

Perceptions and experiences with District Health Information System software to collect and utilize health data in Bangladesh: A qualitative exploratory study

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Research article

Keywords: Electronic health management information System, District Health Information System software², Facilitators, Barriers, Bangladesh

Posted Date: October 12th, 2019

DOI: <https://doi.org/10.21203/rs.2.12293/v2>

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Version of Record: A version of this preprint was published at BMC Health Services Research on May 26th, 2020. See the published version at <https://doi.org/10.1186/s12913-020-05322-2>.

Abstract

Background: Accurate and high-quality data are important for improving program effectiveness and informing policy. Bangladesh Health Management information System (HMIS) has adopted District Health Information software 2 (DHIS) in 2009 to capture real-time health service utilization data. However, routinely collected data are being underused because of poor data quality. We aim to understand the facilitators and barriers on implementing DHIS2 as a way to retrieve meaningful and accurate data for the Reproductive, Maternal and Child Health (RMCAH) services. **Methods:** This qualitative study was done among two districts of Bangladesh from September 2017 to 2018. Data collection method were key informant interview (n=11); in-depth interview (n=23); focus group discussion (n=2). Study participants were individuals involved with DHIS2 implementation from the community level to the national level. The data were analyzed thematically. **Results:** DHIS 2 could improve the timeliness and completeness of data reporting over time. The reported facilitating factors were strong government commitment, extensive donor support and positive attitude of staffs. Quality checks and feedback loops at multiple levels of data gathering points was helpful to minimize data errors. Introducing dashboard makes the DHIS2 compatible to use as monitoring tool. However, the barriers to DHIS 2 implementation were lack of human resources, slow Internet connectivity, and frequent change of DHIS 2 versions, maintaining both manual and electronic system side by side. The collected data remains incomplete as private health facilities are not covered. The parallel presence of two MISs to report same RMNCAH indicators is a threat to achieve quality data and increases workload. **Conclusion:** The overall insights from this study are expected to contribute to the development of effective strategies for successful DHIS 2 implementation and building responsive HMIS. To sustain the achievements of digital data culture, focused strategic direction is needed. Periodic refresher trainings, incentives for increased performance, automated single reporting system for multiple stakeholders could make the system more user friendly. A national electronic health strategy and implementation framework can facilitate creating a culture of DHIS 2 use for planning, setting priorities, and decision making among stakeholder groups

Background

Electronic-health (e-health) provides timely and accurate collection of health data leading to better health care planning and improved diagnosis⁽¹⁾. A significant initiative under the umbrella of e-health has been the introduction of DHIS 2⁽²⁾ The DHIS2 is an integrated, open-source and web-based platform for health data collection, validation, analysis and presentation of aggregated and individual data, aiming to improve health service delivery^(3,4).

DHIS 2 has been used for the HMIS of 46 countries and has also been translated into multiple languages⁽⁵⁾ Easy aggregation of Reproductive, Maternal, neonatal, Child and Adolescent Health (RMNCAH) data in DHIS 2 is a supportive factor for effective strategic planning, priority setting, and decision making^(6,7). Evidence from Uganda and Kenya shows that implementation of DHIS 2 has improved reporting of immunization coverage, antenatal care (ANC) visits, and facility delivery rate^(8,9).

In Laos, the effective implementation of DHIS 2 on maternal and child health (MNCH) surveillance data could improve service delivery through identification of service coverage, barriers to access and causes of maternal death⁽¹⁰⁾. In Sri Lanka, using DHIS2 data for MNCH information management has also improved quality of care⁽³⁾

Bangladesh's HMIS is considered an active contributor in the global DHIS 2 implementation strategy⁽¹¹⁾. Currently, about 75 percent of public health facilities are covered under the DHIS 2 network and real-time health service utilization data, with particular attention to RMNCAH, are available from the community level to the tertiary hospital level⁽¹²⁾. The RMNCAH services in Bangladesh are offered by two directorates under the Ministry of Health and Family Welfare (MOHFW): Directorate General of Health Services (DGHS) and Directorate General of Family Planning (DGFP)⁽¹¹⁾. The HMIS of DGHS and DGFP are different where DGHS only uses DHIS 2 software. The vast majority of private facilities are not covered by the national HMIS⁽¹²⁾. The data flow system under the DGHS and DGFP is presented as additional Figure 1 and 2 respectively. The common RMNCAH indicators retrieved through DHIS2 are also listed under additional Table1

The HMIS data collected under DHIS 2 is under-utilized for health planning purposes due to its poor quality. Policy planners still have to rely on survey data which is financially burdensome⁽¹³⁾. Given the importance and potential benefits of a strong HMIS, it is critical that the deterrents and enablers that influence utilization of DHIS 2 are identified and properly addressed. The main objective of this study was to explore the perceptions and experiences of study participants with implementing DHIS2 to collect, analyze, and use RMNCAH-related data in Bangladesh.

Methods

Study design & setting

This qualitative exploratory study was conducted in two districts of Bangladesh between September 2017 and September 2018. Data collection sites were selected based on the variation in RMNCAH indicator performance reporting among districts reported by DHIS 2. For the last one year period, Khulna was identified as the highest-performing division and Chittagong was the lowest-performing division. From each division, one district and two sub-districts were selected using indicator of reporting RMNCAH data to DHIS 2.

Study Participants

Forty-seven stakeholders from all levels of the health system were selected for the study to gather details about experiences with using DHIS 2 at each level. The participants at the community level were community healthcare providers (CHCPs), nurses, health inspectors, upazila statisticians, and upazila health and family planning officers (UHFPOs). At the district level, participants were civil surgeons and district statisticians. The assistant chief of MIS was involved at the division level, and from the national

level system analysts and program managers under MIS directorates and representatives (e.g., monitoring officers, IT programmers) from development partner organizations, such as GIZ and the United Nations Children’s Fund (UNICEF), were contacted.

The inclusion criterion was willingness to participate in the study. The exclusion criteria were unwillingness to participate, and those who had been working in the specified sector for fewer than six months.

Data Collection Methods

The data collection methods were directed by the research objective. Primary data collection methods were In-depth interviews (IDIs), focus group discussions (FGDs), and Key informant interviews (KIIs). . Before initiating data collection, we pretested the interview and FGD guides several times to establish tool validity and reliability. The final guidelines for data collection are added as additional file 4. The IDIs were conducted with multi-level field staffs; CHCPs), upazila statisticians, nurses, and health inspectors. Study participants for IDIs were selected based on convenient sampling. Emergent questions and reflections from IDIs was also being discussed during FGDs. Each FGD was comprising of six to seven purposively selected participants. The key informants were categorized into three subgroups at three different levels: health managers; (UHFPOs and civil surgeons) HMIS experts (system analysts, IT programmers), and key decision makers (assistant chief MIS-DGHS, program managers from MIS directorates, and divisional focal persons from development partners). A purposive sampling strategy was followed to ensure participation from each stakeholder group. The snowball sampling technique was also used to identify key personal to be interviewed, to ensure collection of rich data. Interview time was selected according to participant’s convenience mostly during afterhours of office period. A relatively quiet room within the office premises was selected for interview. Only the interviewer, interviewee and note taker were present during all face to face interview sessions. Interview time lasted from minimum 45 mints to maximum two hours. All interviews started with the brief introduction of study objectives, introduction of interviewer and reading out of privacy declaration form. None of the Interviewers were previously known to interviewees and reason of interrogation was stated as general interest in the research topics. Written informed consent was taken from all the participants in an anonymous privacy declaration form (added as additional file_5) . The interviews were audio recorded with the participants’ consent. Field notes were taken during interviews to back-up the audio recorded data in case of equipment failure. The interview was stopped when data saturation achieved.

(Table 1)

Table 1: Data collection methods

Data collection method	Study respondents	Number of interviews	Sampling technique	Purpose/Main issues explored
IDI	CHCPs, nurses, health inspectors, upazila statisticians	23	Convenient	Efficiency of record keeping using DHIS2; staff attitudes; reporting status; factors hampering data entry and processing
FGD	District statisticians	2	Purposive	Multiplicative information and knowledge of using DHIS2; Cross checking reflections that emerged during the IDIs
KII	Health managers (UHFPOs, civil surgeons)	5	Purposive, Snowball	Role of DHIS 2 technology on improving RMNCAH service delivery; Constraining and facilitating factors faced during DHIS 2 implementation; Other implementation challenges; scope of improvement of servers and software
	HMIS experts (system analysts and IT programmers)	3		
	Key decision makers (assistant chief MIS-DGHS, program managers from MIS directorates and divisional focal persons from development partners)	3		
Total sample size (N)		N= 36		

Data analysis

The collected data was analyzed by contents using thematic approach. The recommended six staged thematic approach was followed that consist of data familiarization, coding, identification, review and naming of the major themes and writing final reports⁽¹⁴⁾. Interview transcription, translation, and coding

all were iterative process. As part of data familiarization, the research team met regularly during data transcription and cross-checked the confusing data against the recordings. For content analysis, we followed “directed content analysis” approach, where codes were selected both before and after analysis⁽¹⁵⁾. A-priori codes were prepared based on previous research findings and theory .ATLAS ti software⁽¹⁶⁾. was used to do the coding and it was done independently by two researchers. Intra-coder reliability was checked before listing it in the final code list

After coding, the research team translated the coded data into English. IDIs, FGDs, and KIs were analyzed separately and drew collective inferences from the findings collectively under identified themes⁽¹⁷⁾. The flow of coding to emergent theme is presented in Figure 1 named data structure The findings were shared and discussed in a consultative workshop with relevant stakeholders for data interpretation and validation (including study participants). The suggestions came during workshop were also incorporated into the final reports under respective study theme.

A 32 item checklist to report qualitative research findings known as “Consolidated criteria for reporting qualitative studies (COREQ)” has been followed with this research and added as additional file 6.

Results

We organized the findings under four major themes. attitudes against DHIS2, challenges faced, enabling factors and finally recommendation to improve DHIS2 implementation for RMNCAH data collection and use at different level of health system

Section 1: Attitude against DHIS 2

The majority of study participants expressed a strong, positive attitude toward using DHIS 2 for RMNCAH data collection. They described DHIS 2 as a dynamic system that has improved overall medical record keeping and the accountability of data reporting from community clinics at the periphery to district-level hospitals.

“Online is a perfect system. Previously I used to collect data in papers, and at the end of the year my office gets full of papers. It was also very difficult to retrieve data from thousands of piled up paper forms. Now, in online, by clicking the date or by name or phone number of the patients, I can easily check the data. I am getting the data collection form even in my mobile, by which I can fill up the form, from any place and any time! So, it is easier.” – Community health care provider, IDI

The supervisory team perceived that initiating such technology has contributed to instant monitoring, cross-checking of collected data, setting priorities, and making decisions, which was time-consuming with the previous paper-based system. With the DHIS2, statisticians are assigned to tabulate the data from DHIS 2 and share the generated summary reports with district and divisional health managers. Managers observe and flag the gaps in service delivery and noted achievements. Findings are discussed at monthly review meetings in the presence of field staff. At these meetings, which are held in each sub-

district, district, and divisional health manager's office, comparisons are made with the previous month, present month, and yearly national targets to track improvements in performance and identify any hindrances to achieving targets. Most respondents, from the community to the national level, identified this review meeting as a platform for RMNCAH-related data observation, monitoring, and instant planning for the coming weeks

"From DHIS 2, along with [the] national scenario, we can see the status of districts and sub-districts, even unions and wards. All the field staff are forwarding data on rate of using contraceptives, maternal death, amount of IUD [intrauterine device] delivered, and number of oral contraceptives supplied". – Information communication technology focal person, IDI

Some additional factors also played strong influence on user perception about DHIS2. These were both individual and at institutional level. DHIS2 users who were more frequent on using it and had sufficient training perceived the true need of it. Availability of sufficient technical equipment like laptops, desktops and tablet personal computers at the field level made them more enthusiastic.

The demand of using DHIS2 is going beyond RMNCAH. Key informants who had been involved with DHIS 2 since its inception explained that the software is maturing continually. During 2009, when DHIS 2 was launched, it was not used for data visualization and decision making because accessing the system was challenging. Since DHIS 2 introduced the dashboard concept in 2012, it has drawn the attention of directors working at the national level, who demanded the platform be used for their own reporting. As a result, the online data entry forms increased from 12 in 2012 to 32 in 2013. The perceived need of DHIS2 can be better explained from the below quote

In 2013, the DHIS 2 log in dashboard became much popular, all users could access it. At that time, 5,000 to 6,000 graphs were made using DHIS 2, which eventually increased to 15,000 to 16,000. It means, people were trying to use it. To justify my argument I must say, these much of graphs were prepared by users from 64 districts not by a single use,, that means people are using it!— HMIS expert, KII

A few health managers expressed a contrasting view, arguing that staff orientation and adaptation to technology is somewhere working as major obstacle to electronic HMIS implementation.

"In some places . . . a complex device, [like a] computer has been handed over to the hand of an old community health worker, hence she cannot use it."—Upazila health manger KII

DHIS2 has been used to report aggregated data on monthly basis. CHCP need to maintain both paper and electronic form as automated data reporting is not possible within the current system. This make the data entry process time-consuming and complicated, hence less use or misreporting at the end.

Moreover, insufficient understanding on the RMNCAH indicators sometimes act as cause of unintentional errors in data entry

Section 2: Challenges to RMNCAH Data Collection and Analysis with DHIS 2

DHIS 2 Platform

Several technical challenges with the DHIS 2 platform were highlighted during the KIIs. There is no provision of automated calculation for aggregated data, and key informants expressed that its absence increased the possibility of data disparity and generating errors.

“DHIS 2 has a problem. . . . There are [boxes] for entering aggregated data. But, now, it is needed to use the formula. Many of the staff do not understand these formulas. In training sessions, I provide them the formula, explain this using multimedia presentation. Many [field staffs] do not understand it. In several cases, they put the value of one indicator in boxes designated for other indicator”. – IT expert for MIS, KII

In addition, DHIS 2 has the provision to “SKIP” for all indicators, which contributes to data incompleteness. With incomplete data, it is difficult to retrieve valid results from DHIS 2.

Respondents also referred some technical issues with the data collection forms that should be checked to decrease misreporting and improve efficiency.

“In [the] individual server, first, I put mother's name, her EDD [estimated date of delivery], date of enrolment, and then a box will pop up for gender. There is male, female and transgender. The data is on a pregnant mother, which is clear from this information, I don't understand what the need of gender then? There should be a system that [the] computer would recognize the gender automatically when pregnant women has been marked. We should not put it manually. Here our field workers are making mistake[s]”– District statistician, FGD

Instead of using unique health identification numbers to track patients, their cell phone numbers are used. However, it is difficult and time-consuming to search the database with a cell phone number. To get around this, CHCPs prefer to enroll follow-up patients as new ones. This raises a data quality issue since repeat clients are identified in the system as new clients. According to the key informants, this has created a gap in the system, as it is not possible to track the health status of a single patient in the existing system during data analysis and visualization. It was suggested that the system could be linked to Bangladesh's National Identification Database. It was also noted that the platform design makes data validation challenging.

Updating the data entry forms to facilitate comparisons among data variables is challenging. DHIS 2 has started with version 2.6 on 2009, which was upgraded, version-by-version, to 2.13 at the end of 2013 to make the system faster. Each time the data entry forms are changed it becomes more difficult to compare the old and new data because the software cannot match the data variables, resulting in invalid findings.

“For those, who are computer literate, for them, version change is an “attraction.”“ Let us explore, what are the new features?” But, our CHCPs do not perceive it in this way. They think, there was a box here in the older version, where did the box goes now with the newer version? They don't understand, we are trying to make their work easier! It will take some time, to change the culture”. – HMIS expert, KII

Several informants reported that in the existing system, searching for sub-districts is a time-consuming process.

Workforce

At the supervisory level, district and sub-district health managers could not find the time to use DHIS 2 on a daily basis because they were involved in other activities. Sometimes they can escape the use of DHIS 2 too.

“A health manager knows clearly about his district's targets on immunization coverage, or ANC coverage, or even for facility births from their years of experience. So they do not need to open the computer and get into the DHIS 2. The mechanism is such; you cannot trap him for this reason”. – Senior programmer, KII

The DHIS2 is an additional task for the statisticians with other regular administrative duties (e.g., preparing salary sheets, drafting letters). They need to do extra hour work for that. National-level key personnel acknowledged the shortage of statisticians or other staff trained in data analysis. They admit that in many areas, qualified statisticians have not been recruited. Even so, many statisticians are not efficient in using computer software and do not understand health indicators and data compilation. In many areas, statisticians do not even attend trainings.

“The job description and responsibilities of statistician should be separate. But, in many districts there is no designated statistician. . . . In area “YY,” a ward boy does all the work of statistician; you cannot expect anything better from him! There should be an assigned person, who will do research [with data]”. –

District health manager, KII

The RMNCAH data collected by the MIS Division of DGHS have also been used by the RMNCAH line directorate of DGHS. However, data retrieval from the DHIS 2 platform is not the regular practice for the RMNCAH line directorates; like all other directorates they rely on their own reporting format.

Logistics Management

Although the participants said the number of electronics provided for data collection is sufficient, slow Internet connectivity makes real-time data entry difficult. As one CHCP described,

“At dawn, sometimes the Internet speed is better. In most cases, I enter the data at this time. It happened, I could not report for one week, two weeks, as the speed was slow. With a weak connection, I cannot even log in into the system” CHCP, IDI

The provision of offline data entry could make the things little easier. The process of sending broken tablets to capital city for repairs and transporting them back to the community took a long time. The majority of respondents reported internet modem shortages as well. In many areas, sub-district and district health managers personally obtain a modem and Wi-Fi router.

Capacity Building

Statisticians reported not receiving any specific training on DHIS 2; rather it was a part of computer literacy training. Participants received DHIS 2 training manuals, though these were not updated to reflect changes in newer versions of the software and forms. Since DHIS 2 was introduced, all the line directorates want to incorporate their relevant indicators to be collected and analyzed through DHIS2 using same workforce.

“Now everybody wants their data from DHIS 2. Non-communicable Disease division add some indicator[s], RMNCAH add some too. In some cases, the reporting format is also different than the one used by DHIS 2. For example, if [the] EmNOC [emergency newborn and obstetric care] reporting format for [the] MIS division and RMNCAH would be same, I can get the report by clicking on DHIS 2 data. But [the] EmNOC report for RMNCAH directorates have 27 indicators while it is 25 in DHIS 2 database”. – Sub district statistician, IDI

Section 3: Facilitators to RMNCAH Data Collection and Analysis with DHIS 2

Mandatory quality checks at different tiers and regular monthly feedback meetings have played a significant role in improving data quality.

A national-level expert shared his experience with checking data validity:

For example, when we check MMR [maternal mortality ratio], we locate where the ratio is high. Then we review the ratio of that particular district for consecutive months to explore the consistency of data and reporting status, either it was low or high for the previous months. We check all these. Then we send an e-mail, to respective authority, to look into the matter. – HMIS expert, KII

So far, DHIS 2's performance has been measured from the perspective of timeliness and completeness. A positive competition for service improvement has been nurtured. The best-performing district or division receives recognition from the national level.

“In our monthly meeting we discuss our shortfall; we plan how to improve the reporting rate. We always analyze the data, hence our performance is better!! We have a silent competition with other districts of this division and we do better always and got national award as model district” – District health manager, KII

International donors strongly support strengthening Bangladesh's HMIS. They share financial costs with the government for national- and international-level training for the staff, IT equipment purchases, and other needs. In collaboration with other NGOs, like icddr,b, they are providing technical support to the IT programmer for online platform improvement and organizing a training on the DHIS 2 manual for staff working at different tiers of health system. Donor organizations have demonstrated a strong commitment to the successful implementation of DHIS 2 by deploying their staff as monitoring officers at each administrative division and ensuring their physical presence and participation during monthly coordination meetings at the divisional and central levels.

The government has limited capacity and could not develop that capability till now. From the side of development partners, we are giving them that support. If development partners withdraw their support, how will the system run? But the DHIS 2 dashboard is already sustainable, and its automatic; staff have training and they can handle it. The government is cordial, and they have sufficient resources, training arrangement, hardware. In this context, strict monitoring and defined role of staffs are important. In addition, ownership of data is a major concern, many health managers do not own the data. – HMIS expert from donor, KII

Factors affecting the DHIS 2 implementation in Bangladesh context are highlighted through Figure 2.

Section 4. Recommendations for Strengthening the HMIS to improve RMNCAH Outcomes

Based on the study findings, the participants' major recommendations for strengthening the HMIS to ameliorate RMNCAH outcomes in Bangladesh are elaborated below.

The DHIS 2 platform should be programmed to generate automated data for specific RMNCAH indicators. A pop-up box with the indicator definition, calculation (if applicable), and any possible disaggregation should be included. This will provide instant help to the CHCPs and standardize data collection. The software should be translated into Bangla (the local language) to help create a clear understanding of instructions and RMNCAH indicators. An online dashboard should be installed in the platform where instant RMNCAH-related reporting and performance status updates should be exhibited automatically at the sub-district and district levels. Statisticians should be informed in advance about software updates and notified of specific changes so they can prepare the CHCPs.

Data collection forms should be simplified to ease the data collection process and data reporting. Creating unique health identification numbers for patients and issuing individual health cards will decrease the time spent on data entry and help mitigate data duplication. Since the system will contain clients' contact information, statisticians can verify the collected data through random phone calls. A geographic information system should be installed in CHCPs' electronic devices used for data collection to track the providers' movement. Users should be able to enter data into DHIS 2 daily, as aggregated data increase the risk of errors, thus compromising data quality.

Since DHIS 2 is used at different levels of the health system, the DHIS 2 training curriculum should be tailored to the needs of health professionals working at different levels. The IDIs and FGDs revealed a need for separate training sessions on medical terminology for community and sub-district level staff. After every update to the software or data collection forms refresher trainings should be organized to improve staff knowledge and efficiency. A standardized training curriculum and tools are also needed. Furthermore, soft copies of training manuals should be shared with staff via e-mail so they can be easily updated and disseminated.

Along with a statistician, another staff member should be trained in data compilation and analysis to complement the statistician's work and support the statistician in his/her absence. A separate MIS unit

can be formed comprising, at a minimum, a statistician and a supporting staff member who will be assigned to perform all MIS-related tasks only. Sub-district and district health managers should be more involved in data reporting and analysis to develop ownership and a regular practice of using DHIS 2.

Computers and other electronic devices for data collection should be repaired at the local level to save money and time. Providing CHCPs with an Internet data subscription can ensure timely reporting. The number of modems at the subdistrict and district levels should be increased, and each municipality should have its own dedicated laptop for the statisticians to use to ensure timely reporting.

The country would benefit from a national e-health strategy and implementation framework to facilitate a culture of DHIS 2 use for planning, setting priorities, and decision making among different stakeholder groups. This strategy should include how the country intends to provide the resources to fund DHIS 2's long-term sustainability when donor support is no longer available.

Discussion

A strong, positive attitude toward a digitized e-health system and corresponding actions taken from the directorates could make nationwide implementation of DHIS 2 possible in Bangladesh. In our paper, we could point out some unique initiatives of Bangladesh health system which make the DHIS2 functional. Such as presence of IT focal person at the peripheral level health facilities, option of both online and offline data entry, adding DHIS2 dashboard in the online platform make it more user friendly for the health managers and useful for local level planning. Mandatory data quality checks, regular monthly coordination meeting at different tiers of the health system with active participation from all levels of key stakeholders, rewarding the best performing district to enhance positive competition among DHIS 2 users, and close collaboration with donor organization are some of the noteworthy initiatives taken by the MIS directorates. Although data accuracy and completeness remain an issue, data quality has improved with multiple levels of quality checks and feedback loops. Monthly data review meeting have been organized at each level of data gathering points. The importance of data review meetings to strengthen the HIS has been highlighted in other studies too^(9, 18)

The barriers to implementing an electronic HMIS mentioned under this study are similar to those reported by other developing countries: inadequate human resources, frequent power outages, low internet connectivity, and a poor culture of using data for decision making⁽¹⁹⁻²³⁾. Some field staff are still struggling with the mindset change – moving from paper-based to electronic data collection and appreciating the usefulness of collected data. In this regard, another study highlighted that time is needed to allow community health workers to adapt and increase their computer literacy. This can be improved with onsite supportive supervision and providing trouble shooting at the district level^(8, 24). Encouraging data ownership and adding incentives for accurate and timely reporting at the community level brought a positive mind set change among field-level health workers in different country contexts⁽¹⁸⁾ (7, 25). Data ownership enabled the field-level workers to understand the purpose of data collection and how the information would be used rather than considering it an administrative burden⁽⁸⁾.

The data collected under DHIS 2 was considered comprehensive in our study. In addition to collecting RMNCAH health indicators, it captures human resources, medicine and logistics data. This data availability allows the health system to address broader contextual factors like human resource shortages or stock outs, which can act as hindrances to achieving high-quality RMNCAH data. Above all, individual needs, motivations, and relationships among those working within the health system play a significant role in the successful implementation of electronic HMIS ^(12, 26).

Since DHIS 2 is used at different levels of the health system, the training curriculum should be tailored to the needs of health professionals working at different levels. The IDIs and FGDs revealed a need for separate training sessions on medical terminology for community and sub-district level staff. After every update to the software or data collection forms refresher trainings should be organized to improve staff knowledge and efficiency.

Although the study participants felt the data collected under DHIS 2 were comprehensive, the system lacks critical information, such as family planning statistics. Because the DGFP MIS is not connected to DHIS 2, data collected under the DGFP cannot be accessed and analyzed with DHIS 2. This lack of synchronization creates parallel reporting systems⁽²⁷⁾. The study participants highlighted this duplicity in reporting and mentioned the difficulty of managing multiple forms and needing to report the same RMNCAH indicators in different formats for different stakeholders. Duplication of data with different reporting formats has been noted in other countries⁽²⁶⁾ To mitigate this data duplication issue, a pilot project funded by USAID has launched at the 20 sub-districts of Tangail and Habiganj . Every eligible mother and under-five child at the community level has received a health card with a unique identification number that allows the system to retrieve and monitor their MNCH service uptake data at any service delivery point⁽²⁸⁾ The outcome of that pilot project will be supportive to understand the feasibility of HMIS's unification of the DGHS and DGFP .

The RMNCAH indicators from the majority of urban health facilities are not being reported in DHIS 2 in Bangladesh. The urban health system is dominated by the private sector, which is not accountable for monthly reporting to DHIS2. However, some aggregated data are collected from the private facilities operating at the district level. Exclusion of data from private health facilities in DHIS2 has been reported in other developing countries too ⁽²⁴⁾.

Instead of generating monthly aggregated data, the electronic data collection forms should be designed in such a way that monthly reports are generated automatically. Automating the system has proven to minimize the time required to generate reports and could increase completeness and accuracy of MNCH data reporting in some African countries as well ^(26, 29). DHIS 2 users from other countries opine that collected data need to be analyzed and used at more frequent intervals. Health managers should develop the practice of using a dashboard daily for data visualization. Errors in data collection or reporting can be immediately addressed from their feedback ^(23, 30, 31).

The national-level key stakeholders of our study mentioned that DHIS 2 implementation in Bangladesh is largely dependent on international donors. To ensure sustainability, the country should adopt its own strategy to self-finance the HIS. Evidence has shown that building the capacity of IT staff with public-private partnerships to generate funding has been a successful strategy for ameliorating donor dependency in other countries (5, 18).

Conclusion

Our study found that most study participants exhibited a positive attitude toward an electronic HIS. Although DHIS 2 has become the data repository for different health data, multiple reporting formats for different stakeholders, in addition to the ongoing reporting requirements, negatively impact the workload of field-level health workers. The exclusion of data from large private health sector is a hindrance to getting a complete picture of the country's RMNCAH status. Slow Internet connectivity, some health workers' defensive attitude toward an electronic system, and limited use of data for local-level decision making prevent the successful implementation of DHIS 2. We recommend periodic refresher trainings to increase staff confidence in computer literacy. A national e-health strategy and implementation framework, as recommended by key stakeholders, will outline how the country will fund the sustainability of DHIS 2 and facilitate a culture of data use for planning, setting priorities, and decision making.

List Of Abbreviations

ANC antenatal care; CHCP community healthcare provider; DGHS Directorate General of Health Services; DGFP Directorate General of Family Planning; e-health electronic health; FGD focus group discussion; HIS health information system(s) HMIS health management information system(s) IDI in-depth interview IT information technology; KII key informant interview; MIS management information system(s) MOHFW Ministry of Health and Family Welfare; MNCH maternal, newborn, and child health; PNC postnatal care; RMNCAH reproductive, maternal, newborn, child, and adolescent health; UHFPO upazila health and family planning officer; WHO World Health Organization

Declarations

Acknowledgements

We appreciate the support received from the Management Information System under Bangladesh's Directorate General of Health Services (DGHS), in the Ministry of Health and Family Welfare (MOHFW) particularly to Dr. Adnan Khan for their contribution during study implementation, building trust and network with the study participants and organizing stakeholder workshop. Special thanks to Farina Naz, research fellow from icddr,b for helping with literature matrix and to Dr. Shahed Hossain, faculty of James P Grant School of Public health for his help during study conceptualization.

Funding

This research project got financial support from USAID, Palladium under the PRH Small Grants Program Round IV. The funding body had no role on the study implementation starting from study design, data collection, analysis, or interpretation.

Author contributions

All authors have read and approved the manuscript. The role of researchers in different aspect of research are as follows; Conception and research design: TB, SMK,IA,AK,JF,MPSI; Data analysis: TB,SMK,FAK; Data interpretation: TB,SMK,FAK,IA; Drafting the manuscript: TB,SMK, AB, IA,FAK,AR,JF,MPSI

Critical revision: AB

Ethics Approval and Consent to Participate:

The study protocol was reviewed and approved by the Institutional Review Board (IRB) of international centre for Diarrhoeal research (icddr,b) , Dhaka . The IRB comprises of two independent research and ethics review committee and provide approval to conduct research after reviewing full proposal, informed consent form and data collection guideline against the protocol number PR-17086. Informed written consent were taken from all the study participants.

Consent for publication

Not applicable

Availability of data and material:

Data supporting this study findings will be available from the Research administration of icddr,b with reasonable request of anonymous data. Please email to director research administration of icddr,b for further data request

Competing interests: All authors declare they have no competing interests.

References

1. Fox LA. Fitting in, standing out. Leading effectively within your organization. Journal of AHIMA. 2005;76(1):24.
2. Garg R, Garg A. District Health Information System (DHIS2) Software in India. Advances in Computer Science and Information Technology (ACSIT). 2015;2(10):39-42.
3. Manoj M. Customising DHIS2 for Maternal and Child Health Information Management in Sri Lanka. Sri Lanka Journal of Bio-Medical Informatics. 2013;3(2).
4. Gathogo JK. A model for post-implementation valuation of health information systems: The case of the DHIS 2 in Kenya. University of Nairobi. 2014.

5. Dehnavieh R, Haghdooost A, Khosravi A, Hoseinabadi F, Rahimi H, Poursheikhali A, et al. The District Health Information System (DHIS2): A literature review and meta-synthesis of its strengths and operational challenges based on the experiences of 11 countries. *Health Information Management Journal*. 2018;1833358318777713.
6. Krishnan A, Nongkynrih B, Yadav K, Singh S, Gupta V. Evaluation of computerized health management information system for primary health care in rural India. *BMC health services research*. 2010;10(1):310.
7. Maternal Child Survival Program. Review of the Maternal and Newborn Health Content of National Health Management Information Systems in 24 Countries. 2017 May 2018.
8. Kiberu VM, Matovu JK, Makumbi F, Kyoziira C, Mukooyo E, Wanyenze RK. Strengthening district-based health reporting through the district health management information software system: the Ugandan experience. *BMC medical informatics and decision making*. 2014;14(1):40.
9. Manya A, Braa J, Øverland LH, Titlestad OH, Mumo J, Nzioka C, editors. National roll out of District Health Information Software (DHIS 2) in Kenya, 2011–Central server and Cloud based infrastructure. *IST-Africa 2012 Conference Proceedings*; 2012: IIMC International Information Management Corporation.
10. Chu A, Phommavong C, Lewis J, Braa J, Senyoni W, editors. Applying ICT to Health Information Systems (HIS) in Low Resource Settings: Implementing DHIS2 as an Integrated Health Information Platform in Lao PDR. *International Conference on Social Implications of Computers in Developing Countries*; 2017: Springer.
11. Birdsall K. A Quiet Revolution: Strengthening the Routine Health Information System in Bangladesh: a Publication in the German Health Practice Collection: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH; 2014.
12. Management information System. *Health Bulletin 2017*. Dhaka, Bangladesh: Director General of Health System 2017 [Available from: <http://www.dghs.gov.bd/index.php/en/home/4364-health-bulletin-2017>].
13. Ahmed T, Lucas H, Khan AS, Islam R, Bhuiya A, Iqbal M. eHealth and mHealth initiatives in Bangladesh: a scoping study. *BMC health services research*. 2014;14(1):260.
14. Nowell LS, Norris JM, White DE, Moules NJ. Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods*. 2017;16(1):1609406917733847.
15. Hsieh H-F, Shannon SE. Three approaches to qualitative content analysis. *Qualitative health research*. 2005;15(9):1277-88.
16. Lewins A. Computer assisted qualitative data analysis. *Researching social life*. 2001:302-23.
17. Wilkinson S. Analysing focus group data. *Qualitative research*. 2011;3:168-84.
18. Karuri J, Waiganjo P, Orwa D, DHIS MA. The Tool to Improve Health Data Demand and Use in Kenya. *Journal of Health Informatics in Developing Countries*. 2014;8(1):38-60.
19. Garrib A, Stoops N, McKenzie A, Dlamini L, Govender T, Rohde D, et al. An evaluation of the district health information system in rural South Africa. *South African Medical Journal*. 2008;98(7):549-52.

20. Poppe O. Health information systems in West Africa: implementing DHIS2 in Ghana 2012.
21. Matera E, Imoko J, Berhe G, Dawuda C, Omar M, Pinto A, et al. Rapid surveys in support of district health information systems: an experience from Uganda. *East African medical journal*. 1995;72(1):15-8.
22. Dickey C, O'Connell T, Bedford J, Thiede M. Integrating an approach to assess UHC access barriers into district health systems strengthening in Uganda, Ghana and Rwanda. 2014.
23. The Three Millennium Development Goal Fund. Review of DHIS2 implementation experience 2016.
24. Nielsen P. Advancing health information systems: Experiences from implementing DHIS 2 in Africa 2013 [Available from: https://www.who.int/woman_child_accountability/ierg/reports/11_Nielsen_HISP.pdf].
25. Lungo JH. Data Flows in Health Information Systems: An action research study of reporting routine health delivery services and implementation of computer databases in health information systems 2003.
26. Okello G, Gerrets R, Zakayo S, Molyneux S, Jones C. "Every day they keep adding new tools but they don't take any away": Producing indicators for intermittent preventive treatment for malaria in pregnancy (IPTp) from routine data in Kenya. *PloS one*. 2018;13(1):e0189699.
27. Ahsan KZ, Tahsina T, Iqbal A, Ali NB, Chowdhury SK, Huda TM, et al. Production and use of estimates for monitoring progress in the health sector: the case of Bangladesh. *Global health action*. 2017;10(sup1):1298890.
28. Plannig DGF. One year of RHIS: looking back Rroutine health information system. Dhak, Bangladesh: Ministry of Health and Family Welfare 2016 [Available from: <https://www.measureevaluation.org/countries/bangladesh/focus-on-rhis-bangladesh-newsletter-february-2016>].
29. Kariuki JM, Manders E-J, Richards J, Oluoch T, Kimanga D, Wanyee S, et al. Automating indicator data reporting from health facility EMR to a national aggregate data system in Kenya: An Interoperability field-test using OpenMRS and DHIS2. *Online journal of public health informatics*. 2016;8(2).
30. Gathua PW. Assessment of Data Use of the District Health Information System (DHIS 2): A Case Study of Nairobi County. MA Project, University of Nairobi, Nairobi. 2016.
31. Mera M, Gonzalez C, Lopez DM. Towards an intelligent decision support system for public health surveillance - a qualitative analysis of information needs. *Studies in health technology and informatics*. 2014;202:44-7.

Additional Files

Additional file 1: Fig1: HMIS data flow under Director General of Health, Bangladesh

Additional file 2: Fig2: HMIS data flow under Director General of Family Planning, Bangladesh

Additional file 3: Table 1: Common RMNCAH indicators retrieved by the DHIS2 under DGHS

Additional file 4: Interview guidelines

Additional file 5: Privacy declaration forms

Additional file 6 : study quality assessment checklist (COREQ checklist)

Figures

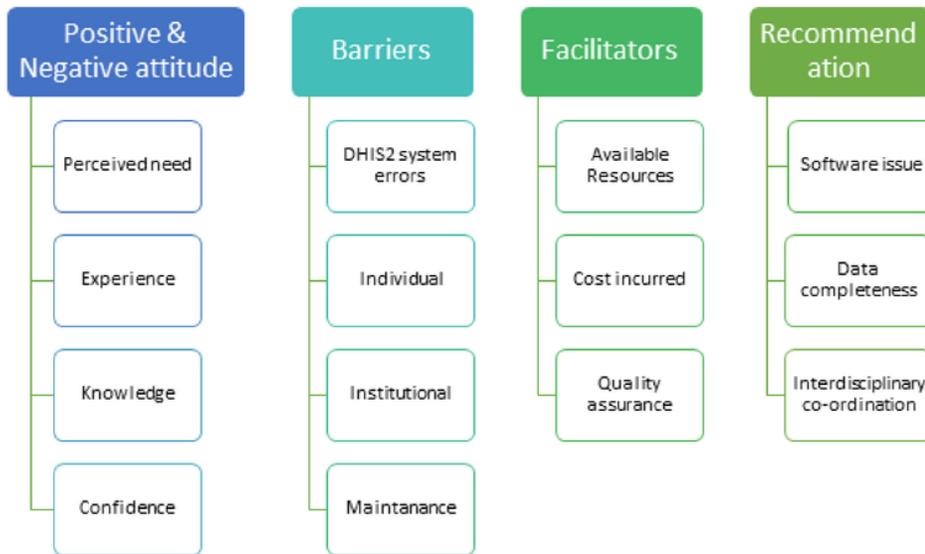


Figure 1

Data structure

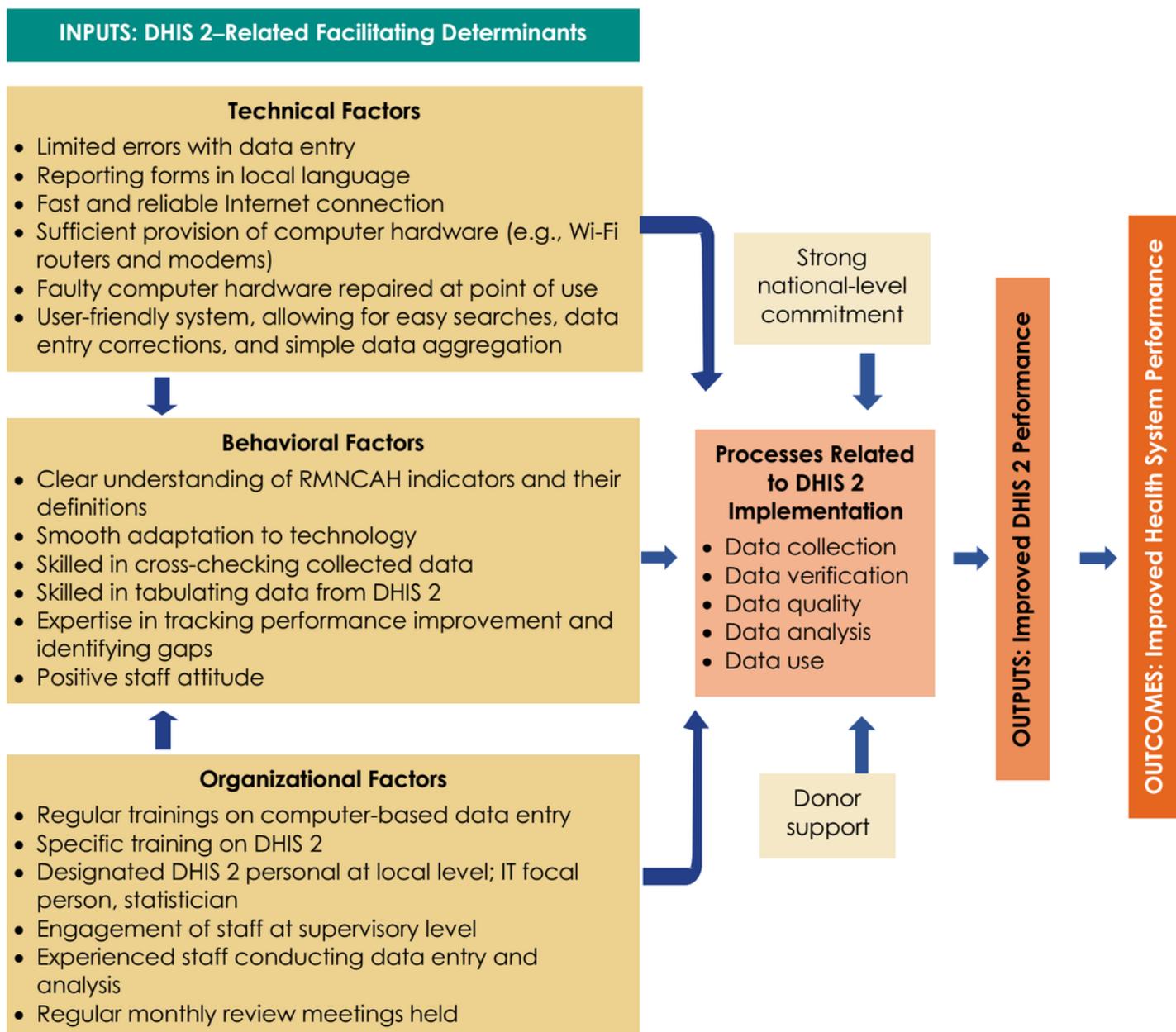


Figure 2

analytic framework on strengthened DHIS 2 in Bangladesh

Supplementary Files

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- [AdditionalTable1.pdf](#)
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- [Additionalfile4INTERVIEWGUIDELINE.pdf](#)
- [Additionalfile6COREQchecklist.pdf](#)
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