A PILOT STUDY ON DISTRICT HEALTH INFORMATION SOFTWARE 2: CHALLENGES AND LESSONS LEARNED IN A DEVELOPING COUNTRY: AN EXPERIENCE FROM ETHIOPIA

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Abstract - A properly functioning health information system is central to achieving better health outcomes. Henceforward, strong health management information system is a backbone of strong health system. A properly functioning health management information system gets the right information into the right hands at the right time, enabling health data consumers to make effective information use. District health information software 2 is open source software for collection, validation, analysis, and presentation of data tailored to manage integrated health information. This study examines lessons and challenges of DHIS-2 to advance electronic health information management system in Ethiopia. A cross-sectional pilot study on twenty six health facilities found in four purposefully selected regions of the country was conducted from February to November 2015. Data were collected using interview and Likert scale questionnaire. A central server was configured. The software was customized in view of the national health management information system. Training of trainees was given to users. The software was piloted on those twenty six health facilities for three months following the training. It was found that District Health Information software contributes in advancement of existing health information system primarily in terms of data utilization and information use. However, since Ethiopia has a unique calendar, customizing reporting period to local calendar was a major challenge.

Key Words: District health Information Software, DHIS-2, Pilot Study, Health Management Information System, Challenge, Lessons Learned, Developing country, Ethiopia, Experience

1. INTRODUCTION

Utilization of precise, valid, timely and credible data and information are the bases of decision making, policy and planning development [1, 2]. Strong health systems are central to achieving better health outcomes. Henceforward, strong Health Information System (HIS) is a backbone of strong health system. A properly functioning HIS gets the right information into the right hands at the right time, enabling health data consumers to make effective information use [3].

Ethiopia adopted a "one plan, one budget, and one report" policy. In this regard, since 2004 Ethiopia implemented two types of electronic Health Management Information System (e-HMIS) as integral part of HIS providing fundamental information for health system monitoring. Recent assessment conducted by Ethiopian Federal Ministry of Health (FMOH) showed that despite intensive efforts to improve the efficiency of e-HMIS, data quality and information use had been challenges for the past few years. In this circumstance, existing e-HMIS could be incompetent to come across with high demand information in order to make impressive gains and phenomenon advancements on major health outcomes in the newly approaching Health Sector Transformation Plan (HSTP).

District Health Information Software (DHIS-2) is open source software for collection, validation, analysis, and presentation of data tailored to manage integrated health information. DHIS-2 has been adopted for national and program specific health information system in around 47 countries globally. It is a preferred health information system especially as developing countries try to transform health care system by effective information use as a critical process [4].

DHIS-2 in itself is a mirror that shows the picture of DHIS-2 to managers and policy makers, in district and national level. Whatever information transparency with assistance of proper and efficient information technology, and integrity in its components, shows a better picture of the organization, organizational units and services delivery methods [2].

Consequently, this pilot study aimed to oversee likely opportunities and challenges of DHIS-2 to advance existing e-HMIS in Ethiopia.

2. METHODOLOGY

2.1 Pilot team composition

A national DHIS-2 core team comprising different skills and backgrounds (Public health, Health Information specialists, Epidemiologists, Information and Communication Technology specialists, data managers and a project manager) was formed at the initial stages of the project. One member of the team was appointed as the team leader. The purpose of the team was to coordinate the implementation of the DHIS-2 project by driving the database design process and customization. Technical assistants from Health Information Systems Program, Oslo University were borrowed to support the implementation.

2.2 Pilot Study Area, Design and Period

Ethiopia, officially known as the Federal Democratic Republic of Ethiopia, is a landlocked country located in the Horn of Africa with over 91 million inhabitants occupying a total area of 1,100,000 km2 [5]. A cross-sectional study design was conducted from February to November 2015.

2.3 Pilot Site Selection Procedures

Type of previously deployed e-HMIS, socio-economic status, geography, human resource, information technology infrastructure, available historical data, and administrative structure were used as pilot site selection inclusion and exclusion criterion. Accordingly, FMOH in consultation with Regional health bureaus and Zonal health departments selected districts from the entire pool of available districts to clearly extract lessons and challenges of DHIS-2 pilot implementation under aforementioned criterion.

2.4 Sample Size and Sampling Techniques

The pilot study was based on regions which were designed to provide important lessons for large scale implementation of DHIS-2 at national level. In general, based on inclusion criterion eleven regional states (nine regional and two city administration health bureaus) found in Ethiopia were stratified and a purposeful sampling method was deployed in order to select four regions. Accordingly, South Nations, Nationalities and Peoples' Region (SNNPR), Oromia, Addis Ababa, and Gambella regions were selected. Henceforth, following pilot site selection procedures Zonal health departments found in each of four selected regions carefully nominated their respective districts for DHIS-2 pilot implementation.

All the 37 professionals who were working in the selected districts (7 at Oromia, 12 at Addis Ababa, 8 at Gambella and 10 at SNNPR) were included in the pilot study. Accordingly, seven day training of trainers was given on the objective of the pilot study and on basic data entry, analytics and reporting procedures of the software for higher precision and accuracy.

2.5 Data Collection Procedures, Processing and Analysis

A five point Likert scale questionnaire was developed in order to assess attitudes, opinions, and perceptions of users towards customized DHIS-2. Users choose from a range of possible responses to a specific question; typically include "Excellent", "Good", "Satisfactory", "Poor", and "Very poor". Data were also collected using interview of users. Variables primarily focus on six Non-functional requirements of software engineering. Data was numerically coded, transformed, and entered in to SPSS version 20.0.

Descriptive statistics was done to describe the characteristics of users. Sequential mixed method analysis (quantitative data analysis supplemented by qualitative data analysis) was conducted; as a result, findings were triangulated in order to fully explain and make accountable conclusions and recommendations from the pilot study.

3. RESULTS

3.1 Setting Up of a Central Server and Customization of the DHIS-2

A central server was configured for the database. The advantage of using one central server in the country was because it was easier to provide technical support to only one central server installation. If standalone (offline /online) installations in each district, health facility, had been chosen, then one needed to provide technical support to all the hundreds of installations, when new versions needed to be synchronized or when something went wrong. Due to poor Internet connectivity and inadequate capacity of the servers at the Ministry of Health headquarters, a central server using cloud computing was set upped. The goal of cloud computing was configured to provide easy and scalable access to well managed computer servers and other information communication technology services.

DHIS-2 was customized to fit with Ethiopian health system based on a template of currently functioning e-HMIS. All customization of the system was performed by the Ethiopian team under the supervision of Oslo University. The Ethiopian team demonstrated great knowledge of information systems and the team members were quick learners. The customization

process went smoothly demonstrating the importance of knowledge transfer and capacity building. Service delivery, outpatient and inpatient disease report types were designed. All report types collect and report data on monthly, quarterly and yearly basis.

A total of 122 indicators were included in the software. Age, sex, region, and other disaggregation performance metrics were used for indicators based on type of program they monitor. Public Health Emergency Management (PHEM) module was also added to amplify the use of information in protecting the nation from health and health related hazards. PHEM module collects and reports data on thirty three immediately reportable diseases and seven weekly reportable diseases as part of public health emergency preparedness and management. DHIS-2 was customized to enable data entry, exchange and reporting to the next higher level using internet. During weak or no internet connectivity, data exchange is supported by exporting/ importing techniques using simple secondary data storage devices such as flash disk and memory sticks. Data flow was based on the health system hierarchy starting from health facilities to FMOH. Customized DHIS-2 was installed on existing e-HMIS computers found in 26 health institutions found in four regional health bureaus selected for the pilot study. Every HMIS officer at each health facility and administrative structure has its own privilege to access and consume data.

3.2 Users' Satisfaction on Customized DHIS-2

Table 1, Table 2 and Table 3 shows the overall mean for users' satisfaction among various key nonfunctional requirements of software engineering. Regarding interoperability, 23(62.17%) and 28(75.68) of the users' were agreed that DHIS-2 imports and exports data in suitable formats. Although 21(56.76%) of the users' reported that DHIS-2 doesn't function together with locally implemented m-Health.

20(54.05) of the users' were agreed that DHIS-2 used low computing resources in terms of performance while 17(45.95%) of them responded that they are only satisfied. Majority (70.27%) of users' were satisfied that DHIS-2 was easy to understand and learn. 25(67.57%) and 16(43.24%) of users' were agreed that DHIS-2 has easy data entry and analysis respectively.

18(48.65%) of users' were satisfied that DHIS-2 had a feature to enter annual targets and eligible for their specific district. 24(64.87%) of users' found that customized DHIS-2 included all types of reports. Regarding security, 24(64.87%) of users' revealed that

customized DHIS-2 incorporated strong authentication procedure in order to access data.

Table-1: Users satisfaction on customized (Measure1)

Measures	Very Poor	Poor
Interoperability	Very Poor	Poor
	n	%
Data Importing	0	0.00%
Data Exporting	0	0.00%
Supportability	10	27.03%
Performance	Very Poor	Poor
	n	%
Low response time	0	0.00%
Low computing resource	0	0.00%
Usability	Very Poor	Poor
	n	%
Easy Login	1	2.70%
Data entry and Editing	0	0.00%
Data aggregation and compilation	0	0.00%
Reporting	0	0.00%
Data analysis	0	0.00%
Output	0	0.00%
Understandability	0	0.00%
Feedback mechanism	0	0.00%
Install/ uninstall	0	0.00%
Comprehensiveness	Very Poor	Poor
	n	%
Targets and Eligible	0	0.00%
Incorporating all report types	0	0.00%
Data transfer	0	0.00%
Geographic Information System	0	0.00%
Reliability	Very Poor	Poor
	0	0.00%
Security	Very Poor	Poor
	n	%
Login authentication	0	0.00%
Define roles and responsibilities of different user accounts?	0	0.00%

Table-2: Users satisfaction on customized (Measure2)

Measures	Satisfactory	Good		Measures	Excellent	Mean	SD
Interoperability	Satisfactory	Good		**Interoperability**	Excellent	Mean	SD
	n	%			n	%	
Data Importing	8	21.62%		Data Importing	6	16.22%	3.62
Data Exporting	9	24.32%		Data Exporting	7	18.92%	3.95
Supportability	16	43.24%		**Supportability**	0	0.00%	2.16
Performance	Satisfactory	Good		**Performance**	Excellent	Mean	SD
	n	%			n	%	
Low response time	19	51.35%		Low response time	2	5.41%	3.38
Low computing resource	17	45.95%		Low computing resource	4	10.81%	3.65
Usability	Satisfactory	Good		**Usability**	Excellent	Mean	SD
	n	%			n	%	
Easy Login	18	48.65%		Easy Login	4	10.81%	3.27
Data entry and Editing	8	21.62%		Data entry and Editing	6	16.22%	3.76
Data aggregation and compilation	13	35.14%		Data aggregation and compilation	5	13.51%	3.41
Reporting	11	29.73%		Reporting	7	18.92%	3.62
Data analysis	21	56.76%		Data analysis	4	10.81%	3.54
Output	20	54.05%		Output	3	8.11%	3.54
Understandability	26	70.27%		Understandability	3	8.11%	3.22
Feedback mechanism	23	62.16%		Feedback mechanism	2	5.41%	3.43
Install/ uninstall	22	59.46%		Install/ uninstall	0	0.00%	3.14
Comprehensiveness	Satisfactory	Good		**Comprehensiveness**	Excellent	Mean	SD
	n	%			n	%	
Targets and Eligible	18	48.65%		Targets and Eligible	4	10.81%	3.19
Incorporating all report types	13	35.14%		Incorporating all report types	3	8.11%	3.73
Data transfer	18	48.65%		Data transfer	5	13.51%	3.65
Geographic Information System	15	40.54%		Geographic Information System	2	5.41%	3.16
Reliability	Satisfactory	Good		**Reliability**	Excellent	Mean	SD
	6	16.22%			11	29.73%	4.14
Security	Satisfactory	Good		**Security**	Excellent	Mean	SD
	n	%			n	%	
Login authentication	13	35.14%		Login authentication	7	18.92%	3.84
Define roles and responsibilities of different user accounts?	11	29.73%		Define roles and responsibilities of different user accounts?	5	13.51%	3.84

4. DISCUSSION

Table-3: Users satisfaction on customized (Measure3)

Health information system effective management is one of advanced and valuable outcomes of health system management. Therefore, one of the greatest challenges for health system managers is commitment and deep belief of implementation and utilization of modern management in health information management area [7, 8].

The result of the pilot study revealed important challenges and lessons of DHIS-2 in Ethiopian context. According to findings, interoperability, performance, usability, comprehensiveness, reliability, and security criteria were met with needs of users participated in the pilot study. Authors believe that HMIS officers at health facilities and administrative levels should participate in proper training courses of information use in decision making.

In this context, similar study conducted in Ethiopia, Tanzania, Malawi, Botswana and Mongolia showed these challenges:

- Customization of Ethiopian calendar

- Health Information experts did some other tasks; such as: service delivery to clients [9]

- High human resource turn over [10]

- Not enough computers for health data management [10]

- Inadequate access to DHIS skilled personnel [10]

- Low health information knowledge [11]

- Instances of DHIS-2 being not compatible with computers having windows service pack 2 Operating System

- Challenges on Antiretroviral Treatment data management

- Personnel resignation during DHIS activities, leads to improper DHIS implementation [11]

- Not enough attention paid to district information technology protection and infrastructure to ensure DHIS software maintenance [12]

- No appropriate policy for hardware, software, and system development [12]

The findings of our study also showed important lessons that infrastructure significance for proper implementation of DHIS, there is not enough attention paid to this subject in many other countries. For example, there is not primary infrastructure for team working, participation in information interpretation and decision making. Furthermore, DHIS training infrastructures is undesirable, first level data production and gathering is inefficient, there is no computerized report in urban and rural health facilities, and namely, there is not enough information for decision making in this level.

The statistics tell us that the system is being used. Generally, due to the good attributes of the software, data managers and data entry staff readily welcomed it. They are describing it as being "user friendly" and very easy to use. The standard reports and the data visualizer are very popular tools for making graphs and reports. Users in districts and health facilities also stated that they had easier access to their own data, as well as data from the rest of the country from DHIS than before. The argument is that they can now access their data regardless of power-cuts (when they used their laptop), viruses or computer problems, because the data was "up there", always available, "in the Internet". Furthermore, they really appreciated the dynamic updates of data from around the country and the messaging system in the DHIS, used for communication between users and the system support team to report bugs and to get help when having problems. "Just like Facebook" as one HMIS officer said.

The pilot study revealed that user's participation in all stages of DHIS designing is very important to comply with all users' information needs [2, 13]. This study showed that there is user participation in DHIS designing stage. In 2005, one study about DHIS in Kenya showed that information systems cannot perform effectively unless users have enough knowledge of information system design, implementation and application and to be empowered about information culture, values and its impact on effective health services delivery [14].

The present pilot study also identified that DHIS-2 provided simple analysis encouraging data use for decision-making. With inbuilt validation process, data managers are able to pick errors thus helping in improving data quality. A study conducted in Kenya also indicated that DHIS has further [15]:

- Improved the dissemination of public health information and facilitated public discourse and dialogue around major public health threats

- Strengthened ability to monitor the incidence of public health threats and timely response

- Improved the efficiency of administrative systems in health care facilities.

The present pilot study also revealed that users were able to get instant access to their own data, from "anywhere" and at "any time". This greatly improved the sense of "ownership" to the data and the system and thereby enabled important learning-by-doing processes, significantly complementing the formal training and support.

The study clearly showed that integrating PHEM benefited the health system to capture public health emergencies before causing social disruption and economic loss in addition to high degree of morbidity and mortality. One user also added that "Role of incorporating PHEM in to DHIS-2 is very essential and priority of the health system that plays a key role in minimizing public health emergency threats in Ethiopia".

5. CONCLUSIONS

The norm when implementing country health information system in Africa has been to capture the data in standalone databases and transmit to the next level through e-mail attachments, electronically or physically on a memory sticks. Significant human capacity on databases, data management and system support is needed in order to manage a national health information system based on numerous standalone database applications with fragile flows of data between them. Problems of data reporting, completeness and the maintenance of numerous standalone applications across the country make it very complicated.

Ethiopia made a bold move to adopt a web based system for data management. The ability to implement DHIS-2 online on one central server made it significantly "easier" to roll out the system countrywide, as compared with the alternative of having to support and maintain separate installations in all districts, hospitals and health facilities around the country.

Pilot of DHIS-2 indicates that there are many areas being improved. According to our findings the majority of DHIS criteria compliance with HMIS officers is desirable. In general, the pilot study contributes in advancement of the existing HMIS, especially in terms of data utilization and information use. It is however important that capacity building, relevant infrastructure and staffing levels be evaluated for the system before rolling out at national level. Also, we suggest that FMOH and regional health bureaus must work together before system implementation to increase its adoption.

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BIOGRAPHIES

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