

**DIGITALIZATION OF HEALTHCARE SYSTEMS IN BANGLADESH -
IMPLEMENTATION CHALLENGES AND HEALTH SERVICE IMPACT**

BY

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This Report Presented in Partial Fulfillment of the Requirements for the
Degree of Master of Science in Computer Science and Engineering

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DAFFODIL INTERNATIONAL UNIVERSITY

DHAKA, BANGLADESH

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APPROVAL

This Thesis titled “**Digitalization of Healthcare Systems in Bangladesh– Implementation Challenges and Health Service Impact**”, submitted by **Md Ferdous Alam (ID:123-25-277)** to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of M.Sc. in **Computer Science and Engineering** and approved as to its style and contents.

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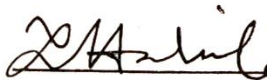
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ABSTRACT

To broadly examine the potential health and financial benefits of health information system (HIS), this paper compares healthcare with the use of IT in other manual system. It estimates potential savings and costs of widespread adoption of OpenMRS based systems (like Bahmni) and other digital health systems, model's important health and safety benefits, and concludes that effective HIE implementation and networking could eventually save more than TK.500 crore annually by improving health care system efficiency and that savings while increasing health and other social benefits. However, this is unlikely to be realized without related changes to the medical record system.

The developing world faces a series of health care crises that threaten the lives of millions of people. Lack of infrastructure and trained, experienced staff are considered important barriers to scaling up treatment for these diseases. In this paper we explain why digital healthcare system are important in many healthcare projects in the developing world. We discuss pilot projects demonstrating that such systems are possible and can expand to manage hundreds of thousands of patients. We also pass on the most important practical lessons in design and implementation from our experience in doing this work. Finally, we discuss the importance of collaboration between projects in the development of digital healthcare system rather than reinventing systems in isolation, and the use of open standards and open source software.

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CHAPTER – I: INTRODUCTION

1.1 Introduction

Healthcare system is always a challenging area regardless of size of a country, population number and economic status. It is not easy to provide good services and make a country's population satisfied with the healthcare services. However, like any other services, healthcare service can be improved, make it more effective and resources of healthcare service can be used more efficiently.

Digitalization of healthcare systems can make healthcare services more convenient and time-savings for the patients and by facilitating effective monitoring system, the transparency and accountability of the service providers can be improved significantly.

Bangladesh is the eighth most populous nation in the world, with a democratic government at its controls. The country is seen as poor and under-developed (recently named as developing country), due to devastating natural disasters, and the socio-political instability. The resources of the country is very limited considering huge number of population. Thus, it is very important to use the limited resources more effectively and efficiently.

The Bangladesh government is actively investing and seeking foreign investment, particularly in areas of health sector to improve health services at all levels.

1.2 Motivation

Government of Bangladesh understands the need of digitalization of services in all sectors. The government has set a vision for 2021 which has been declared as Digital Bangladesh. As a major initiative for digitalization of healthcare system, Directorate General of Health Services (DGHS)¹ under Ministry of Health and Family Welfare (MOHFW)² has taken several initiatives to digitalize the healthcare services, especially for the government services. As I was involved in the whole initiative to implementation, I was wondering what would happen if it was done. So, I started to work on it.

1.3 Rationale of the Study

Working with the MIS of Directorate General of Health Services (DGHS)¹ has given me opportunity to research on that. This research can point out the implementation challenges and health service impact on Bangladeshi citizens. However, scaling up the project depends on the success and overcoming the shortcomings and challenges for implementation.

1.4 Research Questions

There are a lot of questions when we started the research work. However, my focus was to find out the ultimate objective of the whole work which is “*Can digitalization of healthcare system improve health service delivery?*”.

1.5 Expected Output

Digitalization of services is meant to make life easier for the service recipients as well as service providers. However, from the research we expect to find out more services provided by the same number of service providers within the same amount of time and resources and the transparency and accountability of the provider and organization is increased. Ultimately, the patients are happier than former services.

CHAPTER – II: BACKGROUND

2.1 Introduction

Digital Bangladesh is the ultimate future of the country. To make it possible, digitalization of healthcare system comes as a top priority. There are many factors that are needed to be considered before going for digitalization of healthcare systems. First of all, health is not a regional or country specific issue rather it is a global concern which made us think globally. For instance, a disease which might be found in a certain country might eventually be spread out to other countries of the world. Similarly, treatment of a disease is not limited to by any geographic area.

World Health Organization (WHO)⁵ plays the vital role to bring all the health related concerns in one umbrella. They set the global standard for different health components like disease classifications, generic names for medicines, standard laboratory test names etc.

2.2 Related Works

Healthcare system is always a tough area. A lot of researches have been done on different healthcare systems. However, research on digitalization of healthcare systems has not been done to that extent, especially, country-wide single medical record for each patient hasn't yet been possible to any country except United Kingdom. Countries like Bangladesh which are still under development, is nowhere near digitalization of healthcare systems. This is why, finding related works to digital healthcare system are not available yet.

Most of works found were done especially on small scale digital healthcare systems like, health call center, SMS based services and online medical related databases.

2.3 Research Summary

Under the 3rd Health, Population and Nutrition Sector Development Program (HPNSDP)², Management Information System (MIS) of Directorate General of Health Services under Ministry of Health and Family Welfare (MoHFW)² started the Shared Health Record (SHR) project aimed to have every citizen of Bangladesh one single health record. Joint Donor Technical Assistance Fund (JDTAF)⁷ provided the fund for this project. A USA based software development company, namely

ThoughtWorks Inc⁶. got the opportunity to plan, design and implement the Central System for Shared Health Record. Under the same fund, I was also hired to coordinate among all the software development teams and provide technical assistance where required. After the project implementation and a year after, I started to conduct this research. My primary audiences were the patients and the system users. A 200-patient samples were chosen randomly, as they visit the hospital, of which 100 males and 100 females for quantitative study and 10 randomly selected patients were our for qualitative study to conduct Focus Group Discussion (FGD). I also selected three doctors, one pharmacist, two registration clerks, two nurses, one laboratory technician, one statistician for Focus Group Discussion (FGD) for the qualitative study of the research.

The software tool used for this implementation was Open Medical Record System (OpenMRS)⁸ based software namely Bahmni (www.bahmni.org)⁴ which led by ThoughtWorks Inc⁶. The central system Shared Health Record (SHR)¹ is based Apache Cassandra⁹ database which is a NoSQL database.

2.4 Scope of the Research

I set my research scope on a primary healthcare facility where the digitalization took place. The hospital name is Kaliganj Upazila Health Complex under Gazipur district in Dhaka Division.

2.5 Challenges and how to mitigate some of them

First of all, the infrastructure was not ready. Though there were a few computer, printers and an internet modem, these were not enough. We had to build the infrastructure the support of the MIS of DGHS¹. Starting from the computer setup to building and running the Local Area Network.

One of the major challenges is the consistent power supply, especially the power system in the sub-urban region is not up to the mark. Depending on the time of the year, the availability of electricity varies. In many cases, the electricity is not available whole the out patient service time. It really hampers the system to operate to the mark. To keep minimize the service interruption, we convinced the authority to buy at least one big UPS for the server to that the server runs smoothly.

Consistent Internet connectivity for real time data synchronization is also a great challenge. Though the Bahmni⁴ system operates in the hospital premises, the local server needs the internet to synchronize the data with central SHR database. Moreover, if any patient registered in other hospital outside of the current catchment area, the registrar needs to find out the patient through the system which also requires internet connection. To overcome this limitation, we used a mobile internet based modem to the server. So, that the connectivity is always there.

Most of the users of a hospital are not very good in computer operations, especially the people who do the registration at the first place. Due to lack of human resources, hospital manager uses the other personnel like gardeners, office helpers to register a patient. However, we provide intensive training to the end-users and motivated them to learn computer. It really worked.

After the system was deployed, there rose another challenge. Who would be the ICT administrator or provide the ICT support. We all know that at least one ICT support member should be assigned for every organization where a full fledged ICT infrastructure is running. Providing remote support is not always enough for smooth service. To overcome support related issue, we recommended to appoint at least one ICT support personnel for every hospital.

There were other issue related to logistics support, change management etc. which were not that prominent like those mentioned above. However, like any other automation, it improving over time.

CHAPTER - III: RESEARCH METHODOLOGY

3.1 Introduction

Digitalization of healthcare systems in Bangladesh is a very challenging job. We have a large population with a little literacy specially a large living population at the rural areas. Before choosing any methodology, I had to go through a lot background work. However, I came across to the work I was involved with. The project is called Shared Health Record implemented by Management Information System of Directorate General of Health Services which is under Ministry of Health and Family Welfare. The project was funded by Department for International Development of UKAID. Initially we rolled out the system to two government hospitals and six community clinics.

3.2 Research Subject and Instrumentation Architecture

The main concept of this architecture is to enable portable medical record which can flow to other medical facilities. This is done by the Health Information Exchange Gateway. The system can provide APIs to other medical system to access and pull

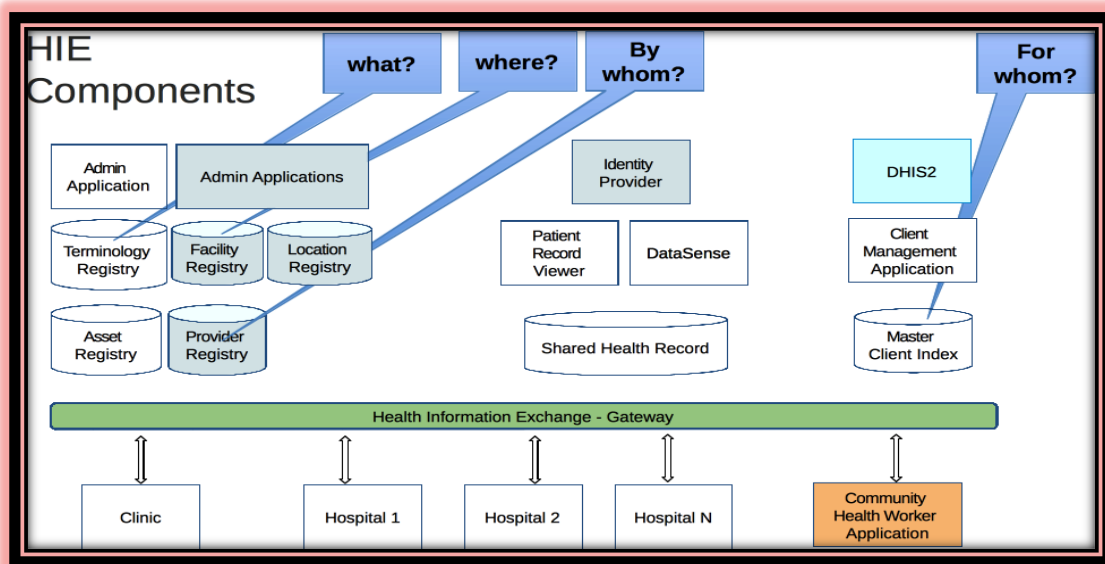


Figure 3.2.1: HIE¹⁰ Architecture

data and push data to the central data warehouse which we call Shared Health Record, SHR in short. Two of the major components of the Health Information Exchange

system are the authentication and authorization systems. This is critical for valid data entry by valid health service providers. This was carried out by the facility registry and provider registry system.

Health Information Exchange (HIE)¹⁰ facilitates as the main gateway among various systems. SHR is one of the systems in HIE storing patient data. SHR identifies patients through another system called 'Master Client Index (MCI)'

which manages patient general data and provides a unique Health ID to each patient. MCI can identify a patient by other identifiers like NID, BRN, UID etc. There are other systems in the HIE, 1. Terminologies Registry – Stores and manages the central repository for various standard like, ICT10 and 2. Provider Registry - manages all service providers in the country like doctors.

Facility Registry - manages all facilities registered like government hospitals.

Location Registry - assigns a geo location code in hierarchical manner for all regions in Bangladesh.

The end user product is a collection of few modules:

1. Registration module
2. Out Patient Department Module
3. Emergency Module
4. Indoor Module
5. Pharmacy Module
6. Laboratory Module
7. Imaging Module
8. Inventory and Stock Module

Registration Module:

The registration module has the following interface.

The screenshot displays a registration form with the following fields and values:

- Registration Date: 25 Feb 16
- রোগীর নাম: ফেরদৌস আলম
- Patient Name: Ferdous Alam
- Gender: Male
- Age: Years 38, Months 1, Days 15
- Date of Birth: 2/15/1979
- Division: Dhaka
- Upazilla: Adabor
- Ward/Union: [Blank]
- Address Line: Monsurabad
- Birth Time: [Blank]
- Zilla: Dhaka
- Paurasava: [Blank]
- Rural Ward: [Blank]
- Additional Identifiers: [Blank]
- Health Id: 98001331241
- Other Information:
 - Father's Name: Md. Khairul Hoda
 - Spouse's Name: [Blank]
 - Education Details: [Blank]
 - Birth Registration Number: [Blank]
 - Mother's Name: Mst. Safeka Begum
 - National ID: 19792617272887949
 - House Hold Code: [Blank]
 - Occupation: Professional, technical

Figure 3.2.2: Registration Module

The primary challenges of the registration module to rollout is the government staffs who do the registration. These staffs are not literate to that extent. However, with proper extensive training we were able to make them habituated with digital system.

Patient Dashboard:

Patient dashboard is a unique feature of this system which provide an interface to look into the patient current status of earlier diagnosis and treatment. Service providers do not need to ask the patients to tell the previous history of disease or treatment. Even the previously treated prescriptions are not needed to be carried with the patients.

The patient dashboard looks like the below screenshot:

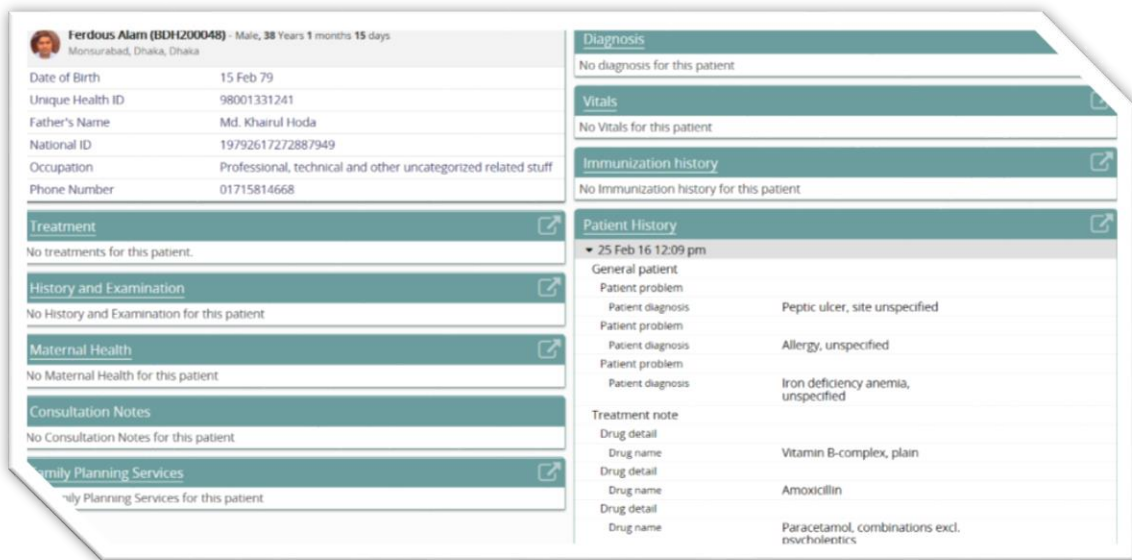


Figure 3.2.3: Patient Dashboard

The Out-Patient Department Module:

The OPD module interface looks like the below screenshot:

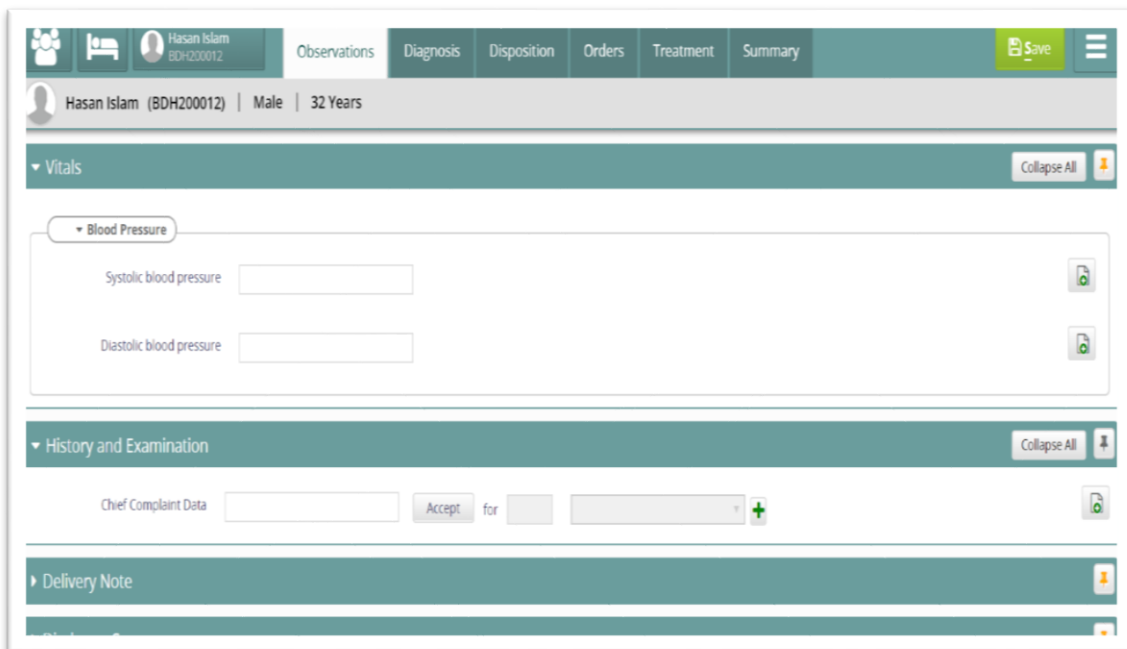


Figure 3.2.4: OPD Module - Observation

Diagnosis	Order	Certainty	Status
<input type="text"/> Accept	PRIMARY SECONDARY	CONFIRMED PRESUMED	RULED OUT

Past Diagnosis	Initial	Current
Paratyphoid fever B		PRESUMED PRIMARY 30 Dec 15 Super Man

Figure 3.2.5: OPD Module - Diagnosis

We know that we have a huge out patient load at the outdoor services of government hospitals. Doctors really don't get enough time to fully diagnose a patient with full concentration. However, the interface is designed to minimize the writing time than paper. The auto suggestion feature helps the service provides write less. This way, time can be saved, and patient can be diagnosed with more time.

The Laboratory Module looks like below:

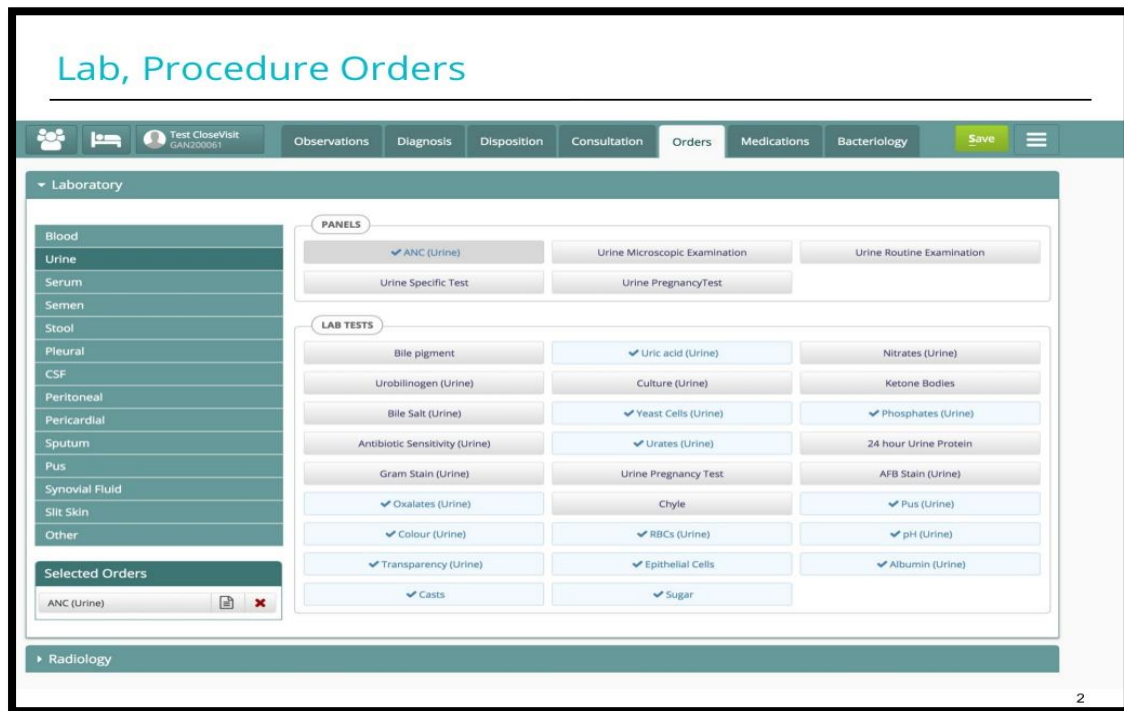


Figure 3.2.6: Laboratory Module

The laboratory module is very comprehensive, user friendly and time saver. The laboratory orders provided by the physicians are automatically received by the laboratory technicians for the next course of action. So, the Laboratory technicians do need to write all the information for the patient as well as the medical tests. Once the test is done, the technicians can put the laboratory result to the system which immediately visible and accessible to the physician.

There are other modules for Pharmacy, Imaging and Payment and Stock management. One questionnaire was developed to collect data from the patients for quantitative analysis. However, one FGD guideline and one IDI guideline were used for qualitative data collection.

3.3 Data Collection Procedure

Onsite data collection was done. This was done by going onsite and selecting the patients who visited on that day. Once a patient got a service and all the procedures were completed, I caught the patient and asked for permission to talk about my

research and asked for their consent for data collection. Those who agreed, I provided them with the form and explained.

Similarly, the qualitative data was collected by doing two Focus Group Discussion with the patients and the software users.

3.4 Statistical Analysis

The quantitative study data were analyzed and got the following self-illustrative figures:

The qualitative study revealed a very important information. Though they are very satisfied with the digital system, but they want the providers and the hospital to be more patient friendly.

CHAPTER - IV: EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Introduction

The hospital management system is a mandatory requirement for a country's health system automation. It could be done using many other systems, it could be nationally built by local vendors. However, taking an international software which is open-source and easily customization and driven by a strong open-source community, helps minimize the software cost, development cost as well as provides global level development support and recognition.

4.2 Experimental Results

Figure & Table 4.2.1: Reduced the registration time in digital system

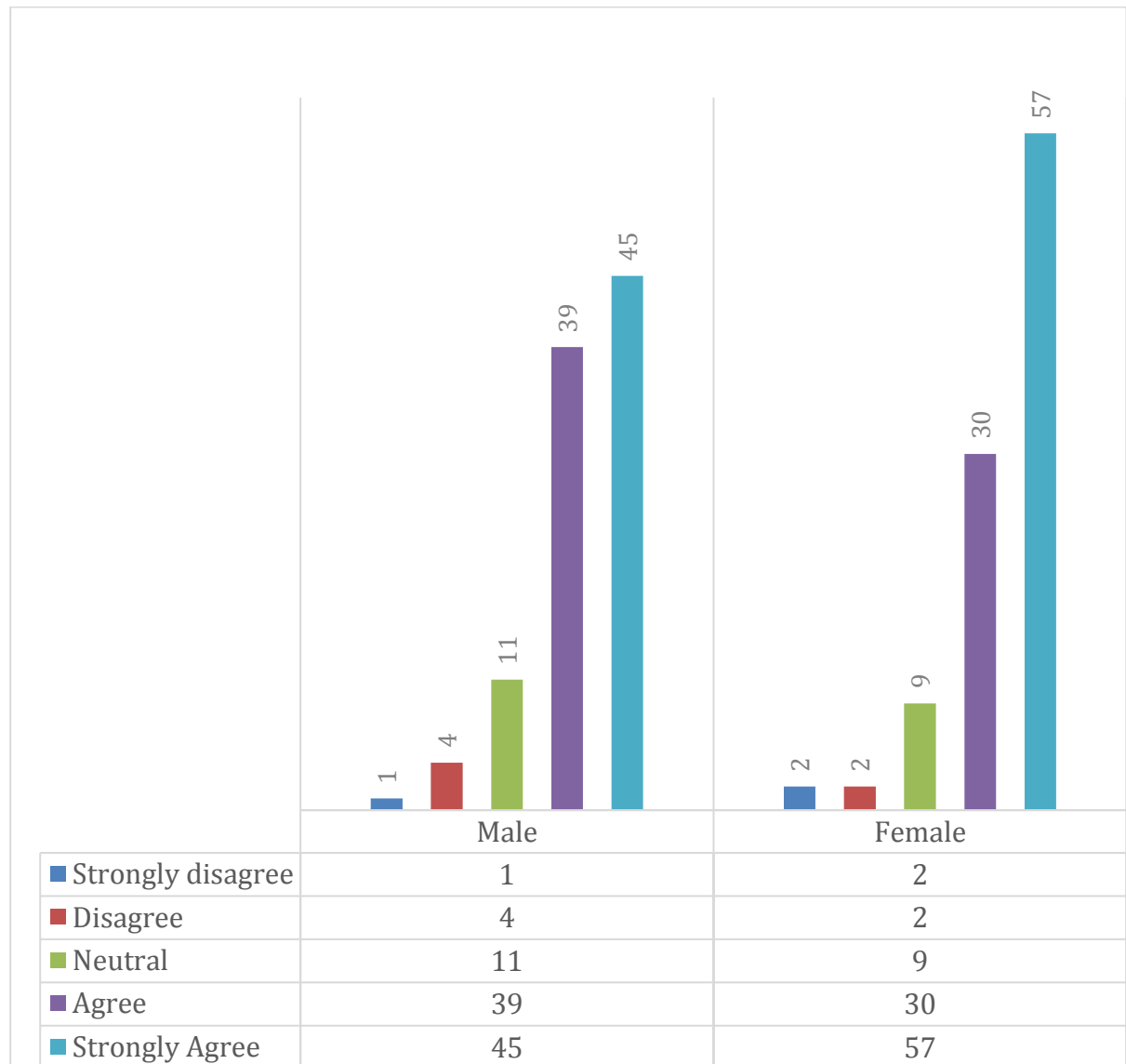


Figure & Table 4.2.2: Revisiting patients do not need to carry their previous records

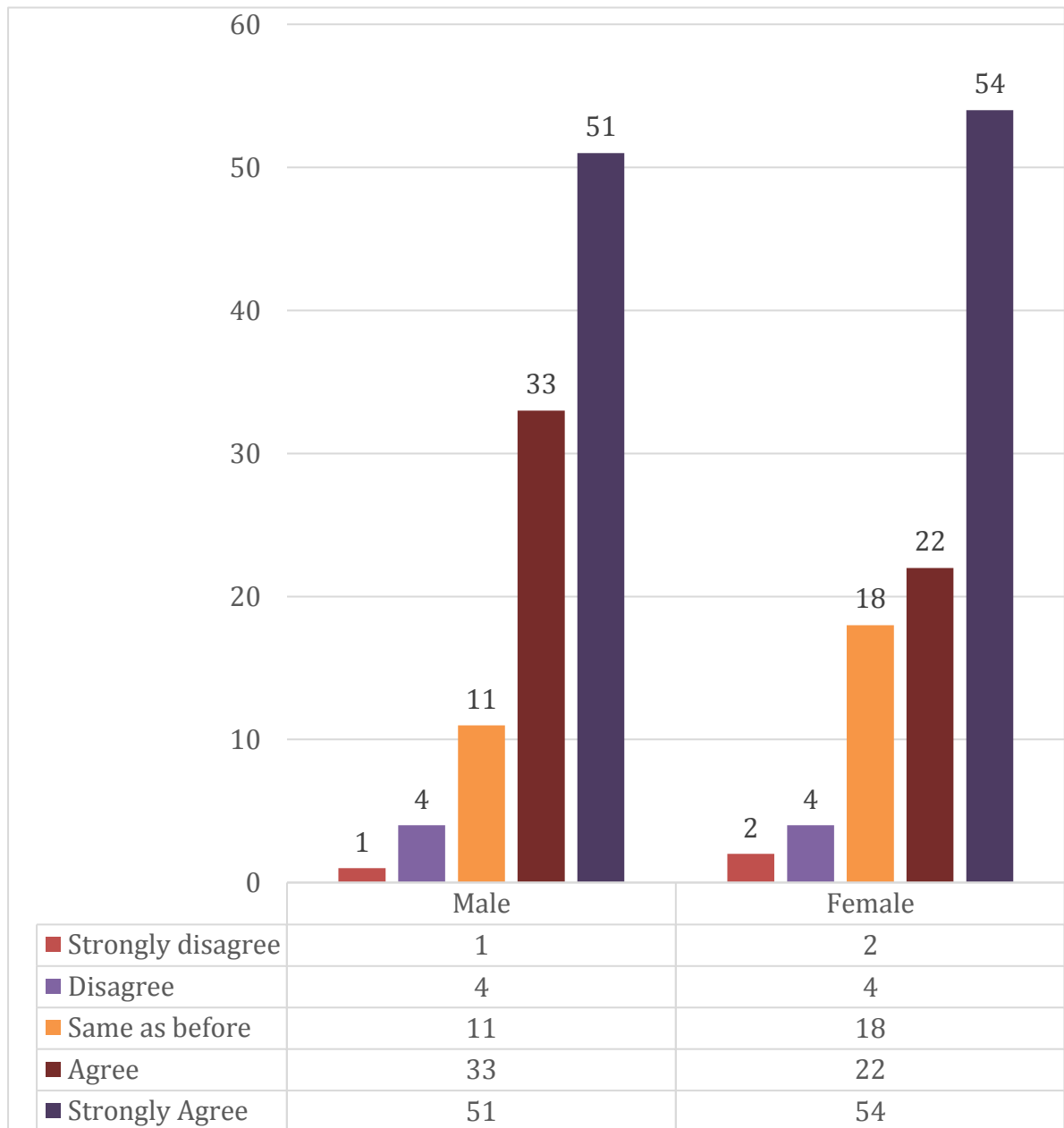


Figure & Table 4.2.3: The speed in providing services has been increased in digital system

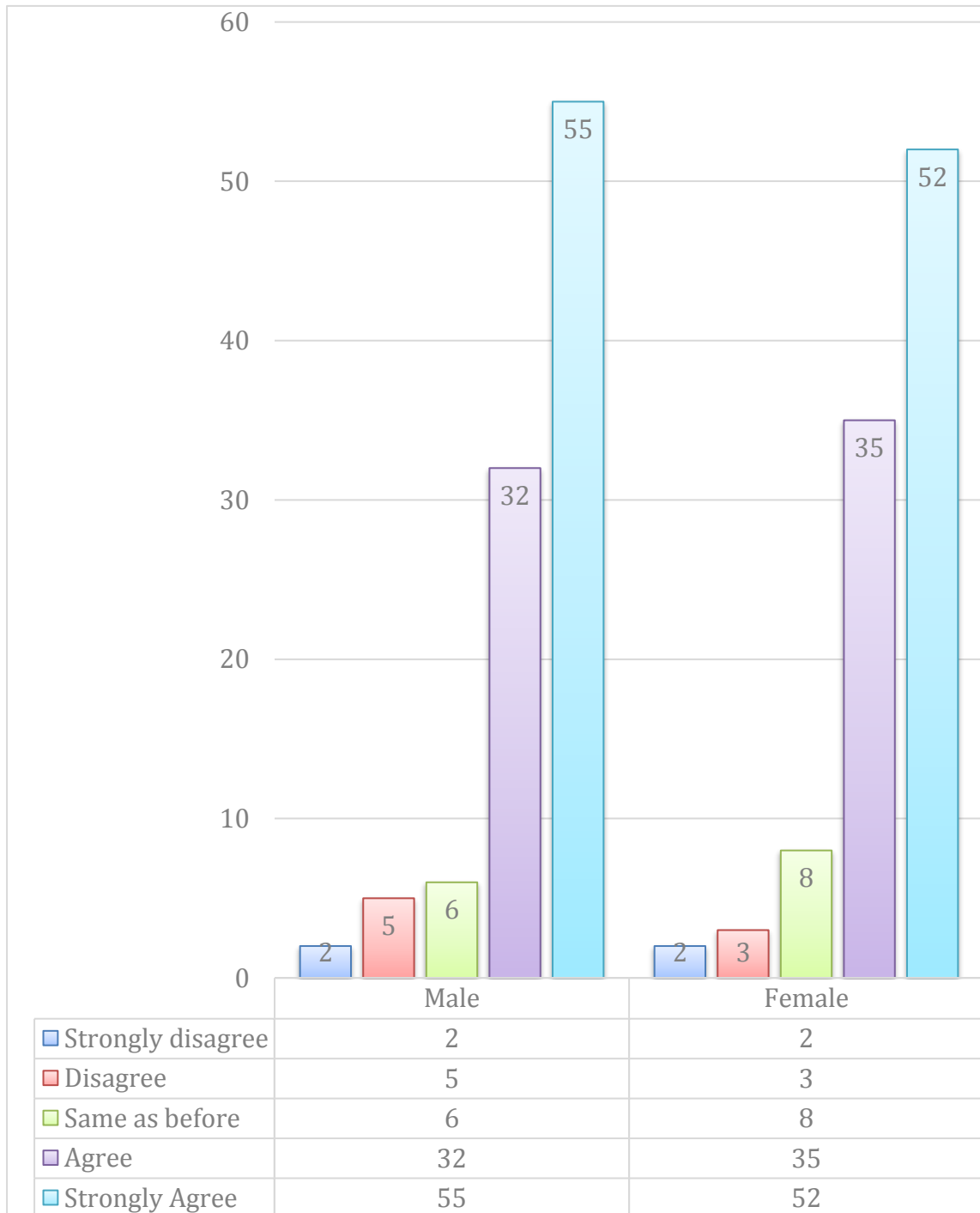


Figure & Table 4.2.4: Due to digital system harassment by the broker has been stopped

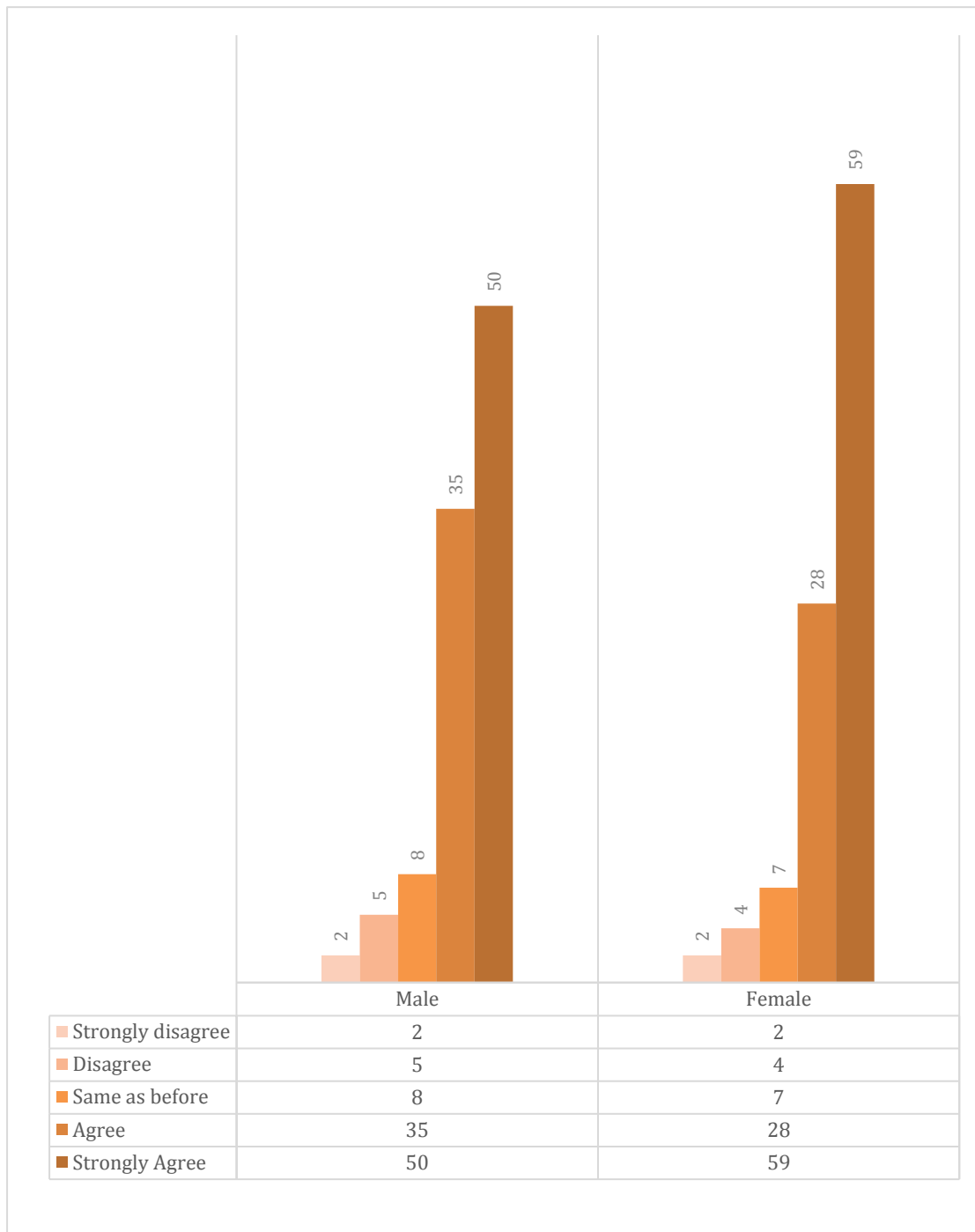
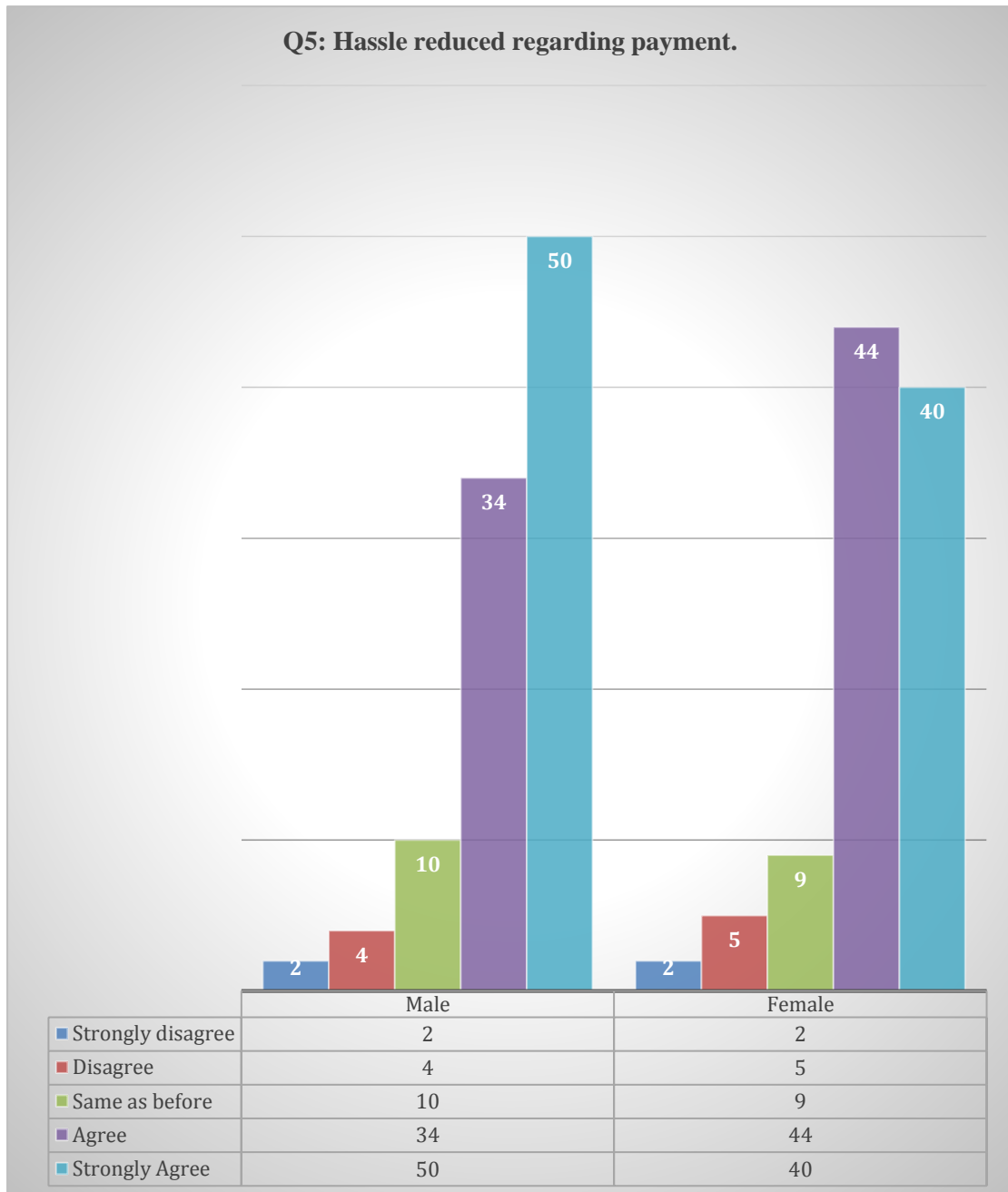


Figure & Table 4.2.5: Hassle reduced regarding payment



With the experiment, I found the following positive results:

- Results exceeded the expectation
- In a year, patient increased from 250 to 500 per day
- Even patients from adjacent UHC visit this UHC
- Improved healthcare services
- Decision making improved drastically

But above results were not only the results. However, there are challenges to implement such digital system, especially for digital healthcare system

Here is a glimpse of the challenges:

- Consistent Power Supply
- Power Backup
- Consistent Internet connectivity for real time data synchronization
- User adaptability to the computer & HMS system
- Readiness of Infrastructure
- Local Administrator and ICT Support

4.3 Descriptive Analysis

We our experience on automating system is not an easy job. Many projects fail due different many reasons. Automating healthcare system is even much more vulnerable to fail. In countries like Bangladesh where resources are very limited, people and decision makers are reluctant to take challenges and accept the changes through modern technologies, digitalization of healthcare systems is much more difficult job. Even though, Bangladesh has made tremendous improvement in many areas in digitalization but not so much in healthcare system. Most of the works are being done on trial and piloting basis.

This implementation has got a very good impression and yielded very good result. If we see the figures from figure one to five, we see great results from the patients' responses. The qualitative figures are self-explanatory.

However, we ran two **Focus Group Discussions (FGDs)** with the service receivers (i.e. patients) selected randomly and one with the service providers. Each group had 5 participants to respond to our queries and discussions.

The result of Focus Group Discussion also yielded well. Here are a few comments from the patients as well as the service provides:

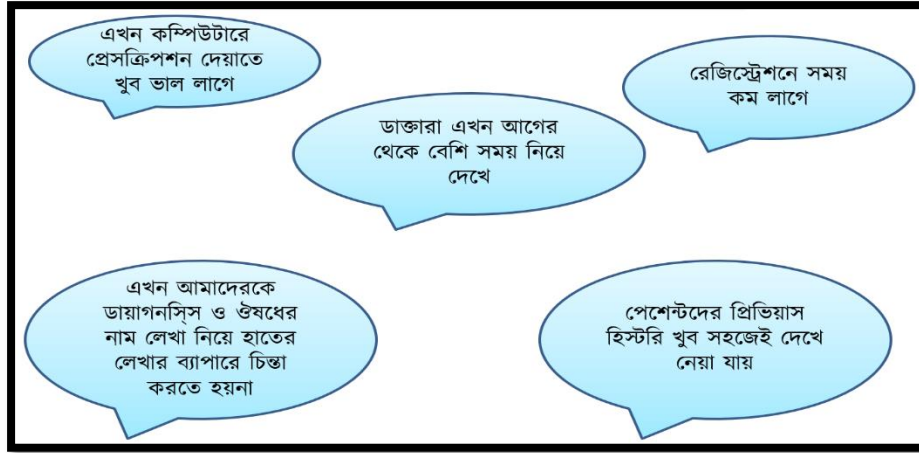


Figure 4.3.1: FGD Findings

We have got the following responses from the two Focus Group Discussions (FGDs)

- They liked the printed prescriptions and laboratory reports
- Now time at the registration counter reduced, especially for returning patients
- Patients do not get hassled for any services
- Doctors get the history for of earlier diagnosis and treatment without asking the patient
- There will be no mistake in writing disease names in ICT-10 code
- Very easy to refer a patient for admission
- Very easy to refer to higher level hospital

CHAPTER - V: CONCLUSION, RECOMMENDATION AND FUTURE RESEARCH

5.1 Conclusions

Digital healthcare systems in Bangladesh is going to flourish in near future. Though it is being deployed in small scale but eventually, it is going to be rolled out to all government hospitals, especially Upazila, District and Tertiary level hospitals. Management Information System (MIS)¹ of Directorate General of Health Services (DGHS)¹ is seeking large amount of budgetary support to roll this automation system out to at least 300 Upazila Health Complex and all the district hospital initially. Once it is rolled out to as many hospitals as possible, we will see visible impact on the health services for the Bangladeshi citizens.

5.2 Recommendations

To implement digital Bangladesh vision is to digitize every service including healthcare services. To achieve sustainable development goal (SDGs)¹ Bangladesh must implement Universal Health Coverage (UHC)⁵. UHC can only be achieved if every citizen is counted for the healthcare services, regardless of people's economic quintile. No matter how poor somebody is, must be provided with healthcare services whatever the disease they have. Therefore, it has already become a mandate for MIS of DGHS to implement digital healthcare systems and achieve the SDG through Universal Health Coverage (UHC)⁵.

Through this research I want to recommend Government of Bangladesh to carry on the digitalization of healthcare systems in Bangladesh and scale it up to all the government hospitals first. Once the digitalization is complete, all the citizens, healthcare service providers and policy makers will have the benefit of the system.

5.3 Further Research

My research was many focused on the healthcare service delivery and patient satisfaction, there need further researches and recommendations for area specific concerns and improvement. For example, how to overcome the limitations of healthcare service implementation in low resource settings or how the quality of healthcare service can be further improved.

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APPENDICES

Appendix A: Research Resources



Daffodil International University
Dept. of Computer Science and Engineering

Questionnaire for Patient Survey

<u>Kaliganj Upazila Health Complex, Kaliganj, Gazipur</u>						
Date (তারিখ):						
Patient Name (আপনার নাম):			Gender (লিঙ্গ): Male/Female/Other (পুরুষ/মহিলা/অন্যান্য)			
Age (বয়স):			Years (বছর)			
Please tick to what extent you agree to the statements below. আপনি নিচের বক্তব্যগুলোকে কতটুকু সমর্থন করেন, টিক চিহ্নের সাহায্যে তা প্রদান করুন।						
Performance scale: 1= Strongly disagree, 2= Disagree, 3=Same as before, 4= Agree, 5= Strongly Agree. 1 = দৃঢ়ভাবে অসম্মতি, 2 = অসম্মতি, 3 = পূর্বের মত, 4 = সম্মত, 5 = দৃঢ়ভাবে সম্মত						
Statements/বক্তব্য		Scale				
		১	২	৩	৪	৫
১.	ডিজিটাল সিস্টেমে আপনার রেজিস্ট্রেশন করতে সময় কমেছে। Reduced the registration time in digital system	দৃঢ়ভাবে অসমর্থন করি	অসমর্থন করি	নিশ্চিত নই	সমর্থন করি	দৃঢ়ভাবে সমর্থন করি
২.	পুরাতন রোগীদের তথ্য আর সঙ্গে বহন করতে হয় না। Revisiting patients do not need to carry their previous records	দৃঢ়ভাবে অসমর্থন করি	অসমর্থন করি	নিশ্চিত নই	সমর্থন করি	দৃঢ়ভাবে সমর্থন করি
৩.	ডিজিটাল সিস্টেমের কারণে চিকিৎসা সেবা প্রদানে গতি বৃদ্ধি পেয়েছে। The speed in providing services has been	দৃঢ়ভাবে অসমর্থন করি	অসমর্থন করি	নিশ্চিত নই	সমর্থন করি	দৃঢ়ভাবে সমর্থন করি
৪.	ডিজিটাল সিস্টেমে কারণে দালাল কর্তৃক হয়রানি বন্ধ হয়েছে। Due to digital system harassment by the broker has been stopped	দৃঢ়ভাবে অসমর্থন করি	অসমর্থন করি	নিশ্চিত নই	সমর্থন করি	দৃঢ়ভাবে সমর্থন করি
৫.	আর্থ প্রদানে হয়রানি কমেছে। Hassle reduced regarding payment	দৃঢ়ভাবে অসমর্থন করি	অসমর্থন করি	নিশ্চিত নই	সমর্থন করি	দৃঢ়ভাবে সমর্থন করি
Your comment/suggestion/feedback for information: আপনারা কোন মতামত বা পরামর্শ থাকলে বলুন						
Signature: স্বাক্ষর						
Date: তারিখ						



Daffodil International University
Dept. of Computer Science and Engineering

Guideline for Focus Group Discussion (FGD)

<u>Kaliganj Upazila Health Complex, Kaliganj, Gazipur</u>	
Date:	
FGD No.:	
Question and probing	
1.	Do you think that the registration time in digital system reduced? If yes, how? If no, what can be done?
2.	Revisiting patients do not need to carry their previous records. How do you feel about that?
3.	The speed in providing services has been increased in digital system. If yes, how? If no, what can be done?
4.	Due to digital system harassment by the broker has been stopped. If yes, how? If no, what can be done?
5.	Hassle reduced regarding payment. If yes, how? If no, what can be done?
Any other comment/suggestion/feedback?	
<u>Before the focus group discussion:</u>	
<ol style="list-style-type: none">1) Thank the individuals for agreeing to participate in the focus group discussion.2) Give a short introduction of this study and ask for a verbal consent for the FGD, if they agree3) Say: "I want to thank you for agreeing to participate in this discussion. I have taken consent from you, so you now know what this study is about. Are there any questions before we begin?"4) Explain that there are no right or wrong answers.5) Switch on audio recorder	