family Planning Officer for the Ramu Upazila, responsible for all public health programmes in this sub-district of 260,000 people in southern Bangladesh. One of Islam's main priorities is to increase the proportion of pregnant women who give birth in facilities, in line with the government targets for MDG 5 (maternal health). DHIS2 and the patient tracker function are powerful tools for him in this quest.



■ Dr Akterul Islam

vacant and there's limited manpower. If I had to call someone in here to discuss something, that meant one or two hours that they weren't working with patients.'

'Now,' he says with satisfaction, 'everything comes into this one machine. This is a very good system.'

In April 2014 Islam's clinic began creating individual records for pregnant women, using the women's mobile phone numbers as unique identifiers. 'Now when a pregnant woman comes, her whole record is right here,' he explains. 'And if she misses her appointment, we call her.'

Islam is responsible for 23 community clinics in his sub-district and by logging into DHIS2 from his office can monitor trends in births in these facilities. Many of these clinics have also started using individual records, which makes it easier for the health workers to follow up with pregnant women. 'If I see that the number of deliveries in a facility is going down, I call the Community Health Care Providers to see what's going on and to make sure they motivate the women registered with them to come to the facility.'

'Before this tool it was difficult to do this,' explains Islam. 'In our sub-district there are community workers over here, hospital-based workers there – and everyone had their own job to do. Lots of positions are

■ Digitising inpatient records with OpenMRS

At the same time that the MIS unit at the Directorate General of Health Services opted to roll out DHIS2 for the collection of routine health information, it was also exploring options to digitise patient records in the country's public hospitals. Electronic medical records are a powerful tool which allow health workers to capture in one digital file all the essential data generated throughout the course of a patient's hospital stay or outpatient visit, starting with the patient's complaint and presenting symptoms, through to the results of physical examinations, laboratory tests, or other investigations; diagnosis; the indicated treatment and/or medications; and need for follow-up consultations. Compared to the DHIS2 patient tracker function, which captures limited information for specific population groups (pregnant women and young children) and acts as an appointment management system, electronic medical records are more multi-faceted and can be used to manage the care of patients with any type of health condition.

A joint evaluation facilitated by GIZ led to the selection of another open source software, OpenMRS (MRS stands for Medical Record System), which, while newer than DHIS2, was designed with many of the same goals in mind. Like DHIS2, OpenMRS is supported by a vibrant international network of software developers, health professionals and development practitioners who are committed to optimising a technology platform suitable for use in hospitals in developing countries. There are also strong links internationally between the two open source communities.

When GIZ and the Directorate General of Health Services started working with OpenMRS, it was built around one core module: medical records. With help from HISP India (the Indian 'node' of HISP Global), GIZ and staff at the MIS unit began to customise OpenMRS for use in Bangladesh. The changes they introduced expanded OpenMRS from a tool focused on electronic medical records to one which covers the core ecosystem of any hospital, from lab services, pharmacy and radiology through to inventory and patient billing.

GIZ's primary contribution to the introduction of OpenMRS was supporting the software customisation process; the Directorate General of Health Services took over from that point on, procuring the necessary equipment, setting up training programmes for health personnel, and organising the roll-out of OpenMRS at selected sites. The software went live at three hospitals in Dhaka in 2013, with three more sites coming on line since then.

The introduction of OpenMRS is significantly more complex and expensive than that of DHIS2, since it involves the establishment of whole computer networks within institutions, as well as training and coaching to reengineer existing work processes. That the adoption of OpenMRS has not occurred as quickly as it did with DHIS2 is therefore not surprising. As Kelvin Hui, the head of the HIS strengthening efforts at GIZ, summed it up, 'OpenMRS changes entire work processes: one throws away the paper ledgers, but has to deal with things like losing electricity. The dynamics here are totally new.' Despite teething problems, the MOHFW has continued to expand the number of computers in public hospitals.

The potentials for OpenMRS in Bangladesh are enormous – especially in combination with DHIS2, with which it is fully interoperable. OpenMRS is a more powerful tool for data collection, since it allows for huge amounts of detailed information to be compiled about individual cases. DHIS2, however, is a better tool for aggregating, compiling and analysing data – and is therefore likely to remain more popular with and useful for decision makers.

Building a culture of information use

■ 'Use it, or lose it'

Between 2009 and 2014, the main focus of the MIS unit was to firmly establish DHIS2 and OpenMRS as the basis for routine data collection within public sector facilities country-wide. 'We had to push to get the data flowing,' says Professor Azad, the head of the unit. 'The next job is to push on data quality and on the use of data. Even at the policy level, where people are older and wiser, they are skeptical of the power of computers. We have to win this situation.'

The challenge to which Professor Azad refers is a critical one: now that the National Data Warehouse is fully functional and its datasets are continuously updated via DHIS2, there is an urgent need that the data be used to support evidence-based decision making at both local and national levels. Idle storage of data is of no use to anyone. 'If you don't use the data, you risk losing it,' the GIZ technical advisors are fond of saying: people are only motivated to collect good quality data when they know that it is being accessed and viewed by others.

As the new routine information system has consolidated, GIZ has been working more closely with the MIS unit to build a culture of information use in Bangladesh.

■ The DHIS2 public view server

In order to encourage widespread use of routine health information – including by stakeholders outside government – the MIS unit has made the contents of the National Data Warehouse available to outside users through a link on the website of the Directorate General of Health Services (www.dghs.gov.bd).

To gain access to data in the National Data Warehouse, visitors can either establish their own account with a username and password or enter the site as a guest. Once logged in, they can work with the contents of all facility-level datasets (the individual record datasets are not available, for privacy reasons) using all the standard DHIS2 data visualisation functions, such as charts, tables and maps. They can also customise their own dashboards and export data to Excel or PDF files.

GIZ has actively promoted the availability of the public view server among development partners in the health sector in Bangladesh, and has worked with the MIS unit to do the same at all levels of the MOHFW.

■ Training in health informatics

While Bangladesh has had remarkable success in developing local expertise in the fields of public health and information technology, there are relatively few people with expertise in health informatics – a rapidly-growing interdisciplinary field concerned with putting information and knowledge to use to improve health.

GIZ saw an opportunity to expand the pool of professionals trained in health informatics by facilitating a partnership between the James P. Grant School of Public Health at BRAC University⁴ in Dhaka and the Department of Informatics at the University of Oslo, a global leader in the field and guardian of the DHIS2 software. It supported experts from Oslo to adapt an existing curriculum on health information systems in low- and middle-income countries into a five-day intensive training for mid-career professionals in Bangladesh. The partnership was also designed to build the capacity of lecturers at BRAC to eventually take over the course.

Since 2013 more than 100 people have participated in three rounds of the course, including policymakers from the MOHFW, representatives of all the MIS teams within the directorates of Health Services and Family Planning, academics

Box 10. What participants say about the short course on health informatics



■ *Shukhrat Rakhimjanov, Health Manager, UNICEF Bangladesh*

Shukhrat Rakhimjanov: ‘What I liked about the course is that it gave me information on the structure of health information systems. It brought everything into one picture and I really appreciated this. Over the course of five days, it put the puzzle pieces together. This was really valuable, at least for me as someone who’s been working in the field of public health for the past 20 years.’

Muhammad Ziaul Hoque: ‘At the course I saw a lot of young professionals who were interested in health information systems. The course covered a lot of basic things, such as how to calculate indicators, but it also provided the big picture of what is happening in Bangladesh through the lens

of health information systems. Everyone on the course was really interested in this because of the great progress that’s been made in recent years. I think the course was really effective in motivating professionals to work in this sector.’



■ *Muhammad Ziaul Hoque, Senior Programme Manager, Urban Primary Health Care Project*

⁴ BRAC University is a private university founded in 2001 by BRAC, an anti-poverty organisation formerly known as the Bangladesh Rural Advancement Committee. Since its founding in 1972, BRAC has become one of the largest development organisations in the world. It is also one of the largest health service providers in Bangladesh.

affiliated to the School of Public Health at BRAC, and representatives of development agencies. Course content covers current trends in health information systems, Bangladesh's experience in moving towards an integrated health information architecture, using information for programme management, and emerging issues like the implications of universal health coverage for health information systems.

■ Promoting local, regional and international networks

Since the advent of Digital Bangladesh, the country has become a hotbed for testing technological innovations in the field of health and beyond. As Bangladesh's expertise in the field of eHealth grows, it becomes more and more important that these experiences be shared with others in South Asia and beyond. With this goal in mind, GIZ in collaboration with WHO and the UBS Foundation supported the MOHFW to host the first Regional Health Informatics Conference for South Asia in Dhaka in June 2014. The meeting, which focused on the theme of mHealth, brought together more than 200 experts in health informatics and eHealth from local, regional and international organisations to discuss current innovations, policy frameworks, infrastructure issues and the role of public-private partnerships, among others.

GIZ has also supported the formation of two local networks of practitioners involved with health information systems: alumni of the BRAC short course in health informatics and a general interest Facebook forum called 'HIS Bangladesh.' In addition, it facilitates the capacity building of personnel from the MOHFW working in the field of health information system strengthening by supporting their participation in international trainings and conferences, such as those convened by the Asia eHealth Information Network (AeHIN), a regional body promoting better use of information communication technology in the field of health.

Strengthening the governance of Bangladesh's health information system

Global frameworks for HIS strengthening, such as those promoted by the Health Metrics Network, outline the leadership and governance arrangements which are conducive to the emergence of an effective health information system. Efforts to strengthen the health information system in Bangladesh have not, for the most part, taken place under such conditions. Prior to 2014, Bangladesh has not had, for example,

a national policy on health information systems which sets forth a strategic direction and defines basic issues such as minimum security requirements, or the standardisation of data definitions and structures. The lines of authority for health information systems are fractured and the national health sector reform programme includes two separate operational plans for HIS, one for health services and another for family planning.

The MOHFW has recently begun working on an overarching framework, with the support of various development partners including GIZ. However most of the advances which are described in this publication have occurred in the absence of a guiding strategy and against a complicated governance backdrop.

Given this context, GIZ took a pragmatic approach to HIS strengthening, concentrating its efforts initially upon the establishment of the National Data Warehouse under the auspices of the Project Management and Monitoring Unit to improve reporting on the national health sector reform programme. GIZ worked then closely with the MIS unit of the Directorate General of Health Services to strengthen the country's routine health information system. In both of these efforts, the IT innovations which have been introduced have themselves become engines of change which are leading to greater harmonisation in the collection, if not yet the use, of routine health information.

Thus, despite certain structural weaknesses in HIS governance, the approach which has been taken has succeeded in creating the core of an interoperable system which is likely, in time, to become even more streamlined. Coordination has improved greatly between many of the main actors generating routine health information in the country, with most programmes under the directorate of Health Services, the MIS unit of the Family Planning directorate, and the Urban Primary Health Care Project now using or committed to using DHIS2 and major private providers such as BRAC expressing interest.

As more and more attention shifts to promoting the use of routine information and training personnel within and outside of the MOHFW to use DHIS2 data, the duplications in reporting and inconsistencies in data standards will become ever more apparent and should lead to a rationalisation of reporting formats.

Achievements and challenges

In five short years, the MOHFW has dramatically transformed the way routine health information is collected, stored and used in Bangladesh, putting the country on a path towards a more effective and harmonised health information system.

This section summarises the main results of efforts to strengthen Bangladesh's health information system between 2009 and 2014 and points to some of the challenges which will need to be addressed in the coming years as the system further consolidates.

Routine health data, brought together under one roof

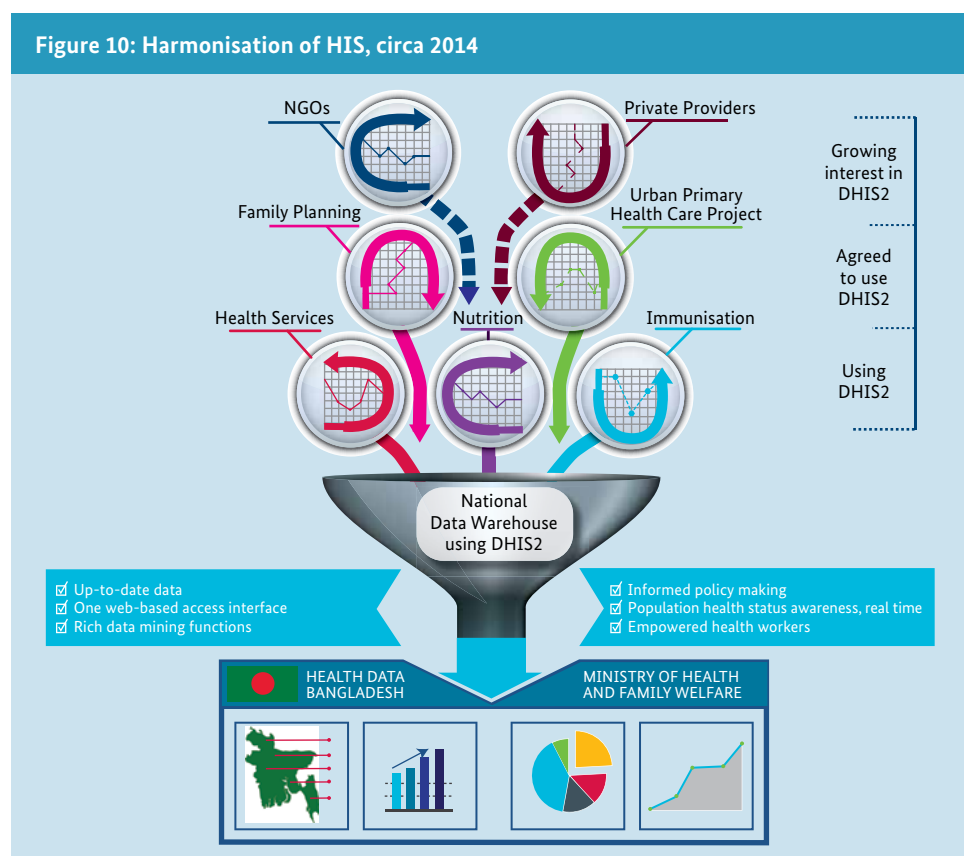
■ Data collection on a mass scale

Since 2009 the MIS unit of the Directorate General of Health Services has equipped almost every public sector health facility in the country – from specialised tertiary hospitals to community clinics – with computers and Internet connections and trained relevant personnel to use DHIS2 to submit

their routine reports electronically. With support from GIZ, it has gradually mastered the technical aspects of this roll-out, including systems development, maintenance and periodic upgrades of DHIS2, and the establishment of systems and processes for troubleshooting both hardware and software issues.

As of June 2014, data was being captured directly in DHIS2 at more than 4,500 health facilities from national down to the union level, and at 3,500 of the country's 13,500 community clinics as well. It is envisioned that the reporting of routine health information in the public sector will be fully paperless by some point in 2015. Sundeep Sahay, one of the architects of DHIS2, notes that Bangladesh has very quickly emerged as a significant actor in the global DHIS2 community. Not only is it one of the largest DHIS2 implementation sites in the world, but it is also testing out innovations at a large scale. 'The distribution of hand-held devices to enable widespread use of the patient tracker function is quite unique,' he says, 'and the goal of integrating hospital data from OpenMRS with routine data in DHIS2 is an area to watch.'

Figure 10: Harmonisation of HIS, circa 2014



■ Steady steps towards a national dataset

Since its debut in Bangladesh DHIS2 has won over an ever-growing roster of health programmes, departments and institutions with its low cost, easy-to-use interface and powerful data visualisation features. As a result of growing adoption, some of the most stubborn information silos are starting to fall – that which historically existed between the directorates of Health Services and Family Planning, for example, and between public sector service provision in rural and urban areas.

Facility-based data from DHIS2 can now be used to calculate approximately half of the indicators used to track the impact of the national health sector reform programme, and can serve as means of verification for many of the activity or output-level indicators in its individual operational plans. The impact indicators, however, cannot be calculated for the country as a whole, since the National Data Warehouse does not yet contain data from private for-profit and not-for-profit providers.

The introduction of individual records in DHIS2 for pregnant women and children under five years of age may hasten the moment when data is available for the entire population. The case-based records, generated in large part by community health workers who visit households, will reduce double counting of patients and get public health experts closer to ‘the denominator’ they require to be able to calculate population-based morbidity and mortality rates using routine information.

■ Improved data quality through automation

Because data is now entered into DHIS2 one time at source, rather than multiple times at different administrative levels, there is much less room for error in capturing information than was the case under the old paper system. The software has also been designed with certain standard features which help to improve data quality (see Box 11).

Box 11. How DHIS2 helps to improve the quality of routine data

Data quality depends on three main elements:

- **accuracy**, capturing information correctly when transferring between data collection tools;
- **completeness** of data elements in reports, and of facilities submitting reports; and
- **timeliness**, submitting data by deadlines.

DHIS2 enhances overall data quality through contributions to all three elements.



■ *Dr Akterul Islam (left) and his colleague, Pankaj Paul, log on to DHIS2 from the Ramu Upazila Health Clinic. Islam laughs: ‘If, on the first screen, it says “Expected Report: 1, Received Report: 0,” I know that I’ll soon be getting a phone call asking why.’*

The accuracy of data captured in DHIS2 is enhanced by the use of data validation rules, such as the designation of minimum and maximum values for specific fields, which trigger warnings when data is entered which falls outside the given range. By automatically aggregating data from lower-level facilities, DHIS2 also greatly reduces the opportunities for data entry errors.

DHIS2’s inbuilt data checking capabilities also help to improve the completeness of reports. Data entry fields designated as mandatory must be completed before a report can be submitted to the server, and tracking the proportion of facilities which have submitted required reports can now be done with the click of a button. Statisticians at the MIS unit of the Health Services directorate responsible for monitoring data begin each day by running ‘completeness reports’ which show the status of reports due the previous day. A colour-coded ‘traffic light’ system is used to

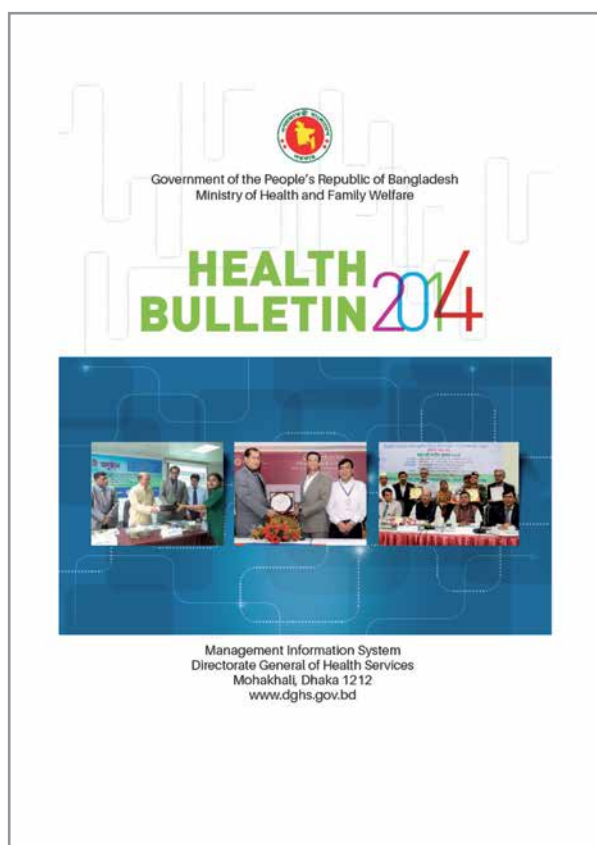
indicate the reporting status, and the statisticians follow up with emails or phone calls to inquire about missing reports and incomplete data.

In such a way DHIS2 also improves the timeliness of data, by making it immediately apparent when a report is overdue. Front-line health workers responsible for submitting reports can see, when they log into the system, whether they are up-to-date with their reporting.

However, DHIS2's inbuilt data checking functions are, on their own, not enough to guarantee good quality data. Current approaches to monitoring data quality focus primarily on completeness and less on accuracy. Some managers at the higher levels of the MOHFW concede that the quality of outpatient data in particular is not at a level which is useful for epidemiological purposes. Among the donor community, there is great appreciation for the advances that have been made, but a feeling that efforts to improve routine information are still a work in progress.

■ Health information available to everyone, everywhere

The architects of DHIS2 were driven by the idea of empowering staff within health systems by giving them access to the information they were generating in the course of their daily work. They were also committed to providing users outside the health system with access to aggregate health information. Both of these principles are being realised presently in Bangladesh: an important contribution to transparency and accountability within the health sector.



■ Health Bulletin cover

Since 2012 the annual Health Bulletin, a comprehensive overview of health in Bangladesh, is based largely on data derived from DHIS2. The document is one of the most frequently downloaded resources on the MOHFW's website and is referred to by many stakeholders and development partners. The MIS unit also uses DHIS2 data to prepare annual newsletters on topics such as the Integrated Management of Childhood Illnesses and the health of children under the age of five, which help to track the country's progress towards the achievement of MDG 4 on child mortality. All of these publications consistently present data disaggregated by sex, something which DHIS2 makes easy.

Local health bulletins, which contain detailed information about the services provided in a given facility, the morbidity profile of patients, and mortality rates and causes of deaths, are another new addition. Since 2012, some 550 hospitals, clinics and civil surgeons' offices have prepared these bulletins annually, following a standard template developed by the MIS unit. The bulletins are available for download, and can also be printed and distributed locally. The MIS unit hosts an annual conference where each organisation presents and publicly defends its local health bulletin.

A reduced administrative burden

■ More time for patients...

DHIS2 has greatly reduced the amount of time that is spent on reporting. Dr Akterul Islam, the head of the Ramu Upazila Health Complex, for example, estimates that the administrative burden in his facility has been cut by half since the introduction of DHIS2 and will fall even further in the coming years as personnel become more proficient with the system, as 3G technology leads to faster connections, and as individual patient records become the norm. According to Islam:

'In the old days people from clinics would prepare the papers and they'd travel to bring them to me. This would take a day of their time. A day's working time – lost – every month for each of the 23 clinics. Now processes are simplified, costs are lower, travelling time is reduced, and as a result we can serve patients more.'

■ ...and more efficient project management

Those working at higher levels of the health system find that the speed with which they can complete managerial tasks has also increased dramatically. Email distribution lists and text messaging have made it possible to communicate with dozens or even hundreds of facilities at a time. Requests for information which used to take weeks or months to receive and compile can now be completed within a day. Reports can be generated instantaneously.

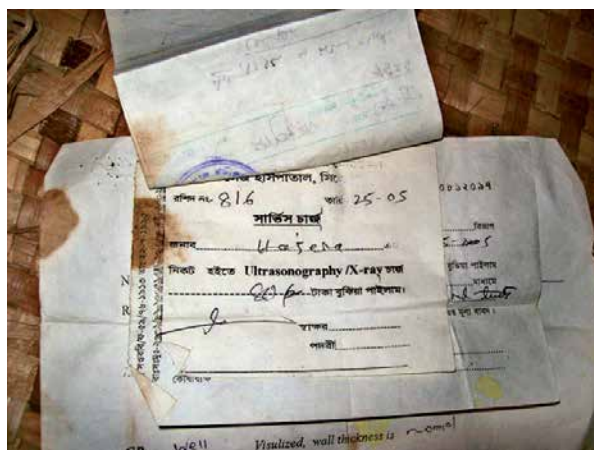
The routine data captured in DHIS2 is also emerging as a powerful monitoring tool. Programme managers can now use data from DHIS2 to verify indicators in the operational plans they oversee under the national health sector reform programme. Within the programme, the fulfilment of certain performance-based indicators triggers the release of additional funding; proving that these targets have been met is now much easier with the availability of routine data – something that greatly accelerates administrative processes.

Better patient care, quicker action and improved planning

There are already signs that the digitisation of Bangladesh's health information system is contributing to improvements in patient care and in the way health services are planned and targeted. While systematic studies are required to document their full extent, anecdotal evidence points to a number of positive changes.

■ Patient tracking boosts clinic attendance

The introduction of individual patient records has given health workers a valuable tool for tracking and following-up with patients who require continuous care. Using the contact information contained in patients' individual records, clinic personnel can contact patients who have missed appointments and encourage them to visit the clinic. Previously, such cases would only be detected later when Health Assistants made their next visit to patients' households.



■ *As hospitals begin using OpenMRS, paper records – such as these containing the results of diagnostic tests – will give way to electronic ones. This will greatly reduce health workers' administrative burden and give them more time to tend to patients.*

■ Individual medical records enable better care

Individual medical records are still in the early stages of roll-out in Bangladesh and it is far too soon to assess their impact, but if maintained and used correctly, they hold great potential for improving the quality of patient care. As a result of individual records in DHIS2 and OpenMRS, health workers will increasingly have access to certain patients' medical histories when providing them with care – something that was never possible before.

The availability of individual medical records is particularly important for improving maternal and child health. Identifying and noting pregnancy-related complications in an individual record, for example, can reduce the likelihood that a woman will die from preventable conditions. It also makes it easier for health workers to remain in contact with women during their pregnancies and to encourage them to give birth with the help of skilled birth attendants.

■ Local evidence bolsters local planning

Local officials responsible for health planning are already benefitting from the information available to them in DHIS2. Monthly district-level meetings and weekly sub-district-level meetings are now informed by up-to-date evidence generated by DHIS2. Facility heads prepare consolidated reports prior to each meeting, use multimedia projectors to display DHIS2-generated charts and graphs, and discuss with their colleagues the issues reflected in the data.

At a community level, coordination and planning around maternal and child health has been greatly enhanced by the introduction of individual records in DHIS2. The three different types of health workers working out of community clinics (i.e. affiliated to the Health Services and Family Planning directorates) now meet weekly to review cases and to make a shared action plan for the coming week. As each pregnant woman and infant is individually identified and entered into a shared electronic register, gaps and instances of 'double counting' which used to be common are slowly being reduced.

■ Real-time information prompts quicker action

DHIS2 data is complementing existing disease surveillance systems in Bangladesh (e.g. network of sentinel sites, event-based surveillance) and helping officials to identify spikes in cases of endemic diseases, such as malaria, as well as potential outbreaks of new diseases.

According to Dr Mahmudur Rahman, the director of the Institute for Epidemiology, Disease Control and Research under the MOHFW, DHIS2 is particularly helpful for detecting outbreaks of foodborne illnesses, such as hepatitis A and typhoid fever, as these are often diagnosed syndromically at hospitals (rather than through laboratory testing, as is the case with many special diseases). At a central level, Institute staff use DHIS2 to monitor where an outbreak may be occurring and to determine whether to send out a rapid response team to investigate. The real-time availability of information from facilities countrywide enhances the chance that a new health threat will be identified and acted upon quickly.

■ More detailed data informs policy and service provision

With improvements in routine information, the MOHFW is now able to track changes in key indicators, such as maternal mortality, at public sector facilities in real time, and to use this in combination with data from the Bangladesh Maternal Mortality Survey to help local health facilities to better understand the situation in their communities.

The digital collection of data is also allowing for more detailed information to be captured about causes of death than was previously possible through paper records. When the Emergency Obstetric Care programme migrated its reporting to DHIS2, it expanded its previous reporting format to capture information about the types of obstetric complications being treated (i.e. classification of cases) and the measures being applied. For the first time, it is now possible to identify the most common causes of preventable deaths in various areas of the country, drilling down even to the level of individual facilities. This makes it possible to develop targeted action plans and to implement appropriate measures.

Technological convergence as a catalyst for better governance

Without a formal mandate, the MIS unit in the Health Services directorate has succeeded in slowly shifting a whole range of programmes and departments – including some key players outside the MOHFW – in the direction of a unified, interoperable information system. While an overarching policy and strategic plan may still be missing, the current situation represents a significantly more harmonised environment than the one which existed five years ago.

There is also reason to hope that the tide may be turning in terms of the health sector's propensity for stand-alone information systems. When people approach the MIS unit with proposals to set up an information system for a new project, the response is unequivocal: 'There's no need. Work with the relevant MOHFW programme and modify DHIS2. There's no need any more to invest in anything new.'

From a governance perspective, the main challenge for the immediate future is to optimise the foundation which has been laid. A functioning system is now in place, but it is still riddled with duplications and inefficiencies. Which dataset can be trusted to provide the most accurate information about incidence of malaria? Why should health workers have to report on new cases of diarrhoea in a monthly report for one programme, and in a weekly report for another? 'These duplications will not be easy to resolve,' says Mahmudur Rahman, of the Institute for Epidemiology, Disease Control and Research and a strong supporter of DHIS2. 'No one wants to give up their share – it's about control. But I think we can improve. We've already come up to this level.'

Bangladesh emerges as a global leader in eHealth

The digitisation of the country's health information system is the largest and most complex of a range of eHealth interventions which have been led by the MIS unit of the Directorate General of Health Services since 2009. For the leadership and innovation which Bangladesh has shown in this realm it has been recognised with a number of high-profile awards, including the UN Digital Health for Digital Development Award in 2011; has been celebrated in a WHO publication on mHealth (2011); and featured prominently at various international conferences and gatherings.

This international recognition has reinforced to the team at the MIS unit that it is on the right track and, perhaps more importantly, has motivated them to become more active in sharing lessons from their own experience with counterparts in other countries. 'Bangladesh is now actively bringing its experience to the world,' observed Sundeep Sahay, one of the architects of DHIS2, approvingly. Staff at the MIS unit, as well as GIZ technical advisors, have become active contributors to the DHIS2 and OpenMRS open source communities, helping project teams in other countries to resolve challenges related to the configuration of the software on different operating platforms. Software improvements and user experiences from Bangladesh are continuously fed back to the network and often picked up on by users in other countries – teams in Nigeria and Sri Lanka, for example, are now working with the version of OpenMRS which was customised in Bangladesh. Where the team in Bangladesh initially relied on the network for support in rolling out its own system, it now serves as an example for other countries to emulate.

■ *Fatema Uddin, Mohammad Ullah and Muhammad Abdul Hannan Khan – technical advisors with GIZ's Support to the Health Sector Programme – have worked in close collaboration with the team at the MIS unit for several years.*



Lessons learned

Bangladesh's experience may contain lessons for other countries seeking to improve and harmonise the collection and use of routine health information. This section summarises some of the main lessons learned from efforts to strengthen Bangladesh's health information system.

■ Invest in partners with strong leadership and a strategic vision

The successes which have been achieved in strengthening Bangladesh's HIS can largely be attributed to the decisive leadership shown by the MIS unit at the Health Services directorate since 2009. The team from the GIZ-implemented Support to the Health Sector Programme has built a strong working relationship with the staff in this unit, providing policy advice and continuous technical assistance in support of their vision for a modern and effective routine information system. Through its contributions, GIZ has helped to strengthen the MIS unit as a strong and dynamic institution ready to lead the HIS strengthening process into its next phase.

■ In the absence of a policy roadmap, a pragmatic approach can still bring results

When GIZ agreed in 2008 to work with the MOHFW on strengthening HIS, it adopted a pragmatic approach aimed at bringing together the government, international organisations, development partners, health planners and health workers to improve the way routine information was collected and used. Following the establishment of the National Data Warehouse, it worked with its counterparts to modernise the HIS infrastructure through the introduction of simple, low-cost open source software and to promote more effective use of routine information. This incremental approach – in which each successive element is dictated by an assessment what is needed and what is possible – has proven to be successful, even in the absence of an overarching strategic framework. In many ways, the reform of Bangladesh's HIS 'from below' has helped to catalyse a process of change which is leading to a more harmonised and interoperable health information system.

As Paul Rueckert, the former head of the Support to the Health Sector Programme observed, 'All of this would have been easier to achieve if a policy was in place, but the experience here has shown that one doesn't always require a traditional policy approach. We had a very narrow horizon at the outset – just one step after another. And at some point it became faster and faster, and everything began to converge.'

■ Take a comprehensive approach that goes beyond software and infrastructure

Initiatives aimed at strengthening health information systems in developing countries often focus on narrow technical issues at the expense of broader systems. The experience of the GIZ-implemented Support to the Health Sector Programme shows that informed, appropriate decisions about software and infrastructure are necessary, but in and of themselves not sufficient for HIS strengthening. A comprehensive approach encompassing capacity building, attention to governance issues and efforts to improve the use of information – in addition to software and infrastructure support – increases the likelihood that routine information will emerge as a robust complement to population-based surveys.

■ Commit to a long-term capacity building process

By embedding technical advisors into the MIS unit at the Directorate General of Health Services, GIZ has invested in a long-term approach to capacity building which emphasises on-the-job training and learning by doing. Early on, the main focus of capacity building efforts was on ensuring that the HIS systems could be operated and maintained independently. The unit's technical team has gradually taken over responsibility for most core tasks, including customising forms in DHIS2 and overseeing the functioning of the servers. The focus of GIZ's capacity building efforts has since shifted to promoting the use of information.

■ Be flexible and respond to changing needs

GIZ advisors working on the Support to the Health Sector Programme have worked closely with their counterparts at the MOHFW to develop a simple yet powerful system for working with routine information in which users both inside and outside the health system can access data, in real-time, and analyse it for a variety of purposes. They have done this by deploying resources flexibly and moving in a stepwise manner to draw closer to this goal – continuously evaluating priorities and needs. At times this has meant moving quickly, to support the roll-out of DHIS2 on a massive scale to community clinics nationwide; at other times it has meant recognising a need to slow down and 'meet people where they are.' Following several years of intense concentration on hardware and software issues, a different approach is now being taken to ensure that the potentials of the technology can be fully exploited by users at different levels of the health system.

Future outlook

The future of Bangladesh's health information system looks bright, but the sustainability of the results which have been generated since 2009 is far from guaranteed. The situation remains delicate and achievements have not yet been systematised. Much depends upon the continued leadership of the MIS unit in the Directorate General of Health Services, where a change in top management could result in diminished commitment and willingness to innovate – factors which have been so critical to successes to date.

Until June 2016, when the Support to the Health Sector Programme will end, GIZ will continue to work with the MIS unit to help programmes, departments and institutions which wish to adopt DHIS2 to do so. At present this is likely to include the Urban Primary Health Care Project and the Directorate General of Family Planning, but may also extend to large NGO service providers such as BRAC. Now that the procedures and processes for integrating new programmes into DHIS2 are so well practiced, extending DHIS2 to new users has become a relatively routine task.

Another technical issue which requires attention is that of confidentiality and data privacy. Enhanced measures need to be taken to protect the security of ever growing amounts of data within DHIS2, particularly since the introduction of case-based records linked to identifiable individuals.

In general, however, the coming years mark an opportunity to turn attention away from the realm of software, systems and infrastructure and to concentrate on the human element of HIS. This final section describes some of the issues which will come to the fore in the coming years.

Activating the use of routine data

Bangladesh has reached a point where routine health information is available in a timely manner, in a format accessible to all. The fact that this data is not yet drawn upon fully by policymakers is partly a result of tradition – habits formed through years of working with surveys – and partly a matter of training. In the coming years, much needs to be done to sensitise decision makers in the health sector to the benefits of routine information for evidence-based planning and to build the skills of personnel at all levels of the health system to analyse and act upon this data.

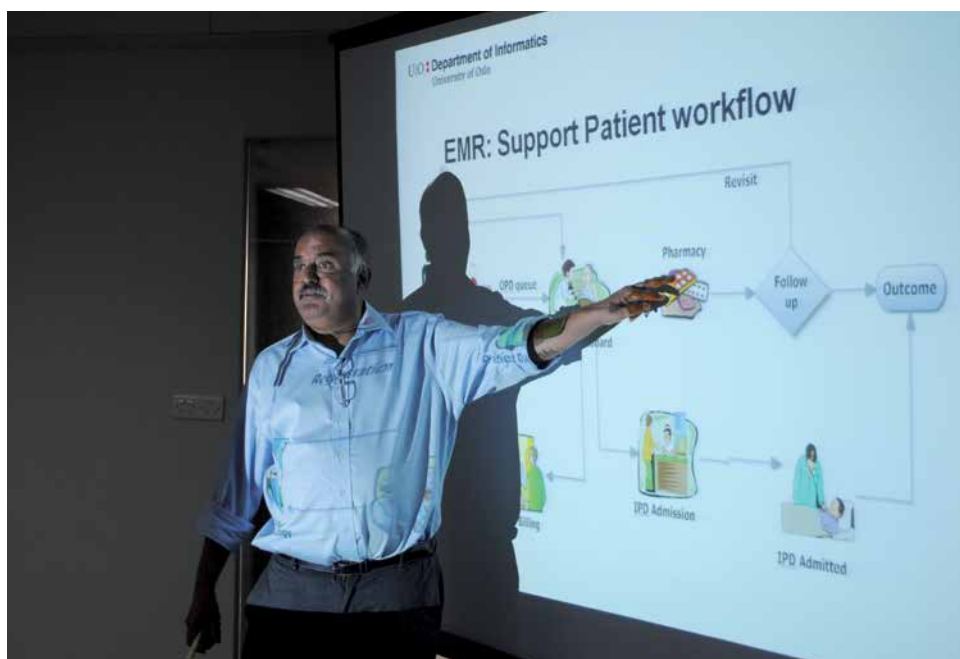
■ Advocacy within the health system and beyond

Despite near universal consensus – both within the MOHFW and beyond – on the need for better routine data, the topic has not yet emerged as a political priority. The commitment shown by the MIS unit of the Health Services directorate to the development of a more robust routine information system is not yet matched by that of other actors within the Ministry. Development partners, while supportive of current efforts to strengthen HIS, do not yet have the confidence in the data to use it alongside survey data. The fact that the National Data Warehouse does not yet contain complete national data – and will be unlikely to anytime in the foreseeable future, given the challenges which will be involved in bringing private providers into a unified system – is cited as one of the main causes for hesitation. Data quality is another.

The further development of the HIS will depend to a large degree on the extent to which key stakeholders begin taking data from the data warehouse into account – despite its limitations – in their planning and analysis. This will require continuous advocacy from the MIS unit to underscore the importance of using data as part of improving its quality. And, simultaneously, it will demand systematic investments to strengthen the quality and reliability of the data being collected. The Support to the Health Sector Programme intends to work with counterparts at the MIS unit to organise inter-departmental workshops and other outreach activities to promote the availability and use of routine information. It will also continue to its advocacy efforts with representatives of development partners. These activities will be the primary priority of the GIZ project until June 2016, when its support for HIS strengthening in Bangladesh will conclude.

■ Building skills at a decentralised level

DHIS2 has already proven itself to be an important tool for programme planners and managers, who can use it to track outputs and results at a local level. But ultimately, the power of DHIS2 should be exploited not only by managers sitting in Dhaka or in divisional capitals, but by facility managers and front-line health workers countrywide.



■ The short course on health informatics held at BRAC University in Dhaka targeted health professionals at the national level. Similar trainings now need to be extended to health managers at a decentralised level.

If the challenge at higher levels of the system is about changing the engrained approach to data use, the challenge at the lower levels is to establish a culture of local-level analysis and planning. Beyond entering numbers into the reporting formats assigned to a given facility, the heads of those facilities should be working with those numbers to assess the availability, accessibility, utilisation, and coverage of key services in their areas, and to identify gaps or resource constraints which are preventing the attainment of objectives. Such data could prove to be a powerful advocacy tool for facility managers requesting additional resources.

As many statisticians under the MIS unit do not have training in statistical analysis, basic courses exposing them to concepts such as numerators and denominators, ratios, proportions, rates, and indicators are needed. UNICEF has begun such an approach in three districts, teaching local health officials how to work with their own data to assess the adequacy and effectiveness of their maternal and newborn care. This effort appears to hold promise and may be scaled up in the future.

Ensuring sustainability: HISP Bangladesh

In June 2014 the Government of Bangladesh approved the registration of a new non-profit organisation, HISP Bangladesh, which is envisioned to become the local 'node' of the HISP Global network in the future. In countries as diverse as India, South Africa, Tanzania and Viet Nam the establishment of an independent association affiliated to the global DHIS2 network has proven to be a successful way to ensure sustainable local support for the maintenance and operation of DHIS2 after the end of direct assistance from development partners.

Until 2016, when German support to the health sector in Bangladesh will phase-out, the GIZ health programme will support the new organisation to become a self-sustaining local entity which can be contracted by the MOHFW and others to provide advice and technical support on the further development of the country's health information system. HISP Bangladesh, in turn, will become an active participant in the HISP Global network, both benefitting from new developments and contributing its expertise to counterparts in other countries. It will serve as a bridge between stakeholders in Bangladesh and experts at the University of Oslo, the 'guardians' of the DHIS2 product, who could also, at key moments, be contracted to provide strategic guidance on the system's further evolution.

The establishment of HISP Bangladesh should help to avoid a situation where key IT management decisions must be outsourced to commercial software developers and companies without experience with DHIS2. With its inside knowledge of the MOHFW's HIS system, and its strong linkages to the global DHIS2 community, HISP Bangladesh will be able to provide expert advice and services which advance the Ministry's larger goals.

A new revolution?

In recent years, Universal Health Coverage has begun to emerge as an overarching framework for health system reforms in the post-MDG era. For countries choosing to adopt social health insurance as the health financing strategy to extend health coverage, Health Insurance Information Systems are of fundamental importance. Every element of a health insurance system – from documentation of services, to claims processing, to identification of beneficiaries and their entitlements – depends on accurate information, and joining all of these elements together into a functioning whole requires a comprehensive and advanced information system.

GIZ is an active participant in global networks aimed at learning and sharing experiences on the road to UHC, including on technical issues such as the role of IT systems. It also has a wealth of country-level experience in the area of health financing reform and the design of social insurance systems, including in Bangladesh, where it is working with the Health Economics Unit of the MOHFW to develop a health insurance scheme, including a health insurance information system, for workers in the garment sector.

Through its parallel efforts to support Bangladesh's health information system, described in this publication, GIZ has developed valuable insights into how health insurance information systems and health information systems need to work together, particularly in the context of a national social health insurance. And through its international collaborations in support of UHC, it also recognises that many countries are still struggling to develop effective health insurance information systems.

Informed by these experiences, GIZ intends to leverage its support for the development of an information system for the health insurance scheme for garment sector workers to create OpenUHC, an open source software which could form the basis for social health insurance schemes in other developing countries. Modelled on DHIS2 and OpenMRS, OpenUHC would offer a core software which communities of users in other countries could modify with functions and features to meet their specific needs, rather than developing a system from scratch or procuring expensive and inflexible proprietary software. This 'public good' would potentially benefit many countries and save countless resources.

The approach will draw upon existing networks and structures, including the community of experienced software developers involved with DHIS2 and OpenMRS who have already lent their support to the idea. Designing OpenUHC so that it is compatible with DHIS2 and OpenMRS will have the added benefit of ensuring interoperability with existing elements of Bangladesh's health information system – as well as those in many other countries which also run both software products.

The heady and energising experience of transforming Bangladesh's health information system using open source software has inspired a core of devoted followers in Bangladesh to take the 'quiet revolution' into a new phase. Just as South Africa served as the originating context for the development of DHIS2 back in the 1990s, Bangladesh is ready to play the same role in the creation of a new open source software that may, in a decade's time, be underpinning universal health coverage around the globe.

Peer Review

To be included in the German Health Practice Collection, a project or programme must demonstrate that it comes close to meeting the majority of the Collection's criteria (see Box 12).

In reviewing this publication, two HIS experts from the World Health Organization and PATH have concluded that the approach to health information system strengthening in Bangladesh can be considered a 'promising practice' whose lessons are worth documenting and sharing widely. They agree that the experience described in this publication is an important example of the 'data revolution' which is increasingly central to discussions about priorities and agendas for the post-2015 period.

The reviewers commented in particular upon the following criteria:

The approach taken in Bangladesh is regarded as **effective**, not least because it is comprehensive in both its design and implementation. The measures undertaken have been oriented at whole-scale system change and take into account the interactions between people, policies, practices and products that are needed to bring about such changes. The **innovativeness** of the approach lies in paying attention to and combining these various elements over a long period of time.

Another important advantage of the approach is that it is highly attuned to the specific country context and to the needs of the health sector in Bangladesh. This makes it **empowering** and enhances its ultimate **sustainability**.

One reason why it is important to document in some detail the lessons learned over time is that many elements of the approach may be **transferable** to other contexts. Readers may find the experience from Bangladesh helpful for better understanding the types of changes which are required in their own health information systems and the factors which have contributed to the achievements to date. However, the challenge in many cases will be to craft a comprehensive and systemic approach to HIS strengthening and to implement it consistently over a long period of time.

Box 12. Publication process of the German Health Practice Collection

Each year, experts working in GDC-supported initiatives propose projects that they regard as good or promising practice to the Managing Editor at ghpc@giz.de. Proposals are posted on the Collection website (health.bmz.de) and several specialist fora to allow GDC experts and the interested public to compare and rate them. Informed by this initial assessment, an editorial board of GDC experts and BMZ officers select those most worthy of publication. Reports are written by professional writers following on-site visits, working with the local partners and GDC personnel who jointly implement the projects. Draft reports are peer reviewed by independent scholars and practitioners, emphasising eight criteria:

- Effectiveness
- Transferability
- Participatory and empowering approach
- Gender awareness
- Quality of monitoring and evaluation
- Innovation
- Comparative cost-effectiveness
- Sustainability.

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References

Access to Information Programme (2009). *Digital Bangladesh: Concept Note*. Dhaka: A2I Programme, Prime Minister's Office.

Ahmed SM et al. (2013). Harnessing pluralism for better health in Bangladesh. *The Lancet*, 382: 1746-1755.

Azad AK (2014). *Presentation on eHealth and HIS*, February 13, 2014. Dhaka: Management Information System, Ministry of Health and Family Welfare.

Braa J and Sahay S (2013). *The process of developing the DHIS*. Available at: <http://www.mn.uio.no/ifi/english/research/networks/hisp/hisp-history.html> (Accessed October 30, 2014).

GIZ (2011). *Capacity Works: The Management Model for Sustainable Development*. Eschborn: Deutsche Gesellschaft für Internationale Zusammenarbeit.

Koehlmoos, TP et al. (2011). Health Transcends Poverty: The Bangladesh Experience. In: Balabanova D, McKee M and Mills A (eds). *Good Health at Low Cost: 25 years on. What makes a successful health system?* London: London School of Hygiene & Tropical Medicine.

Marma U (2014). *HMIS Situation Analysis of Cox's Bazar District*. Dhaka: UNICEF/CIDA.

MOHFW (2014). *Health Bulletin 2013*. Dhaka: Management Information System, Directorate General of Health Services, Ministry of Health and Family Welfare.

Munshi AH et al. (2009). *Health Information System Assessment: Bangladesh Country Report*. Dhaka: Health Metrics Network Secretariat, Ministry of Health and Family Welfare.

Mushtuque A et al. (2013). The Bangladesh paradox: exceptional health achievement despite economic poverty. *The Lancet*, 382: 1734-1745.

UNDP (2014). *Human Development Report. Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience*. New York: United Nations Development Programme.

WHO (2008). *Framework and standards for country health information systems*. 2nd edition. Health Metrics Network. Geneva: World Health Organization.

WHO (2011). mHealth: New horizons for health through mobile technologies. *Global Observatory for eHealth Series*, Volume 3. Geneva: World Health Organization.

WHO (2014). *World Health Statistics 2014*. Geneva: World Health Organization.

World Bank (2014). *Poverty and Equity*. Country Dashboard: Bangladesh. Available at: <http://povertydata.worldbank.org/poverty/country/BGD> (Accessed October 30, 2014).

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