A Study on Remote Healthcare System Consumers in Developing Countries

マスダ, ベガン, ソンパ

A Study on Remote Healthcare System Consumers in Developing Countries

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To my parents…

ABSTRACT

New methods and tools in the healthcare sector are growing gradually through the continuing innovation in medicine and technologies. Along with the scarcity of medical infrastructure and the speedy advancement in Information and Communication Technology (ICT), remote healthcare systems, such as eHealth, mHealth, telemedicine, and telemonitoring, are receiving paramount consideration worldwide.

Because of the potential benefits and various eHealth initiatives in place, many studies have been conducted to determine the acceptance of eHealth technology. However, most were conducted in developed countries. Deployment of eHealth technology is essential for developing countries where access to quality healthcare is hindered by poor governmental policies, political crises, and lack of healthcare infrastructure, very few studies on eHealth consumer behavior were conducted.

This research aims to understand the consumer behavior of eHealth among the urban corporate people of Bangladesh. The study has identified several specific objectives stated below:

1. Identify the factors that affect consumers' acceptance of eHealth to propose a modified eHealth technology acceptance model for urban corporate people.
2. Predict blood uric acid value through machine learning approaches.
3. Redesign the Portable Health Clinic (PHC) architecture for tackling emergency situations, like COVID-19.

In order to obtain consumer behavior, we conducted a survey. We have selected Grameen Bank employees to represent a corporate in a developing country. The sample size was calculated based on "Sample size determination" in Health Studies by S. K. Lwanga and S. Lemeshow. We estimated the target sample size of approximately 300 participants from 18 institutions, 271 employees participated in the survey. The sample was drawn by a simple random sampling method which eliminates the bias by giving all individuals an equal chance to be chosen. Four types of data were collected such as socio-demographic, dietary habits, psychological factors, and clinical measurements. Various statistical tools including descriptive statistics, factor analysis, reliability test, structural equation model, correlation, and multinomial logistic regression models, and machine learning algorithms were used to analyze the data. The major findings and contributions of this research are listed below:

First, this research identified the key factors that can contribute to increasing the future use of a PHC system. Traditionally, the logistic regression model has been used to identify factors of technology acceptance. Logistic regression has limitations in estimating the mediation effect between two or more mediator factors. We used the Structural equation model (SEM) instead to observe the mediation effect. Before applying the SEM method, exploratory factor analysis (using the maximum likelihood extraction method and the Promax rotation method) was conducted to measure factors with the Cronbach's alpha reliability coefficient. The reliability coefficient was assessed to ensure that all questionnaire items measured the same underlying factors. Items with loadings lower than 0.4 were dropped, and then the factor analysis was recalculated. All remaining items were highly loaded on each of the corresponding factors. Specifically, the reliability coefficient (Cronbach's alpha) for perceived usefulness was 0.902, health awareness 0.781, social influence 0.882, privacy 0.904, use 0.741, intention to use 0.898, and self-efficacy 0.855. All of the Cronbach's alpha values are greater than the threshold of 0.70, indicating that all questionnaire items reliably measure each factor. After factor analysis and reliability checked we found 25

questionnaire items among 47 items to be included in the model. By applying SEM, we found that the key factors to promoting the future use of a PHC system lie in the three most important factors: perceived usefulness (0.659), intention to use (0.454), and health awareness (0.447). These factors have a positive and direct influence on the use of PHC. Socio-demographic characteristics such as age, gender, education had no significant effect on accepting and using eHealth services.

Second, the research predicted the blood uric acid value through machine learning approaches. The mean of uric acid measurement was 6.63 mg/dL. That means the uric acid of most of the people is close to the borderline (6.63 mg/dL whereas the normal range <7.0 mg/dL). Therefore, they need to check uric acid regularly. This study evaluated five machine learning approaches such as Boosted Decision Tree Regression, Decision Forest Regression, Bayesian Linear Regression, and Linear Regression. The Boosted Decision Tree Regression model showed the best performance among other models based on the Root Mean Squared Error (RMSE) 0.03, this RMSE is better than any other studies that predicted clinical measurements.

Third, this research used the WHO guidelines and Design Science Research (DSR) framework to redesign the Portable Health Clinic (PHC), an RHS, for the containment of the spread of COVID-19 as well as proposed corona logic (C-Logic) for the main symptoms of COVID-19. We have modified the existing PHC model and proposed a Corona logic (c-logic) by following WHO guidelines and Design Science Research (DSR) framework. Using the distributed service platform of PHC, a trained healthcare worker with appropriate testing kits, can screen high-risk individuals, and help optimize triage to medical services. PHC with its new triage algorithm (C-Logic) classifies the patients whether the patient needs to move to a clinic for a PCR test or not. Through modified PHC service, we can help people to boost their knowledge, attitude (feelings/beliefs), and self-efficacy to execute preventing measures.

The findings of this research are expected to offer proactively important and practical guidelines to service providers, implementers, and policymakers to promote the use of eHealth technology for regular health checkups. The findings can also contribute to the establishment of combined actions to improve NCDs management in the context of limited resources. Finally, the machine learning prediction model will assist for improving awareness among high-risk subjects. By predicting uric acid, this study can help to save medical costs. Our initial examination of the suitability of the PHC and its associated technologies as a key contributor to public health responses designed to " flatten the curve", particularly among unreached high-risk NCD populations in developing countries, indicate the strong possibility of affirmative impact. Theoretically, this study contributes to design science research by introducing a modified healthcare providing model.

This study is limited by geographical scaling as the survey was conducted in one country and focused on only 18 institutions. Thus, the results may raise a concern over the generalizability of the findings, and scope exists to make the findings more generalized by examining additional countries and institutions. Given the cross-sectional design, the present study cannot determine the actual use. Hence, future studies should consider a longitudinal approach through which participants will be interviewed several over a period. Besides, a few variables could be added, such as trust in a PHC system and facilitating conditions, to understand additional insights into the use of eHealth technology by urban corporate people. A future study could include some additional features (e.g. income, work stress, everyday physical activity, alcohol intake, eating red meat, mental health factor, environmental factor, etc.).

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ABBREVIATIONS

BMI	:	Body Mass Index
BMRC	:	Bangladesh Medical Research Council
CDC	:	Centre for Diseases Control
CV	:	Cross Validation
DSR	:	Design Science Research
GBDT	:	Gradient Boosting Decision tree
HER	:	Electronic Health Record
ICT	:	Information and Communication Technology
IPO	:	Input-process-output
ISR	:	Information System Research
MAE	:	Mean Absolute Error
ML	:	Machine Learning
NBC	:	Naïve Bayes Classification
NCD	:	Non-communicable Diseases
NREC	:	National Research Ethics Committee
OR	:	Odds Ratio
PCR	:	Polymerase Chain Reaction
PHC	:	Portable Health Clinic
PPE	:	Personal Protective Equipment
RFC	:	Random Forest Classification
RHS	:	Remote Healthcare System
RMSE	:	Root Mean Squired Error
SDG	:	Sustainable Development Goal
SEM	:	Structural Equation Model
SpO2	:	Peripheral Capillary Oxygen Saturation (Oxygenation of Blood)
TAM	:	Technology Acceptance Model
TRA	:	Theory of Reasoned Action
UTAUT	:	Unified Theory of Acceptance and Use of Technology
WHO	:	World Health Organization
WHR	:	Waist to Hip Ratio

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Masuda Begum Sampa
Fukuoka, September 2020

Chapter 1
Introduction

This chapter presents the background on "A Study on Remote Healthcare System Consumers in Developing Countries". It also introduces the research questions, research goals, and objectives, research methodology, major research contributions, and conclusion and future works.

Remote Healthcare System (RHS) is a process of providing healthcare services to remote patients through information and communication technologies (ICT) such as telephone, internet applications. But, Patients may not have access to any health measurement tools, as shown in **Figure 1.1**.

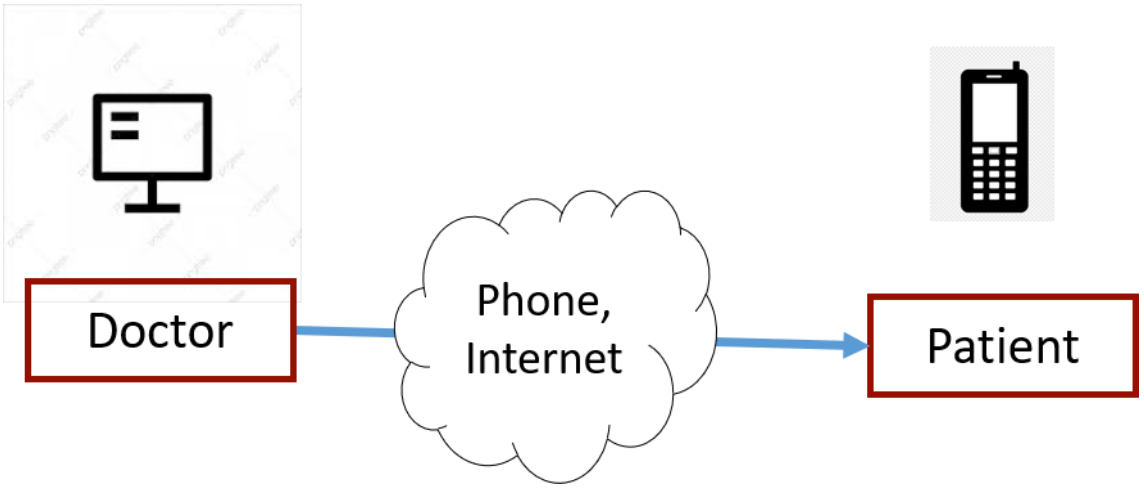


Figure 1.1: Schematic view of remote healthcare system (RHS)

We worked with a particular RHS, named PHC which is developed jointly by Kyushu University, Japan, and Grameen Communications, Bangladesh.

1.1. Background

New methods and tools in the healthcare sector are growing gradually through the continuing innovation in medicine and technologies [1]. Along with the scarcity of medical infrastructure (e.g., clinic and doctors, etc.) and the speedy advancement in Information and Communication Technology (ICT), remote healthcare systems, such as eHealth, mHealth, telemedicine, and telemonitoring, are receiving paramount consideration worldwide [2]. More than half of the world's population does not receive all of the essential services that they need. One hundred million people are pushed into extreme poverty because of their health expenditures, forcing them to survive on just $1.90 or less a day [3]. According to the World Health Organization (WHO), more than one-quarter of the world's countries including

Bangladesh has a critical healthcare workforce shortage [4]. In Bangladesh, only 5 doctors are available for every 10,000 people [5]. eHealth technology, which is a healthcare system that uses ICT, is an important way to solve the scarcity of current medical facilities.

The demand for ICT-based eHealth systems is increasing each day. Advanced technologies (e.g., IoT, BigData, Machine Learning) are being applied to improve the system's efficiency. However, the social adoption of eHealth, especially in developing countries, has not been completely understood. Increasing the acceptability of eHealth technology in developing countries such as Bangladesh is necessary.

Because of the potential benefits and various eHealth initiatives in place, many studies have been conducted to determine the acceptance of eHealth technology. However, most were conducted in developed countries, such as European countries, the United States, Canada, and Australia [6]–[8]. Although the deployment of eHealth technology is essential for developing countries in which access to quality healthcare is hindered by poor governmental policies, political crises, and lack of healthcare infrastructure (e.g., clinics, doctors) [9], very few studies were conducted in these countries, such as Bangladesh. To evaluate and increase the acceptance of an eHealth system before implementing it on a large scale, understanding the factors that are more highly valued by potential user groups is necessary. Because the low usage of ICT-based systems has been identified as a major factor for the "productivity paradox," low returns from organizational investments occurred [10]. Therefore, it is important to determine the factors that influence the adoption and future use of an eHealth system.

Based on the above discussion different key points are considered to investigate and formulate the background of the study which are described in the sub-sections below:

1.1.1. Consumer behavior

The study of how consumers think, feel, and react towards a product or service in different situations is called consumer behavior. It also studies how consumers are influenced by their environment and surroundings. For example, there are two healthcare providing systems which are shown in **Figure 1.2**. One is face to face healthcare system where patients can see the doctors face to face and the consumer behavior of this system is well known. This is a common practice for us. However, in the case of an eHealth healthcare system where patients cannot see the doctors face to face and consumer behavior towards this system is still to be known. This is still the new system for consumers. So, what consumer wants, what they expect, and which factors influenced them to use this system is needed to be investigated.

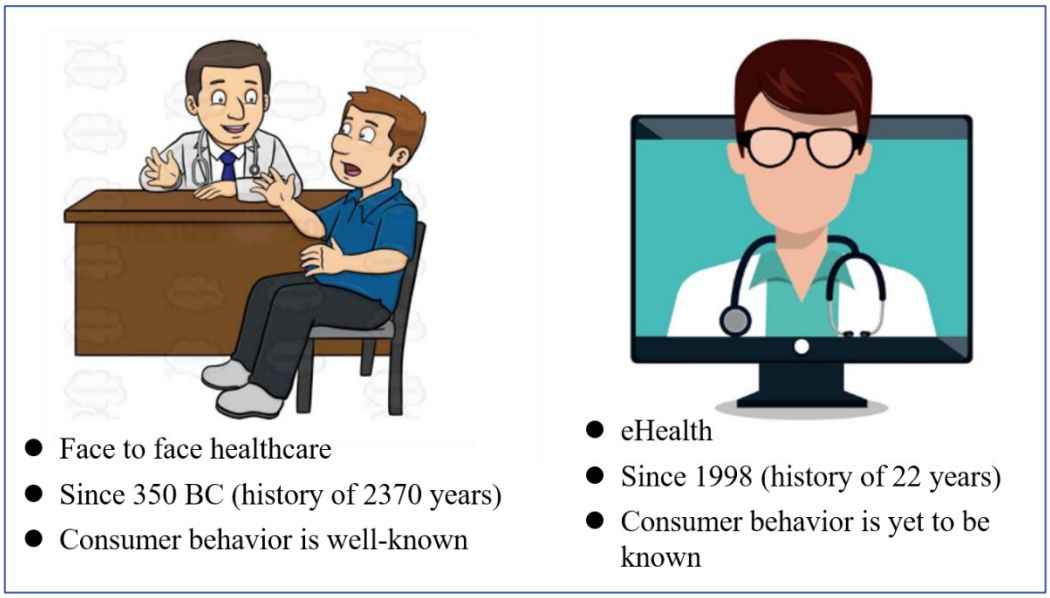


Figure 1.2: Comparisons between two healthcare providing systems

1.1.2. eHealth initiatives in Bangladesh: Portable Health Clinic (PHC)

A process of providing healthcare services to remote patients through information and communication technologies (ICT) is called the eHealth system. Our Portable Health Clinic (PHC) system is an eHealth system that aims to build an affordable, usable, and sustainable preventive healthcare system for unreached people.

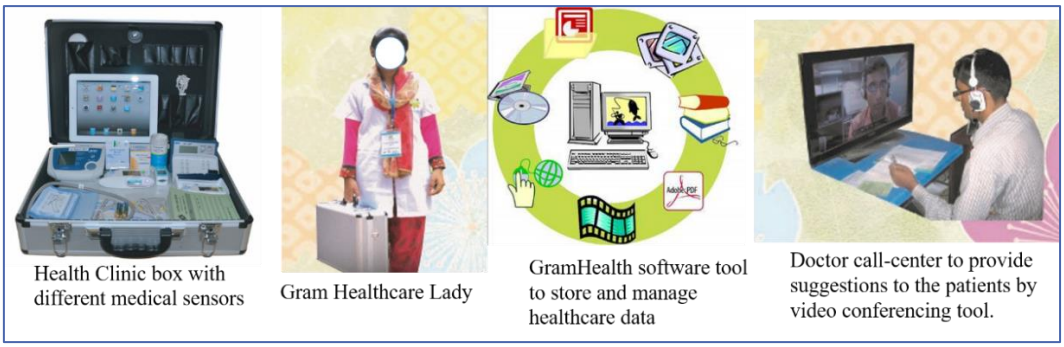


Figure 1.3: Components of the PHC system

Grameen Communications, Bangladesh, and Kyushu University, Japan, have jointly developed a human-assisted PHC system [11]. A PHC is an eHealth system that aims to provide affordable primary healthcare services to prevent severity or to control non-communicable diseases (NCDs). A PHC system has four modules (as shown in **Figure 1.3**): (a) a set of medical devices, (b) a software system to collect and archive medical records, (c) healthcare workers to make the clinical measurements and explain ePrescriptions, and (d) ICT-trained call center doctors. Consumers come to the service point, and a health checkup is conducted by pre-trained

healthcare workers. If needed, the consumer is connected to the call center doctors for a consultancy. The clinical measurements addressed by a PHC are as follows: (1) blood pressure, (2) pulse rate, (3) body temperature, (4) oxygenation of blood (SpO2), (5) arrhythmia, (6) body mass index (BMI), (7) waist, hip, and Waist/Hip ratio, (8) blood glucose, (9) blood cholesterol, (10) blood hemoglobin, (11) blood uric acid, (12) blood grouping, (13) urinary sugar, and (14) urinary protein.

1.1.3. Impact of health parameters measured by PHC on the health status

The health status of an individual can be measured by previous and current diagnosed illnesses and by clinical parameters [12]. Diseases like communicable and Non-communicable diseases (NCDs) have become the leading cause of deteriorating health status resulting in morbidity, disability, and mortality globally [13]. The causes for developing NCDs and mortality due to NCDs vary across different places and regions as well as different populations too [13]–[15]. Anthropometric, biochemical, socio-demographic, and dietary measurements are important factors for determining the health status of an individual. These are also used to diagnose chronic illness [16].

1.1.4. Application of machine learning algorithms to predict health parameters

The health parameter prediction model through machine learning approaches is useful for improving awareness among high-risk subjects. People in Bangladesh usually do not want to go to the doctor to measure blood uric acid, thus by using machine learning approaches we can warn high blood uric acid people. By predicting uric acid, this study can help to save medical costs.

1.1.5. Extension of PHC to tackle emergency situation in developing countries

Beginning in the end-2019, COVID-19 outbreak was declared a pandemic by WHO on March 11, 2020. Highly contagious due to droplet transmission, it continues to extract an equally heavy toll on the developed and developing world alike. Challenges of remote healthcare systems during an emergency like disasters, pandemics, etc. implies unique challenges to healthcare delivery. In the context of developing countries, the scenario of using e-Health technology is completely different, especially for rural people who are typically low health-literate and are more at risk for NCDs. The provision of effective e-Health services likely enhances patients own ability to manage their NCDs during the COVID-19 outbreak, especially in places where lack of sanitation or availability of PPE increases the risk of contagion. More importantly, e-Health solutions minimize direct contact between the public and healthcare

providers and thus optimize social distancing without affecting the strength of patient support. Consultancy over video communications has become useful for the delivery of preventive and consultation services. The governments are supplementing healthcare budgets to counter the impact of the pandemic, such as the Medicare Benefits Schedule, and the Medicare in the United States expanding the coverage range for the test and treat of COVID-19 without subscribers' expense. This allocation can support a range of e-Health services during the COVID-19 phase, enabling more people to receive healthcare at a significantly lower cost compared to hospital-centric services, including telehealth consultations with general practitioners and specialists. Doctors or nurses manning the e-Health service will be able to guide patients over video communication.

1.2. Research questions

Therefore, the following research questions arise:

RQ1. Which factors influence the eHealth consumer behavior in Bangladesh?

RQ2. How effectively can the health parameters be predicted without measuring it? Or, what algorithm suits the most in predicting blood uric acid?

RQ3. How can the PHC be efficiently deployed to contain the emergency situation, like COVID-19?

1.3. Research goal and objectives

Therefore, the goal is set to understand the consumer behavior of eHealth among the urban corporate people of Bangladesh for better management of NCDs by ensuring a time and cost-effective healthcare service. To gain this overall goal, the study has identified several specific objectives stated below:

① To identify the factors that affect consumers' acceptance of eHealth to propose a modified eHealth technology acceptance model for urban corporate people.

② To predict blood uric acid through machine learning approaches.

③ To modify the PHC for tackling the emergency, like COVID-19.

1.4. Research methodology

I followed a scientific process to conduct my research. I conducted a field survey, not an experiment, to collect the data of my research.

Study area selection: Bangladesh is a small developing country but highly populated. There is a lack of quality healthcare facilities like other developing and underdeveloped countries. So, I have selected Bangladesh as my study area. My prime concern was workers of corporate office living in an urban area.

Questionnaire design: Four types of data were collected such as socio-demographic, dietary habits, psychological factors to use eHealth technology, and clinical measurements. The socio-demographic, dietary information and psychological factors were collected using a structured questionnaire (details of the questionnaire are given in appendix 8 and 9).

Sample size determination: The sample size was calculated based on "Sample size determination in Health Studies [9]. The equation is given below:

$$n = \frac{z_{1-\alpha/2}^2}{[\log_e(1-\varepsilon)]^2}\left[\frac{1-P_1}{P_1} + \frac{1-P_1}{P_1}\right]$$

Here,

1-α = Confidence level (%)
= 90

ε = Relative Precision
= 0.30

P1 = Anticipated probability of disease among exposed
= 0.2

n = Sample size
= 277

Based on the equation, we calculated 277 samples, but we could collect data from 271 consumers.

Data Acquisition: A simple random sampling method was used to collect data from the respondents. Data were collected from a sample of 271 employees of Grameen Bank Complex, Dhaka, Bangladesh. The clinical measurements such as height, weight, BMI, waist, hip, body temperature, blood glucose, pulse rate, and blood uric acid were measured by pre-trained healthcare workers (SOP for data collection procedure is given in Appendix 11). **Figure 1.4** shows the data collection process. After informed consent at step 1 consumers are registered and the health checkup is conducted at step 3. And both affected and non-affected persons move to step 5, and we conducted a survey through a structured questionnaire. I have used data collected from the two points marked in red.

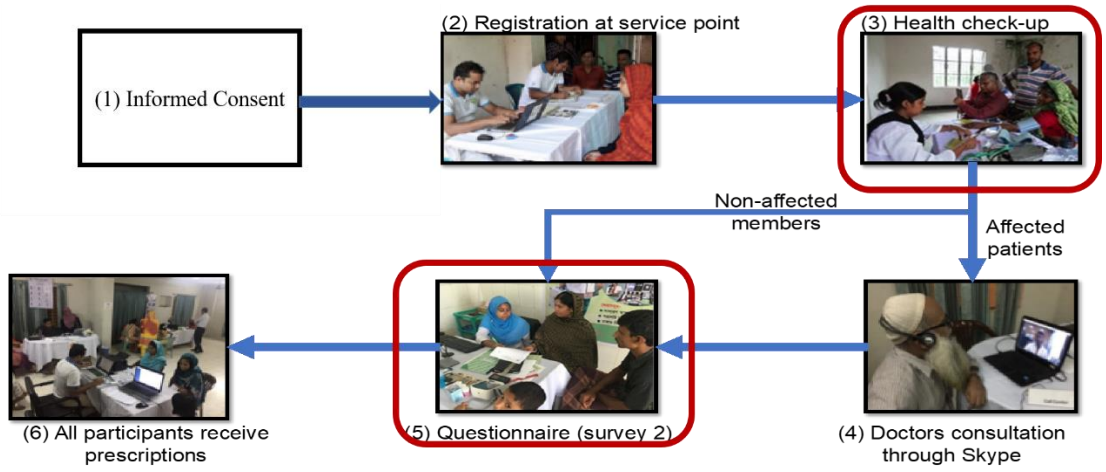


Figure 1.4: Data collection process (Grameen Bank Complex, Dhaka, Bangladesh)

Data preparation steps: There are several simple, but sometimes overlooked steps, required to properly prepare data. They are Questionnaire checking: Questionnaire checking involves eliminating unacceptable questionnaires. These questionnaires may be incomplete, instructions not followed, little variance, missing pages, past cutoff date, or respondent not qualified.

- Editing: Editing looks to correct illegible, incomplete, inconsistent, and ambiguous answers.
- Coding: Coding typically assigns alpha or numeric codes to answers that do not already have them so that statistical techniques can be applied.
- Transcribing: Transcribing data involves transferring data to make it accessible to people or applications for further processing.
- Cleaning: Cleaning reviews data for consistencies. Inconsistencies may arise from faulty logic, out of range, or extreme values.
- Statistical adjustments: Statistical adjustments apply to data that requires weighting and scale transformations.
- Analysis strategy selection: Finally, the selection of a data analysis strategy is based on earlier work in designing the research project but is finalized after consideration of the characteristics of the data that has been gathered.

We excluded missing values, outliers from the data set. We excluded 7 cases that did not respond to psychological factors from the adaption and use of PHC.

In this thesis, we also explained the suitability of the PHC model to satisfy the requirements of emergency like COVID-19. We proposed a modified model and introduce a new triage logic, we call it C-Logic (Corona Logic).

Anyway, to achieve the research goal through different approaches, different statistical tools are deployed as described in **Table 1.1**.

Table 1.1: Tools used to analyze data

Analysis	Tools Applied
Descriptive statistics Analysis	IBM SPSS – 25
Factor analysis & Reliability Test	IBM SPSS – 25
Correlation analysis	IBM SPSS- 25
Structural Equation Modeling	AMOS- 25
Predictive analytics	Microsoft Azure Machine Learning Studio

1.5. Major research contributions

The main objective of this research is to understand the consumer behavior of a remote healthcare system, PHC in particular. In order to achieve the research objective, we conducted a survey among urban corporate people of Grameen bank complex, Dhaka, Bangladesh. Data related to the consumer socio-demography, psychology, dietary habits, and health check-ups are collected through a personal interview with a structured questionnaire and health check-ups items were measured by the PHC service. Data were then analyzed through various statistical models and machine learning algorithms to attain the specific research objective.

The three major research contributions are described below:

First, this research proposes a modified eHealth technology acceptance model by incorporating the health awareness factor. Health awareness is an important factor from the perspective of Bangladesh because the people in this country lack the high health awareness needed to prevent NCDs. The model developed in this study was able to explain 72% of the variance in the use and 61% of the variance in the intention to use which performs better than the existing PHC acceptance model with 54.70% deviance. The findings offer proactively important and practical guidelines to service providers, implementers, and policymakers to promote the use of eHealth technology for regular health checkups.

Second, the research predicted the blood uric acid value through machine learning approaches. The mean of uric acid measurement was 6.63 mg/dL. That means the uric acid of most of the people is close to the borderline (6.63 whereas the normal range <7.0 mg/dL).

Therefore, they need to check uric acid regularly. The Boosted Decision Tree Regression model showed the best performance among other models based on the Root Mean Squared Error (RMSE) 0.03, this RMSE is better than any reported study that predicted clinical measurements.

Third, this research redesigned the existing PHC architecture by following WHO guidelines and Design Science Research framework as well as proposed corona logic (C-Logic) for the main symptoms of COVID-19. The new modified model can reduce the risk of transmission and psychological stress on frontline healthcare staff and optimize healthcare resources for more patients who need them the most. Theoretically, this study contributes to design science research by introducing a modified healthcare providing model with a new triage logic.

1.6. Limitations and future works

Given the cross-sectional design, the present study cannot determine the actual use behavior. Hence, a future study should consider a longitudinal approach through which participants are interviewed severally over a period.

This study is limited by geographical scaling: the survey was conducted in one country and focused on only 18 institutions. Thus, the results may raise a concern over the generalizability of the findings, and scope exists to make the findings more generalized by examining additional countries and institutions.

Besides, a few variables could be added, such as trust in a PHC system, facilitating conditions, service quality, system quality, and hedonic motivation to understand additional insights into the *use* of eHealth technology by urban corporate people.

1.7. Outline of the thesis

This study contains 6 chapters. Following the introductory chapter, chapter 2, systematically reviewed studies of the eHealth technology acceptance model to identify influencing factors and directions for further researches about the adoption of ICT based health services. This chapter informs the scope of future research by identifying gaps in the literature in this field.

Chapter 3 identified the factors that affect consumers' acceptance of eHealth and to propose a modified eHealth acceptance model for urban corporate people. This chapter identified that the key to promoting the future use of a PHC system lies in the three most important factors: perceived usefulness (0.659), intention to use (0.454), and health awareness (0.447). These factors have a positive and direct influence on use. The findings offer proactively important and practical guidelines to service providers, implementers, and policymakers to promote the use

of eHealth technology for regular health checkups.

Chapter 4 includes predicting health parameters through machine learning approaches. This chapter developed a blood uric acid prediction model based on personal characteristics, dietary information, and some basic health checkup measurements. Such a uric acid prediction model is useful for improving awareness among high-risk subjects. By predicting uric acid, this study can help to save medical costs.

Chapter 5 presents the evaluation of the efficacy of the PHC as a remote healthcare system for containing communicable disease outbreaks in unreached communities with lessons from the COVID-19.

And lastly, chapter 6 concludes the study with its major contributions, implications of research findings, limitations, and future works.

Chapter 2
Existing Researches on eHealth Consumer Behavior

Abstract

This chapter presents a systematic review to identify influencing factors and directions for future researches about the adoption of ICT-based health services. New methods and tools in the healthcare sector are growing gradually due to the continuing innovation in medicine and technologies. Health care technology system adoption varies among health care professionals (doctors, nurses), patients, and potential users. Therefore, for an increasing number of technologies in the health care field, the use of the technology acceptance model is needed to guide the implementation process across health care contexts and user groups. Therefore, understanding and creating the conditions under which information systems will be grasped by human remains a high priority research issue of information systems research and practice. Moreover, due to the scarcity of medical infrastructure including doctors and hospitals, remote healthcare services by using advanced Information and Communication Technology (ICT) are getting popular around the world. Due to potential benefits and the various eHealth initiatives in place, many recent studies have been done to enhance the acceptance of eHealth services by all citizens. Therefore, the purpose of this review is to systematically review all published studies on investigating the users' adoption of eHealth to summarize the results of previous studies and to show future direction for further research. This study reviews all published research on the acceptance model in e-health. This study conducted a systematic search of the web of science database and google scholar to collect studies about the adoption of eHealth technology. The author selected 19 articles to review. This literature review is conducted to identify the currently available eHealth adoption framework. The result showed that understanding and creating the conditions under which information systems will be grasped by humans is a high priority research issue of information systems research and practice. Based on the identified adoption factors in different eHealth technological context, it is suggested that the commonly investigated factors in the previous studies for each technological context and user group, need to be tested empirically in real settings. The confirmed factors are then recommended to apply as a basic model in each technological context and user group. This study informs the scope of future research by identifying gaps in the literature in this field. To our knowledge, this is the first study to systematically review to identify influencing factors and future directions of adoption of ICT based health services.

Keywords: eHealth adoption model, User acceptance of eHealth, User acceptance model of eHealth

2.1. Introduction

New methods and tools in the healthcare sector are growing gradually due to the continuing innovation in medicine and technologies [1]. Remote health care systems such as e-health, m-health, telemedicine, telemonitoring, electronic health records, and hospital information systems, are getting consideration due to the speedy advancement in Information and Communication Technology (ICT) worldwide [2]. Healthcare technology adoption varies among health care professionals (doctors, nurses) and patients [17]. User groups involved in most of the studies to assess the acceptance of ICT application in health-sector are nurses followed by physicians and patients [18]. Information Technology Acceptance research has developed many models, each with different sets of acceptance determinants. Therefore, for an increasing number of technologies in the health care field, the use of the technology acceptance model is needed to guide the implementation process across health care contexts and user groups [18]. By testing an information technology acceptance model, it is possible to determine what is more valued by users when it comes to deciding whether to adopt the system or not.

The model could help managers to understand the determinants of acceptance of new technology to proactively design intervention for users those less inclined to adopt and use new systems or technology. Therefore, the purpose of this study is to systematically review all published studies on investigating the users' adoption of eHealth to summarize the results of previous studies and to show future direction for further researches. This study reviews a number of published researches on the acceptance model of e-health. To our knowledge, this is the first study to systematically review to identify reasons, influencing factors, and future directions of adoption of ICT based health services.

Therefore, understanding and creating the conditions under which information systems will be grasped by human remains a high priority research issue of information systems research and practice. Moreover, due to the scarcity of medical infrastructure including doctors and hospitals, remote healthcare services by using advanced Information and Communication Technology (ICT) are getting popular around the world. Due to potential benefits and the various eHealth initiatives in place, many recent studies have been done to enhance the acceptance of eHealth services by all citizens. Therefore, the purpose of this review is to systematically review all published studies on investigating the user's adoption of eHealth to summarize the results of previous studies and to show future direction for further researches. This study reviews all published research on the acceptance model in eHealth.

2.2. Methodology

This study conducted a systematic search in the web of science database and google scholar in October 2017 to collect studies about the adoption of ICT based Health care services. There are 192 'eHealth acceptance' studies and 91 'user acceptance of eHealth' were found and among them, 19 'eHealth users' adoption model' is selected (shown in **Figure 2.1**). Based on the identified adoption factors in different eHealth technological contexts, it is suggested that the commonly investigated factors in the previous studies for each technological context and user group, need to be tested empirically in real settings. The confirmed factors are then recommended to apply as a basic model in each technological context and user group.

Figure 2.1: Study selection process

2.3. Results and Discussion

The result showed that understanding and creating the conditions under which information systems will be grasped by humans is changing for different locations, different populations, and for different technological contexts. This review showed that most of the adoption of ICT based healthcare services was studied in developed countries like European countries, USA, Canada, and Australia, etc. The commonly identified predictive factors were perceived usefulness, social influence, past experience, self- perception, and perceived effectiveness. Separate studies determined different R-square values for different user groups, different predictive factors. R-square means the percentage of the variance explained by the model. Therefore, future studies need to overcome the limitations of existing studies by including a large sample size, more factors, more geographic areas, and using the longitudinal survey. This study pinpointed the scope for future research by identifying gaps in the literature in this field. **Table 2.1** describes the influencing factors and directions for future research cataloged after review work.

Table 2.1. Existing research works, survey area, sample size, analysis methods, findings, and future research suggestions.

Author	Country	Context/ Type of technology	Sample size	Data collection procedure	Methodology	DV	Main finding/ Influencing Factors	R-Square	Future research suggestions
[8]	USA & Portugal	EHR Portal	597	Online survey	PLS-SEM	Behavioral Intention	Performance expectancy, effort expectancy, Social influence, hedonic motivation, price, & habit.	53%	Roger's Innovation Diffusion Theory and Covariance based (CB)-SEM should be used in future studies.
[7]	Netherlands	eMental health tools	12 Psychologists	Face to face, telephone and video call		eMental health adoption	Belief, and experience		Large sample size is recommended for further research.
[19]	Germany	Electronic Health Card (eHC)	502 Physicians	Online survey	SEM	Usage of eHC	Efficiency, usability of the system, and, cos-benefit ratio	98%	Scientific and practical implication could be derived.
[20]	Hong Kong	Telemedicine	400 U	Postal	Sample covariance matrices	BI	TAM is better than TPB for physicians' technology acceptance decisions	42%	Need to include other users groups.
[21]	Portugal	Electronic Health Record patient portal	360 Patients	Online Questionnaire	PLS- Causal modeling approach	BI	Performance expectancy, effort expectancy, habit, and, self-perception.	49.7%	More geographic location could be added
[22]	Indonesia	Hospital Information System (HIS)	1983	Face to face interviewing	SEM	Acceptance of HIS system	non-technological factors, such as human characteristics (i.e. compatibility, information security, etc.), and organizational characteristics (i.e. management support, facilitating conditions)		More user groups and geographic areas
[23]	Australia	accountable eHealth system	334	Online survey	SEM	BI	Self-efficiency, Attitude, Anxiety, and, Performance expectancy	47%	longitudinal survey should be performed
[24]	Finland	future my data based eHealth services	855	Web-based survey	SEM	Acceptance of future MyData	Self-efficiency, Effort expectancy, treat appraisals, and, perceived barriers	60%	Determinants of actual use should be identified wider

						based eHealth services			coverage of consumers should be covered.
[25]	Maryland	Information technology	468	Face to face	Stepwise Regression	BI	Perceived usefulness was the most stable determinant	49%	Large sample size and SEM should be used
[26]	Bangladesh	mHealth	300 Adults	Face to face	SEM	Use behavior of mHealth service	Social influence, technology anxiety, performance expectancy, and, behavioral intention		Longitudinal study could be conducted further
[27]	Canada	eHealth system-Web-based learning resource	500 Type 2 diabetes patients	Longitudinal field survey	PLS-SEM	Use of Web-based learning resource		53%	Time lagging, large sample size
[28]	Canada	Electronic patient Health Record system	800	Cross-sectional study	SEM	BI	Perceived usefulness, security, privacy and trust in PHRs, and , computer anxiety	62%	Functionalities factor should be included
[29]	Netherlands	Patient Portal	439 Adult Patients	Cross-sectional study	Logistic regression analysis	Patient Portal use	Effort expectancy, performance expectancy		Longitudinal survey, more user groups
[30]	Israel	Media(digital vs printed)	103 65 or older aged people	Cross-sectional study	Path analysis using SEM	Use of two information technologies , SDM and ISDM	Perceived ease of use, Perceived usefulness, Self-efficacy, cognitive absorption, and peer influence have an effect on technology use	64%, 65%	Other potential user groups rather than particular assisted-housing residents should be considered
[31]	Finland	MyData-based preventive eHealth service	855	Cross-sectional study with web-based questionnaire	SEM	Behavioral Intention	Effort expectancy, Self-efficacy, Threat appraisals, and, Perceived barriers	59%	influence of factors on actual-use should be investigated with wider coverage of consumers from different background

2.4. Conclusion

In order to increase users' acceptance or generalizability of the model future studies should use other developing countries. More detailed research is required to enhance the utility of the theoretical framework as a success predictive tool. So, this research suggested to make the model generalize, should include different locations, different user groups, and also recommended some potential antecedents such as health awareness, tradition, and socio-economic status.

Chapter 3
Modified Model for Adoption and Use of PHC

Abstract

This chapter describes the influence of the factors that affect the use of a PHC system (portable health clinic, an eHealth technology) by urban corporate people in Bangladesh. This study uses the first and second versions of the technology acceptance model and the unified theory of acceptance and use of technology model as the foundation. Additionally, health awareness factors are incorporated to develop the research model. Structural equation modeling was used to analyze a sample size of 264 urban corporate people in Bangladesh. Based on the total effects, the key to promoting the future use of a PHC system lies in the three most important factors: perceived usefulness (0.659), intention to use (0.454), and health awareness (0.447). These factors have a positive and direct influence on use. The findings offer proactively important and practical guidelines to service providers, implementers, and policymakers to promote the use of eHealth technology for regular health checkups.

Keywords: Portable Health Clinic, eHealth, Future *Use*, Perceived Usefulness, Health Awareness, Urban Corporate People, Structural Equation Modeling

3.1. Introduction

New methods and tools in the healthcare sector are growing gradually through the continuing innovation in medicine and technologies [1]. Along with the scarcity of medical infrastructure (e.g., clinic and doctors) and the speedy advancement in Information and Communication Technology (ICT), remote healthcare systems, such as eHealth, mHealth, telemedicine, and telemonitoring, are receiving paramount consideration worldwide [2]. More than half of the world's population does not receive all of the essential services that they need. One hundred million people are pushed into extreme poverty because of their health expenditures, forcing them to survive on just $1.90 or less a day [3]. According to the World Health Organization (WHO), more than one-quarter of the world's countries including Bangladesh has a critical healthcare workforce shortage [4]. In Bangladesh, only 4.7 doctors are available for every 10,000 people [5]. eHealth technology, which is a healthcare system that uses ICT, is an important way to solve the scarcity of current medical facilities.

The demand for ICT-based eHealth systems is increasing each day. Advanced technologies (e.g., IoT, BigData, Machine Learning) are being applied to improve the system's efficiency. However, the social adoption of eHealth, especially in developing countries, has not been completely understood. Increasing the acceptability of eHealth technology in developing countries such as Bangladesh is necessary.

Because of the potential benefits and various eHealth initiatives in place, many studies have been conducted to determine the acceptance of eHealth technology. However, most were conducted in developed countries, such as European countries, the United States, Canada, and Australia [6]–[8]. Although the deployment of eHealth technology is essential for developing countries in which access to quality healthcare is hindered by poor governmental policies, political crises, and lack of healthcare infrastructure (e.g., clinics, doctors) [9], very few studies

were conducted in these countries, such as Bangladesh.

Researchers found performance expectancy, effort expectancy, facilitating condition, and reinforcement factor having a significant impact on behavioral intention to use telemedicine by clinicians in Nigeria [32]. On the other hand, perceived usefulness, and computer self-efficacy was shown to have a positive and significant impact on Telemedicine acceptance by public hospitals in Malaysia [33]. A study among 600 families in one particular rural area in Bangladesh found that consumers' age, occupation, and purchasing power have a significant influence on their acceptance of eHealth services from a PHC (portable health clinic) system [34]. Another study in the same rural area in Bangladesh identified social reference, advertisement, attitude toward the system, and perceived system effectiveness as influencing the acceptance of a PHC system [2]. However, because both of these studies focused on only rural areas, and the data analysis did not use structural equation modeling, estimating the mediation effect between two or more mediator factors was not possible. These studies failed to consider other important factors from the perspective of Bangladesh, such as the intention to use a PHC system, self-efficacy, and health awareness. Another study identified the factors that influence the adoption of eHealth by a specific user group, such as patients from hospitals in the capital city of Dhaka in Bangladesh [17]. However, this study did not reflect the behavior of other user groups.

Despite the potential benefits, the adoption rate of eHealth technology by citizens in Bangladesh is still low [17]. Yet, no study focused on the use of eHealth technology by urban corporate people in Bangladesh.

Grameen Communications, Bangladesh, and Kyushu University, Japan, have jointly developed a human-assisted PHC system [35]. A PHC is an eHealth system that aims to provide affordable primary healthcare services to prevent severity or to control non-communicable diseases (NCDs). A PHC system has four modules: (a) a set of medical devices, (b) a software system to collect and archive medical records, (c) healthcare workers to make the clinical measurements and explain ePrescriptions, and (d) ICT-trained call center doctors. Consumers come to the service point, and a health checkup is conducted by pre-trained healthcare workers. If needed, the consumer is connected to the call center doctors for a consultancy. The clinical measurements addressed by a PHC are as follows: (1) blood pressure, (2) pulse rate, (3) body temperature, (4) oxygenation of blood (SpO2), (5) arrhythmia, (6) body mass index (BMI), (7) waist, hip, and W/H ratio, (8) blood glucose, (9) blood cholesterol, (10) blood hemoglobin, (11) blood uric acid, (12) blood grouping, (13) urinary sugar, and (14) urinary protein.

Because a PHC is a new system and the doctor is virtual, patients cannot consult a remote

doctor in person. To increase the acceptance and future use of a PHC system, the developers tested the system in different communities with different characteristics, such as urban corporate people. Empirically testing the suggested factors found in the previous studies in real settings is necessary because only the confirmed factors can be applied as a basic model for each technological context and user group [18]. Different factors may affect the acceptance of the same eHealth technology for different user groups [22], and the rank of the factors may differ [36]. In contrast, the established acceptance model can be extended by incorporating new variables in specific technological contexts and user groups [18]. To evaluate and increase the acceptance of a PHC system before implementing it on a large scale, understanding the factors that are more highly valued by potential user groups is necessary. Because the low usage of ICT-based systems has been identified as a major factor for the "productivity paradox," low returns from organizational investments occurred [10].

Therefore, the purpose of this study is to determine the factors that influence the adoption and future use of a PHC system. This study proposes a model by newly incorporating a "health awareness" factor that can investigate the factors behind the use of a PHC system by the urban corporate in Bangladesh. Health awareness is an important factor from the perspective of Bangladesh because the people in this country lack the high health awareness needed to prevent NCDs.

For the interviews, this study selected people from the urban area who work in institutions under the Grameen Bank complex in Dhaka, Bangladesh. Because institutional people have significant workloads and remain seated for a long time to complete their tasks, they are more likely to develop NCDs. The prevalence of risk factors, such as hypertension, obesity, diabetes, and low physical activity, for developing NCDs is also higher among urban than rural people in Bangladesh [37].

In addition, little chance exists to engage in physical activities among the urban people in Bangladesh because of a lack of playgrounds, parks, walkable footpaths, and safe roads for cycling [37]. Therefore, it is important to control and prevent the seriousness of NCDs by getting regular health checkups. However, most people are not interested in spending money and time on preventive healthcare services. Institutional people in Bangladesh lack health insurance and high health awareness, do not get routine mandatory health checkups and are not habituated to use ICT-based healthcare services. Moreover, to get a checkup, they need to visit a hospital in traffic-congested areas and wait in a long, laborious queue. In this situation, the authors conducted a survey of 264 urban corporate people to understand the underlying factors that could influence them to use a PHC system in the future.

3.2. Theoretical basis for building the proposed model

Several previous studies explored the factors that influence the use behavior of new technology. The present study reviews previous studies and develops the proposed model. The theory of reasoned action (TRA) is a major theory that explains people's behavior [38]. Based on the TRA, the theory of planned behavior was developed as is an extension of the TRA [39]. The technology acceptance model (TAM) was developed using these models as a foundation [40]. TAM is a major theory used to understand how users come to accept and use new technology but do not include some important external variables. The TAM2 was developed based on the basic TAM by adding the determinants of perceived usefulness and usage intention constructs. Subsequently, the unified theory of acceptance and use of technology (UTAUT) model was developed by adding new variables to the basic TAM: facilitating conditions and social influences [41]. UTAUT also removed some less important variables. The TAM, TAM2, and UTAUT models are presented in **Figures 3.1**, **3.2,** and **3.3**, respectively.

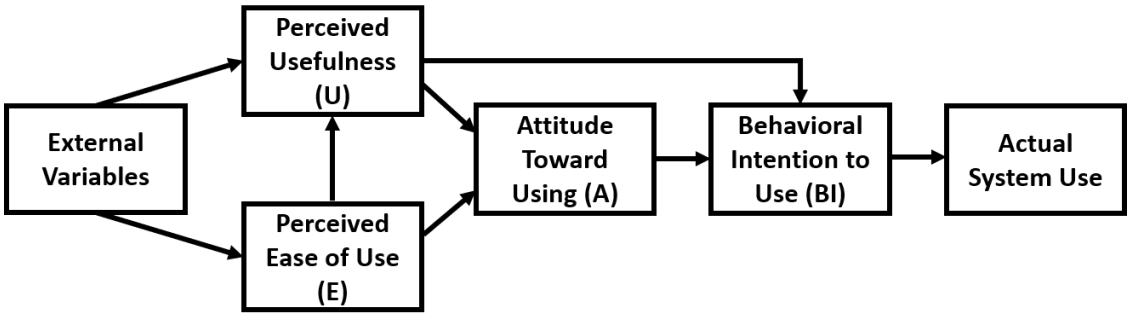


Figure 3.1: Technology Acceptance Model (TAM)

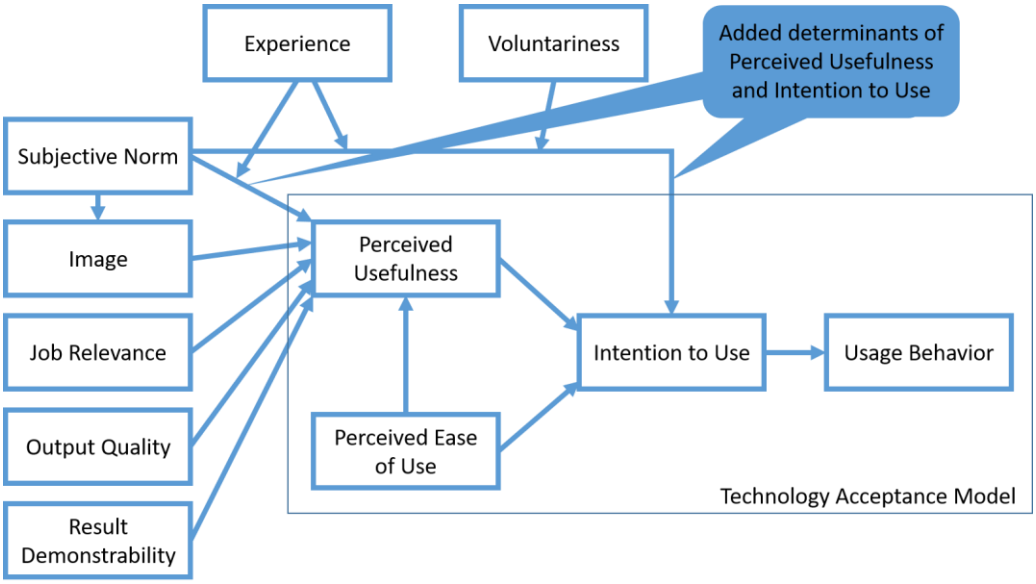


Figure 3.2: TAM2- an extension of TAM

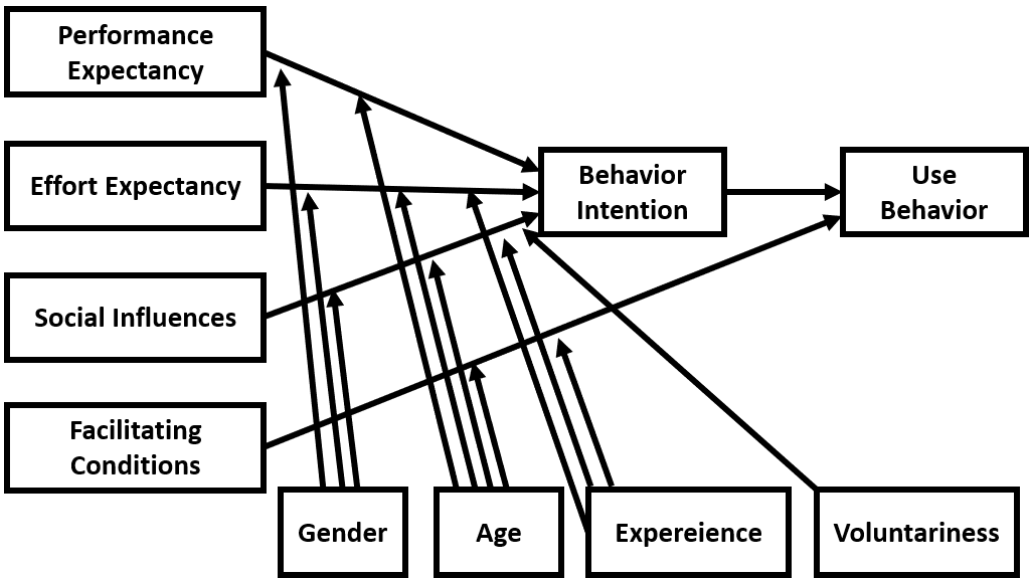
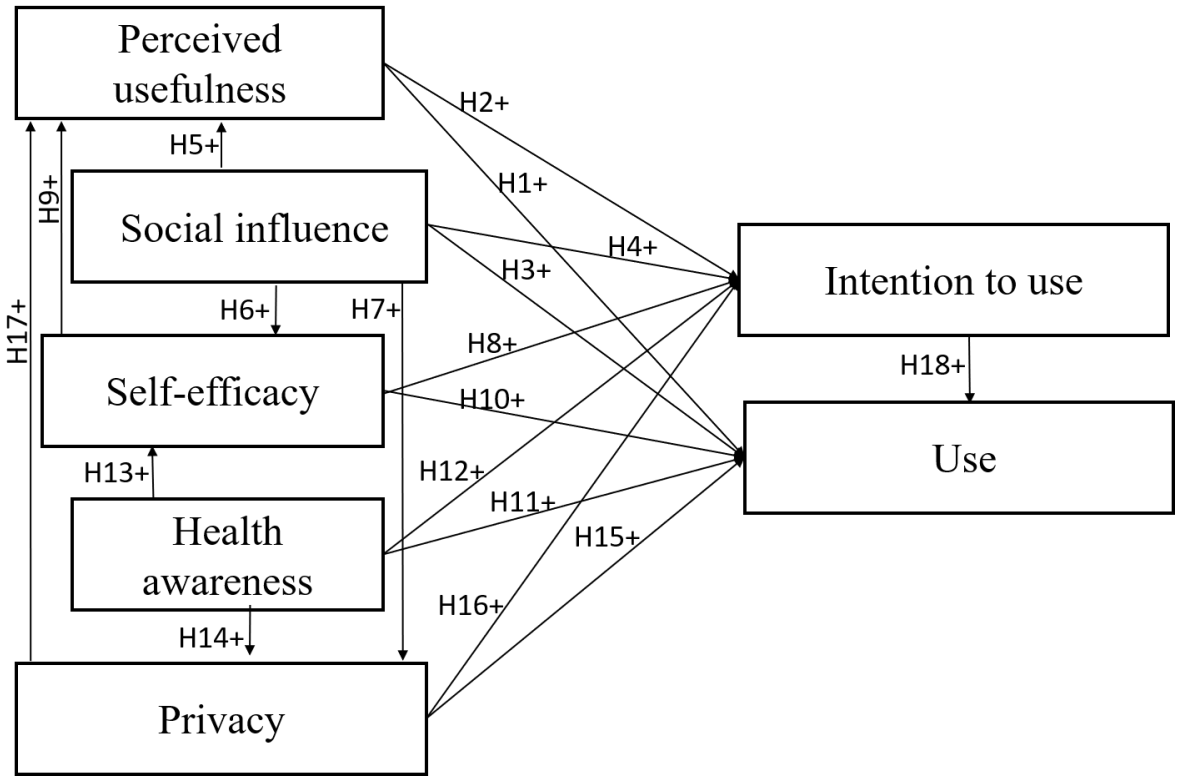


Figure 3.3: UTAUT- an extension of TAM and TAM2

Based on TAM [42], TAM2 [25], UTAUT [41], and other existing technology acceptance models, the present study proposes a model that can investigate the factors affecting the use of a PHC system. Moreover, this study argues that health awareness may directly affect the use of a PHC system.

3.3. Theoretical Model and Hypotheses Development

This study develops a hypothetical model (**Figure 3.4**) that is tested for urban corporate people. A number of key factors are selected that were validated by previous studies, and hypotheses regarding the relationships of these factors are proposed based on empirical findings and theoretical reasoning.



Note: H indicates a hypothesis and + indicates a positive relationship between two variables.

Figure 3.4: Hypothetical model to understand the relationship between factors

Perceived Usefulness

Perceived usefulness is defined as the degree to which a person believes that using a particular technology would enhance his or her job performance [25], [42]. In other words, users may feel that using a PHC system will improve their health status. One study revealed a significant correlation between perceived usefulness and self-predicted future use [42]. Another previous study found a positive effect of perceived usefulness on the intention to use eHealth technology [26]. In many other studies, perceived usefulness was also found to be a significant predictor of behavioral intention [6], [31], [43], [44]. Therefore, the following hypothesis is developed.

H1*:* Perceived usefulness has a positive and direct effect on the use of a PHC system.

H2*:* Perceived usefulness has a positive effect on the intention to use.

Social influence

Social influence is the extent to which consumers realized that others—who are important to them—believe that they should use a specific technology [45]. Previous studies defined social influence as encouragement from friends, coworkers, or family members to using preventive eHealth services [45], [46]. Social influence includes both social and subjective norms as well [41]. Social norms consist of two influences: 1) informational norm to enhance knowledge and 2) normative to conform to expectations of others [47]. Subjective norms concern the perceived social pressures to undertake or not undertake a behavior [48], [49]. Some studies revealed that social influence had a significant impact on intention to use [8], [26], [41]. Other studies also identified social influence as the determinant of the acceptance of eHealth [50]. Yet other studies found that social influence had a significant impact on perceived usefulness [19]. Therefore, the following hypotheses are developed.

H3*:* Social influence has a positive and direct effect on the use of a PHC system.

H4*:* Social influence has a significant influence on the intention to use.

H5*:* Social influence has a significant influence on perceived usefulness.

H6*:* Social influence has a significant impact on self-efficacy. Because friends, family members, or loved ones can be encouraged to perform any action, a person's confidence for performing an action becomes stronger.

H7*:* Social influence has a significant effect on privacy.

Self-Efficacy

Perceived self-efficacy is defined as the judgment of one's ability to use technology to accomplish a particular job or task [41], [51]. In other words, self-efficacy is defined as one's confidence in one's ability to perform a behavior successfully that leads to a valued outcome [44], [46], [52]. Self-efficacy influences one's aspirations and goals [46], [52]. A person's self-efficacy beliefs affect his or her tendency to use eHealth technology [27]. A person with high self-efficacy is more likely than a person with low self-efficacy to believe that using eHealth technology will generate better health outcomes [46]. Self-efficacy has a significant influence on perceived usefulness [22] and significantly and positively influences behavioral intention [46], [53]. Therefore, the following hypotheses are developed.

H8*:* Self-efficacy has a positive and direct effect on the use of a PHC system.

H9*:* Self-efficacy has a significant influence on perceived usefulness.

H10*:* Self-efficacy has a positive effect on the intention to use.

Health Awareness

Health awareness is measured to assess the degree of readiness for undertaking any health actions [54], [55]. This construct reflects a person's readiness to do something for his or her health [56]. Healthy behavior was found to be a significant component of the self-efficacy of using eHealth technology [46]. When people get ready to use eHealth technology to improve their health conditions, they are more concerned about the privacy of the system [57]. Thus, a more health-conscious person will have high self-efficacy to believe that using a PHC system will improve his or her health condition. Therefore, the following hypotheses are developed.

***H11**:* Health awareness has a positive and direct effect on the use of a PHC system.
***H12**:* Health awareness has a significant effect on the intention to use.
***H13**:* Health awareness has a significant effect on self-efficacy.
***H14**:* Health awareness has a significant effect on privacy.

Privacy

The importance of privacy concerns is increasing gradually in the healthcare sector [58]. Privacy is defined as the extent to which a respondent believes that a PHC system will not compromise his or her privacy [59]. Information privacy is defined as the extent to which individuals are disturbed about the information collection practices of others and how the obtained information will be used [57], [60]. Privacy has a significant influence on behavioral intention and perceived usefulness [6]. A consumer who has a more positive perception about the privacy concern offered by a PHC system is expected to be more positive about using the system. Therefore, the following hypotheses are developed.

***H15**:* Privacy has a positive and direct effect on the use of a PHC system.
***H16**:* Privacy has a positive effect on the intention to use.
***H17**:* Privacy has a significant effect on perceived usefulness.

Intention to Use

Behavioral intention is defined as a person's perceived likelihood that he or she will perform the specific behavior. Intention contains four different elements: the behavior, the target object at which the behavior is directed, the situation in which the behavior is to be performed, and the time at which the behavior is to be performed [38]. If one can obtain a measure of the intention immediately before the performance of the behavior, the intention will accurately predict the behavior. However, to predict future behavior, one cannot depend only on the measure of intention—other variables must also be considered [61]. Therefore, the following hypothesis is developed.

***H18**:* Intention to use has a positive and direct effect on the use of a PHC system.

Self-Predicted Future Use

This study uses self-predicted future use of a PHC system as a final dependent variable (use). Self-predicted behavior or behavioral expectations is defined as one's estimated likelihood of performing an action, whether or not a commitment has been made. Behavioral expectations should more accurately predict future behavior than behavioral intention alone [62].

3.4. Methodology

3.4.1. Study place

A cross-sectional survey was conducted in August 2018 among all office workers who agreed to participate in PHC health checkups and eHealth services in the Grameen Bank Complex in Dhaka, Bangladesh. The Grameen Bank Complex holds several different offices, such as Grameen Bank, Grameen Communications, other non-government organizations, and private companies, with more than 500 workers. This study recruited participants from these 18 institutions for several reasons. People working in institutions are very busy and most of the time they work sitting in seats. Therefore, they are more likely to develop NCDs. In addition, little chance exists for physical activities among urban people in Bangladesh because of a lack of playgrounds, parks, walkable footpaths, and safe roads for cycling [37]. Institutional people in Bangladesh do not have health insurance and high health awareness, do not get routine mandatory health checkups and are not habituated to use ICT-based healthcare services.

3.4.2. Data Collection

Before the implementation of PHC services, awareness events, and prior notification to each office were made to provide information on the availability of PHC services.

Those potential users are expected to understand the perceived benefits of using a PHC system. A pilot survey was conducted to test whether or not the questionnaire items were understandable to respondents. The questionnaire was finalized based on feedback from the pilot survey. Then, immediately after receiving PHC services, the survey was given to those who came to the PHC service providing point at the Grameen Bank Complex and received the service. Questions were asked by pre-trained data collectors in Bangladesh.

Data were collected from a sample of 264 people through a face-to-face structured questionnaire survey. A simple random sampling method was used to collect data from the respondents. All participants involved were treated based on the safety procedure described in the "Helsinki Declaration 2013" [63]. The data were secured at the data center, and participants' privacy is protected. Only researchers, data entry officers, and data managers could access the

data with a security password.

3.4.3. Measures

All of the questionnaire items for latent constructs were taken from prior studies and modified according to the context of a PHC and Bangladesh.

3.4.4. Questionnaire Design

The questionnaire consists of two parts: 1) Part A (socio-demographic information): age, gender, education, and experience and 2) Part B (cognitive or perceptional questions): psychological factors. The respondents read each statement and rated them on a five-point Likert scale by placing √ (tick) in the number that best describes them, where 1 = strongly disagree, 2 = disagree, 3= neither disagree nor agree, 4 = agree, and 5 = strongly agree.

3.4.5. Ethical approval

The authors obtained ethical approval from the National Research Ethics Committee (NREC) of the Bangladesh Medical Research Council with approval no. 18325022019.

3.4.6. Data Analysis Method

Two statistical methods were applied to analyze the data: exploratory factor analysis and structural equation modeling. Exploratory factor analysis (by using SPSS 25.0) is used to measure latent factors in our proposed research model, and structural equation modeling (by using the AMOS SPSS 25.0 tool) is used to identify cause and effect relationships among the factors. Before the estimation of the hypothetical model, exploratory factor analysis (using the maximum likelihood extraction method and the Promax rotation method) was conducted to measure factors with the Cronbach's alpha reliability coefficient.

3.5. Results

A descriptive summary of respondents' socio-demographic characteristics is provided in **Table 3.1**.

Table 3.1: Summary of respondents' socio-demographic characteristics (n = 264)

Variable name	Definition	Description	Mean	Standard Deviation
Age	Age of the respondent	34–74 years, continuous data	49.50	7.43
Gender	Gender of the respondent	Male = 1; female = 0	0.84	0.37
Education	Education completed by the respondent	1 = No education (no school entered); 2 = Primary school completed; 3 = Secondary school completed; 4 = High school completed; 5 = Vocation school completed; 6 = College/University completed; 7 = Higher (Master or Doctor) completed; 8 = Others	5.66	1.89
Experience	Experience using any eHealth service	Yes = 1; No = 0	0.25	0.44

The results of explanatory factor analysis with reliability coefficients are shown in **Table 3.2**.

Table 3.2: Explanatory Factor Analysis to determine the loadings (n = 271)

Questionnaire items	*Perceived usefulness*	*Health awareness*	*Social influence*	*Privacy*	*Use*	*Intention to use*	*Self-efficacy*	Cronbach 's Alpha
Using a PHC system would help me better manage/maintain my health [25], [26], [42]	**0.809**	-0.016	-0.032	0.040	0.081	-0.136	0.008	0.902
I feel that using a PHC system would increase my productivity [22], [25], [26], [42]	**0.825**	0.052	-0.009	-0.001	0.052	-0.046	0.000	
I feel that a PHC system is useful in my daily life [25], [26], [42]	**0.895**	0.130	-0.081	-0.002	-0.070	0.045	-0.055	
Using a PHC system will	**0.851**	-0.123	0.166	-0.058	-0.036	-0.033	0.056	

enhance my effectiveness in my life and job [22], [25], [26], [42], [64]								
People who are important to me suggest using a PHC system (other than family members) [22], [25], [30]	0.028	-0.030	**0.646**	0.028	0.102	0.078	0.051	0.882
My family members prefer to use a PHC system [25], [65]	0.032	-0.011	**0.820**	-0.056	0.040	0.133	-0.059	
I use a PHC because my colleagues also use it [22]	-0.006	0.049	**0.939**	0.044	-0.061	-0.087	-0.004	
I believe that the privacy of PHC participants is protected [26]	-0.009	0.107	-0.002	**0.842**	0.075	-0.032	-0.127	0.904
I believe that the personal information stored in a PHC system is safe [26]	-0.037	-0.156	-0.008	**0.943**	-0.003	0.078	0.074	
I believe that a PHC system keeps participant information secure [26]	0.038	0.126	0.036	**0.820**	-0.109	-0.037	0.018	
I consider myself very health conscious [56]	0.050	**0.355**	0.247	0.119	-0.009	-0.179	0.018	0.781
I think that I take into account health a lot in my life [56]	0.043	**0.823**	0.016	0.058	-0.065	-0.078	0.006	
I want to improve my health condition [54]	0.001	**0.761**	-0.073	-0.064	0.128	0.180	-0.168	
I want to do something good for my health [54],	-0.151	**0.497**	0.100	-0.088	0.195	0.023	0.192	

[56]								
I think that by using a PHC system I can prevent the seriousness of diseases (silent killers, e.g., diabetes, stroke, heart-failure) [54]	0.063	**0.515**	-0.055	0.055	-0.057	0.102	0.196	
I could get health checkups by using a PHC system [41]	-0.047	0.005	0.014	-0.020	-0.053	0.090	**0.999**	0.855
I feel confident that I will comply with a PHC prescription [30], [46]	0.149	0.085	-0.056	0.007	0.138	-0.108	**0.633**	
I intend to use a PHC system in the future [25], [26]	0.009	0.008	0.016	-0.003	-0.068	**0.883**	0.088	0.898
If a PHC system is available, I will always use it [25], [26], [36]	0.055	0.035	0.023	-0.015	-0.100	**0.977**	-0.054	
It would be worth it to receive a PHC health service [38]	0.009	0.001	0.019	0.113	0.279	**0.468**	0.021	
A PHC system is a pleasant experience [17], [26]	0.103	0.000	0.065	-0.105	**0.801**	-0.066	-0.075	0.741
I spend time to know about a PHC system [17], [26]	-0.179	0.074	-0.004	-0.018	**0.574**	-0.115	0.034	
I realize that using a PHC system creates many advantages [19], [62]	-0.031	0.015	0.025	0.088	**0.733**	0.077	-0.010	
It makes sense to use a PHC system [19]	0.224	-0.073	-0.098	0.079	**0.674**	0.045	0.075	

Note: All of the questionnaire items for latent constructs were taken from prior studies and modified according to the context of a PHC and Bangladesh.

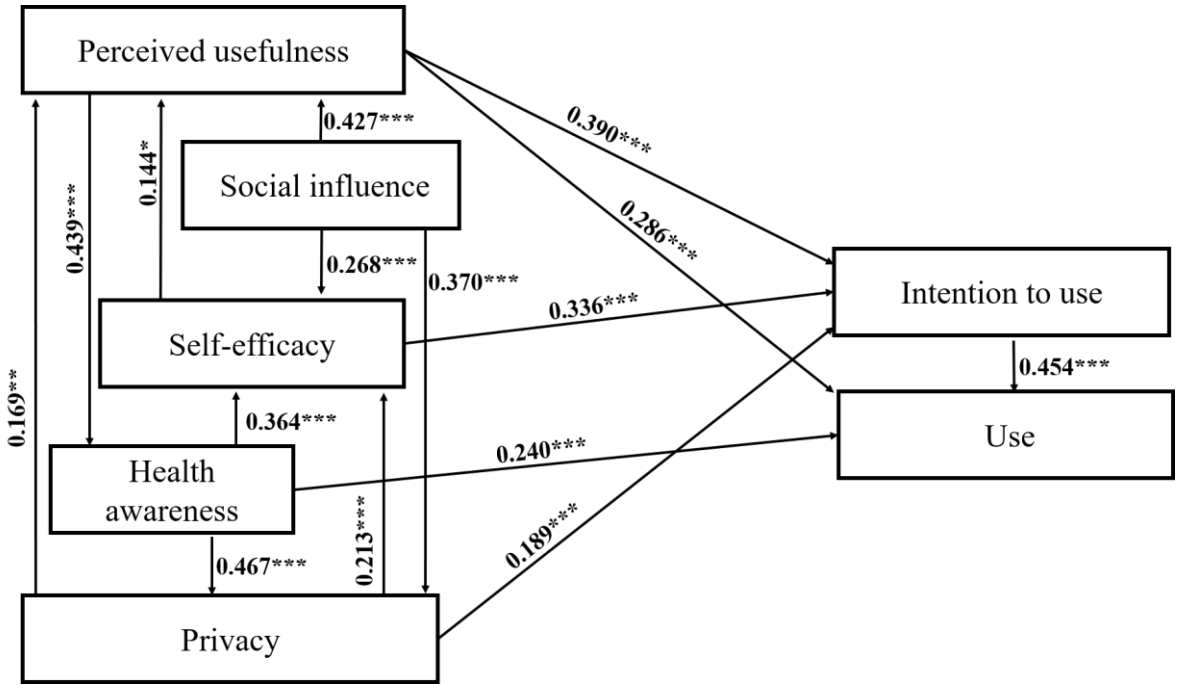
The reliability coefficient was assessed to ensure that all questionnaire items measured the same underlying factors. Items with loadings lower than 0.4 were dropped, and then the factor analysis was recalculated. All remaining items were highly loaded on each of the corresponding factors. Specifically, the reliability coefficient (Cronbach's alpha) for perceived usefulness was 0.902, health awareness 0.781, social influence 0.882, privacy 0.904, use 0.741, intention to use 0.898, and self-efficacy 0.855. All of the Cronbach's alpha values are greater than the threshold of 0.70, indicating that all questionnaire items reliably measure each factor [66].

Table 3.3 provides the common goodness of model fit indices, the recommended value, and the results of the model.

Table 3.3: Goodness of fit indices for the structural model

Indices	Recommended Values	Results of the model	Model fit
1. Chi-square/DF	1 to 5	2.587	< 5 good fit
2. RMSEA	<0.08	0.078	< 0.08 good fit
3. CFI	>0.9	0.962	> 0.9 good fit
4. GFI	>0.9	0.946	> 0.9 good fit
5. AGFI	>0.80	0.902	> 0.8 good fit
6. NFI	>0.9	0.940	> 0.8 good fit
7. R^2	-	0 .715	

By comparing all indices with their corresponding recommended values as suggested by previous studies [67], [68], and shown in **Table 3.3**, the model indicates a better fit to the data (**Figure 3.5**).



Note: *, **, and *** indicates a p-value less than 0.1, 0.05, and 0.001, respectively. The number (path coefficients) indicates the degree of the relationship, n = 264

Figure 3.5: Estimated model to indicate the degree of relationship

The model developed in this study was able to explain 72% of the variance in the use and 61% of the variance in the intention to use. **Table 3.4** shows the result of the hypothesis tests and the direct and indirect effect of predictors on the use behavior.

Table 3.4: Result of hypotheses tests and effect analysis on use behavior

Variables	Direct Effect		Indirect Effect			Total effect	Rank
	s. e	Hypothesis	s. e	Mediator	Hypothesis		
Perceived usefulness	0.286	H1 A	0.373	*Intention* *Health awareness*	H2A	0.659	1
Intention to use (Intention)	0.454	H27 A	0.000			0.454	2
Health awareness	0.240	H11 A	0.207	*Privacy* *Self-efficacy* *Intention*	H14 A H13 A H12 R	0.447	3
Social influence	0.000	H3 R	0.440	*Privacy* *Perceived usefulness* *Self-efficacy* *Intention*	H7 R H5 A H6 A H4 R	0.440	4
Privacy	0.000	H15 R	0.250	*Intention* *Perceived usefulness*	H16 A H17 A	0.250	5
Self-efficacy	0.000	H8 R	0.247	*Intention* *Perceived usefulness*	H10A H9A	0.247	6

Note: s.e: Standardized effect, Total effect = Direct effect + Indirect effect, A: Accepted hypothesis, R: Rejected hypothesis, -: insignificant effect ($p > 0.1$), Indirect effect is the product of two effects. The final endogenous construct is the self-predicted future *use*; n = 264.

The estimation of the standardized direct and indirect effects of each predictor on use permits the relative contribution of each predictor on use. If the absolute standardized total effect is taken into account, perceived usefulness is the most important predictor of use followed by intention to use and health awareness, respectively.

3.6. Discussion

This study applied a modified eHealth acceptance model by incorporating a health awareness factor into the model to understand the acceptance behavior of corporate people in Bangladesh regarding eHealth. This study provides empirical evidence for the proposed hypotheses.

This study found that perceived usefulness, intention to use, and health awareness have direct and positive effects on the use behavior. Many empirical studies found significant effects of perceived usefulness and intention to use on the use behavior but did not check for corporate people in developing countries and did not include the health awareness factor, which has a strong and significant effect on both intention to use and use behavior [22], [26], [69]. The three factors previously mentioned can be presented as follows.

(1) Perceived usefulness: Perceived usefulness has a direct and positive effect on both use (0.286***) and intention to use (0.390***) and, thus, was also the determinant of use and the intention to use. Therefore, hypotheses H1 and H2 were accepted. Davis et al. [42] supported the result of H1. Another study found that perceived usefulness significantly influences intention [26].

(2) Intention to use: Intention to use has a positive and direct effect on use (0.454***). Therefore, hypothesis H17 was accepted. Some previous studies supported this finding [8], [26].

(3) Health awareness: Health awareness has a positive and direct effect on use (0.240***). Respondents who are more health-conscious believe that using a PHC system will help keep them healthier. Therefore, hypothesis H11 was accepted. A former study has shown ‘self-perception about health’ as a significantly influencing factor of behavioral intension to use a technology such as Electronic Health Record (EHR) portal [21], whereas, the ‘subjective health belief’ is described as the same for taking decision to consult with a general practitioner by other researchers [70]. Comparing with these two factors described in Ref. [21], [70] ‘health awareness’ has certainly been identified as an influencing factor for the corporate’s future use of eHealth technology.

The modification indices showed two additional path coefficients from perceived usefulness

to health awareness; that is, a person decides to take any health-related action based on the perceived benefits of taking the action [71].

Moreover, from privacy to self-efficacy, that is, a person who has a more positive perception about the privacy concern offered by a PHC system will be more self-confident when using the system. Age, gender, education, experience using any eHealth service, privacy, social influence, and self-efficacy do not have a significant direct effect on use. However, privacy and self-efficacy have a significant and positive effect on the intention to use. Age, gender, and education do not influence the intention to use. This result is consistent with a previous study [72].

Therefore, perceived usefulness, intention to use, and health awareness are the factors that strongly determine the future use of a PHC system.

A systematic review of the acceptance behavior of eHealth, mHealth, telemedicine, etc. are described in chapter 2 which concludes that very limited studies were conducted in the developing countries. Based on this, we conducted a study on urban corporate people of a developing country, Bangladesh. We have modified the existing technology acceptance model from the perspective of Bangladesh by incorporating the 'health awareness' factor newly. As we know, there are four categories of factors that can affect consumers' usage of any new product or service - (1) demographic factors (2) socio-economic factors (3) cultural factors, and (4) psychological factors [73]. These factors are used in the present study except for cultural factors. The finding and shortcoming s of the current study is compared with other studies conducted in Bangladesh and some other developing countries are compared and presented in the following table (**Table 3.5**).

Table 3.5: Summary of model comparison among developing countries' perspective

Ref.	DV	Study Area	Method	n	Independent Variables						R^2 %	Limitations/ Future works
					Total	Demo	TAM	UTAUT	TPB	Contributions		
[74]	To explore the causes eHealth acceptance in urban Iran	Tehran, Iran	Structural Equation Modeling (SEM)	358	10	0	2	3	1	Trust, Tangibility, Masculinity, Power distance	52	
[32]	behavioral intention to use telemedicine	Nigeria	Structural Equation Modeling (SEM)	252	7	3	2	1	0	Reinforcement factor		More geographic areas, Large sample size
[26]	Use behavior of mHealth service	Dhaka, Bangladesh	Partial least square (PLS)	277	7	0	0	5	0	Technology anxiety, Resistance to change	39	Longitudinal study could be conducted further
[2]	Behavioral Intention to Use	Kushtia, Bangladesh	Logistic Regression Modeling	292	14	4	4	2	0	Service time, Privacy, Cost, Advertisement	54	Other potential user groups rather than rural
[75] Present work	Use behavior of PHC	Dhaka, Bangladesh	Cross-sectional SEM	271	11	4	4	2	0	Health awareness	72	Large sampling, more geographical areas, longitudinal studies, Cultural factors

Note: DV-Dependent Variable, n= sample size, Demo= Demographic characteristics, TAM= Technology Acceptance Model, UTAUT= Unified Theory of Acceptance of Use of Technology, TPB= Theory of Planned Behavior.

3.7. Limitations and future directions

This study is limited by geographical scaling: the survey was conducted in one country and focused on only 18 institutions. Thus, the results may raise a concern over the generalizability of the findings, and scope exists to make the findings more generalized by examining additional countries and institutions.

Given the cross-sectional design, the present study cannot determine the actual use. Hence, a future study should consider a longitudinal approach through which participants are interviewed severally over a period. Besides, a few variables could be added, such as trust in a PHC system and facilitating conditions, to understand additional insights into the use of eHealth technology by urban corporate people.

3.8. Contribution

Theoretical Contribution

The theoretical model developed in this study could support attempts to extend eHealth technology acceptance theories by incorporating the health awareness factor. This study identified health awareness as having a significant influence on the corporate's future use of eHealth for regular health checkups in a developing country. This study checked the complete model and identified the mediation effect between two or more mediator factors.

Practical Contribution

The findings of this study offer proactively important practical guidelines to service providers, implementers, and policymakers to successfully plan their implementations and make them sustainable, make better use of their resources and promote the use of eHealth technology such as a PHC system. The results of this study can also contribute to policymaking to reduce the morbidity rate in the country.

3.9. Conclusion

Despite the inherent limitations of an exploratory study, this research has the merit of identifying, for the first time, the key psychological factors behind the use of eHealth technology by urban corporate people.

Based on the total effect (shown in Table 3), increasing the perception of usefulness (perceived usefulness) of the system followed by intention to use and health awareness, which were also found to have a direct and positive effect on the use behavior, appears necessary to enhance the use of a PHC system. The social influence did not appear to be a determinant of

use because corporate people are literate and earn money. Therefore, they make decisions based on their judgment and do not care about others' opinions. However, the previous study found a social reference to be the most significant predictor of the acceptance of a PHC system by the rural people in Bangladesh [2]. Social influence has an insignificant effect on the intention to use, which is consistent with a past study [47]. Gender, education, and age do not influence the intention to use and use.

Service providers, policymakers, and implementers should attempt to enhance the positive factors among consumers and, in particular, should focus on the benefits of using a PHC system. When individuals perceive the benefits of using a PHC system, they want to use it.

For policy recommendations, perceived usefulness is determined as the most important predictor of use behavior. In other words, providing an opportunity to use a PHC system, for example, could promote the perception of its usefulness. Health awareness should also be a focus. Therefore, enhancing health awareness among people through social media, television, word of mouth, and different programs is necessary to promote the use of eHealth technology for regular health checkups.

However, finally, I can conclude with a table (**Table 3.6**) which demonstrates what has been solved and what are unsolved. How much we contributed and what is remained as a future work are also presented as a total picture of consumer behavior needs to be understood.

Table 3.6: Summarization of the existing problems to determine consumer behavior

What is required to know to explain a consumer behavior	What has been done so far	What this study has added	What is remained
• How consumers think, feel, and react towards a product or service in different situations • How the consumers are influenced by their environment and surroundings • Understanding and creating the conditions under which a product or service will be grasped by consumer • There are four categories of factors that can affect consumers' usage of any new product or service - (1) demographic factors (2) socio-economic factors (3) cultural factors, and (4) psychological factors • Significant influencing factors	• Among the 4 categories of factors till now influence of (1) demographic factors (2) socio-economic factors, and (4) psychological factors have been added in this study • Significant influencing factors of the use behavior of PHC has been identified	• 11 variables • Health awareness factor newly • Modified eHealth acceptance model • Urban corporate people • R^2= 72%	• Cultural factor • Additional factors (e.g. work stress, trust in a eHealth system and facilitating conditions) can be added • Longitudinal study • Other geographic areas

Chapter 4
Prediction of Health Parameters by Machine Learning

Abstract

This chapter describes a blood uric acid prediction model through machine learning algorithm. Uric acid is associated with Non-communicable diseases (NCDs), such as cardiovascular diseases, chronic kidney disease, coronary artery disease, stroke, diabetes, metabolic syndrome, vascular dementia, and hypertension. Therefore, uric acid is considered to be a risk factor for the development of NCDs. Most studies on uric acid have been performed in developed countries. To our knowledge, the application of machine learning approaches in uric acid prediction in developing countries is rare. Different ML algorithms will work differently on different types of data in various diseases such as cancers, diabetes, therefore, a different investigation is needed for different types of data in order to identify the most accurate algorithms. Specifically, yet, no study focused on the urban corporate people in Bangladesh, though they are more likely to develop NCDs. The aim of this study is to use machine learning approaches to predict blood uric acid based on basic health checkup test results, dietary information, and socio-demographic characteristics. The prediction of health checkup test measurements is very helpful to reduce health management costs. This study used machine learning approaches because clinical input data are not completely independent and complex interactions exist between them. Conventional statistical models have limitations to consider these complex interactions, but ML can consider all possible interactions between input data. This study used several machine learning approaches such as Boosted Decision Tree Regression, Decision Forest Regression, Bayesian Linear Regression, and Linear Regression to predict personalized blood uric acid based on basic health check-up test results, dietary information, and socio-demographic characteristics. We evaluated the performance of these five widely used machine learning models. Data have been collected from 271 employees, who work in the Grameen Bank complex, Dhaka, Bangladesh. The mean of uric acid measurement was 6.63 mg/dL. That means the uric acid of most of the people is on the borderline (6.63 whereas the normal range <7.0 mg/dL). Therefore, they need to check uric acid regularly. The Boosted Decision Tree Regression model showed the best performance among other models based on the Root Mean Squared Error (RMSE) 0.03, this RMSE is better than any reported in the literature. This study developed a uric acid prediction model based on personal characteristics, dietary information and some basic health checkup measurements. Such a uric acid prediction model is useful for improving awareness among high-risk subjects. By predicting uric acid, this study can help to save medical costs. A future study could include additional features (e.g. work stress, everyday physical activity, alcohol intake, eating red meat).

Keywords: blood uric acid; urban corporate people; machine learning; non-communicable diseases (NCDs); Bangladesh; Boosted Decision Tree Regression model

4.1. Introduction

Non-communicable diseases (NCDs) such as cancer, diabetes, stroke, and cardiovascular diseases are the leading cause of death, disability, and morbidity worldwide. Surprisingly, the burden is high in developing countries, which bear 80% of death due to NCDs [76]. In developing countries, 29% of NCD-related deaths occurred in the working-age group people (aged <60 years) [77]. Therefore, NCDs have become a big concern for developing countries and have recognized as a threat for young people too [78]. Thus, reducing NCDs is one of the targets of the Sustainable Development Goals (SDGs) [79].

Uric acid is associated with Non-communicable diseases (NCDs) such as cardiovascular diseases and cardiovascular diseases risk factors including chronic kidney disease, coronary artery disease, stroke, diabetes, metabolic syndrome, vascular dementia, and hypertension [80],

[81]. It is known as one of the predictors of various chronic diseases [82]. Hypertension showed positive correlations with the uric acid levels among arsenic-endemic individuals in Bangladesh [83]. A study found significant associations between uric acid and BMI, overweight, and waist circumference among the adult population in Bangladesh [84].

People who are working in urban areas, especially in private sectors have significant workloads and remain seated for a long time to complete their tasks, they are more likely to develop NCDs. Besides, little chance exists to engage in physical activities among the urban people in Bangladesh because of a lack of playgrounds, parks, walkable footpaths, and safe roads for cycling [37]. The prevalence of risk factors for developing NCDs is also higher among urban than rural people in Bangladesh [37]. Therefore, it is important to control and prevent the seriousness of NCDs by getting regular health checkups. However, most people are not interested in spending money and time on preventive healthcare services. Corporate people in Bangladesh lack health insurance and high health awareness, do not get routine mandatory health checkups, and are not habituated to use ICT-based healthcare services. Moreover, to get a checkup, they need to visit a hospital in traffic-congested areas and wait in a long, laborious queue [75].

The health status of an individual depends on uric acid and it is considered to be a risk factor for the development of NCDs [82], [85]. Therefore, uric acid should be measured routinely at basic health check-ups. Because its prediction could be very helpful in preventing various NCDs. As the reduction of NCDs management cost is the main goal of health policy [15], studies are needed to determine the blood uric acid regularly in a cost-effective way. An accurate predictive model can help to identify a risky population [86]. By using the prediction model designed by the machine learning approaches to test individual uric acid measurement rapidly will save the cost and time of doctors and patients as well.

First, to our knowledge application of machine learning approaches in uric acid prediction in developing countries are very rare. That is why uric acid is chosen for this research. Second, different algorithms will work differently on different types of data in various diseases such as different types of cancers, diabetes, therefore, a different investigation is needed for different types of data in order to identify the most accurate algorithms [87].

The machine learning methods have not been practically established for clinical data from developing countries such as Bangladesh. There is a lack of research on predicting blood uric acid based on basic clinical tests, dietary information, and socio-demographic characteristics by using machine learning approaches in Bangladesh. Specifically, yet, no study focused on the urban corporate people in Bangladesh.

Therefore, this study aims to use machine learning approaches to predict blood uric acid based on basic health checkup test results, dietary information, and socio-demographic characteristics. This study used several machine learning approaches to evaluate the predictive power of these techniques and to predict personalized uric acid measurement. The goal of predicting health checkup test measurements is very helpful to reduce health management costs.

4.2. Existing related studies

During the past few decades, the prevalence of hyperuricemia among people is increasing rapidly all over the world [84]. Like developed countries, hyperuricemia is prevalent in developing countries too [88], [89]. Purine enriched diet, obesity, and alcohol intake are reported as the predictors of hyperuricemia [90]–[92]. Approximately two-thirds of the uric acid derived from the metabolism of endogenous purine, and the remaining as a result of eating purine enriched foods [84], [93], [94]. Many former studies found relationships between uric acid and hypertension. For example, Increasing levels of serum uric acid are associated with hypertension [80]. Serum uric acid was positively associated with incident hypertension [95]. Serum uric acid was found associated with the development of hypertension [96]. A number of techniques have been proposed by different studies for the survivability analysis of various cancers [97]. The results of machine learning algorithms may change due to different databases and for different measuring tools [98]. One previous study predicted lung cancer survival time by using supervised machine learning regression predictive techniques though the root mean squared error (RMSE) value for each model was large, more than 15.30 and it was unclear which predictive model would yield more predictive information for lung cancer survival time [99]. One former study predicted hyperuricemia based on basic health checkup tests by using machine learning classification algorithms in Korea with a poor accuracy [82]. By targeting the prediction like a continuous target, rather than a classification into categories or levels, could help to improve such predictions. Further, to make the prediction more accurate, we need to incorporate more new features than traditionally used [100].

Most of the previous studies on uric acid have been conducted in selected white populations of North America and Europe or entirely black populations from South Africa [88]. Most of the previous machine learning-based researches in healthcare was conducted in developed countries [101]. However, the application of supervised machine learning in medical data to predict diseases, survivability of diseases, different types of health checkup test results by using sample data from Bangladesh is very little.

4.3. Methods

This study used machine learning (ML) approaches because clinical input data are not completely independent and complex interactions exist between them. Conventional statistical models have limitations to consider these complex interactions, but ML can consider all possible interactions between input data. Machine learning prediction models can incorporate all the input variables with marginal effect and variables with unknown associations with the targeted outcome variable. Through machine learning prediction models, we incorporated both well-known risk factors of high uric acid such as age, BMI, blood glucose, etc. and factors without clear associations to it as well [82]. Machine learning algorithms are used to identify patterns in datasets and to iteratively improve in performing this identification with additional data [102]. Machine learning algorithms have extensively used in various domains such as advertisement, agriculture, banking, online shopping, insurance, finance, social media, travel, tourism, marketing, consumer behavior, and fraud detection. It is also used to analyze current and historical facts to make predictions about future events. In the healthcare field, machine learning is used in the prevention, diagnosis, and treatment phases [103].

4.3.1. Sample

Data have been collected from the employees who work in the Grameen bank complex, Dhaka, Bangladesh. The Grameen Bank Complex holds 18 different institutions, such as Grameen Bank, Grameen Communications, other non-government organizations, and private companies, with more than 500 workers. The researchers have collected data from 271 employees (n=271) to predict blood uric acid. For machine learning approaches we normally expect a big sample size. However, some studies used a small sample size, e. g 300 [100] and 118 [104]. It is to be mentioned here that sometimes a small sample size is associated with higher classification accuracy [105].

Grameen Communications, Bangladesh, and Kyushu University, Japan, have jointly developed a human-assisted Portable Health Clinic (PHC) system [11]. A PHC is an eHealth system that aims to provide affordable primary healthcare services to prevent severity or to control non-communicable diseases (NCDs). A PHC system has four modules: (a) a set of medical devices, (b) a software system to collect and archive medical records, (c) healthcare workers to make the clinical measurements and explain ePrescriptions, and (d) ICT-trained call center doctors. Consumers come to the service point, and a health checkup is conducted by pre-trained healthcare workers. If needed, the consumer is connected to the call center doctors for a consultancy. The clinical measurements addressed by a PHC are as follows: (1) blood pressure, (2) pulse rate, (3) body temperature, (4) oxygenation of blood (SpO2), (5) arrhythmia,

(6) body mass index (BMI), (7) waist, hip, and W/H ratio, (8) blood glucose, (9) blood cholesterol, (10) blood hemoglobin, (11) blood uric acid, (12) blood grouping, (13) urinary sugar, and (14) urinary protein.

The test items included (except arrhythmia, blood cholesterol, blood hemoglobin, blood grouping, urinary sugar, and urinary protein because there were many missing cases in these measurements) in this PHC system were used as input factors in this study except for the uric acid measurement which is set as an output factor.

4.3.2. Measurements

Clinical measurements are obtained through direct diagnosis using PHC instruments operated by well-trained nurses or healthcare professionals. Data on dietary information and socio-demographic characteristics were collected during interviews by using a standard questionnaire.

4.3.3. Regression predictive modeling

As the targeted output variable of this study is a continuous variable, the regression predictive model will be applied, and our objective is to predict the value of the uric acid of an individual. Within multiple types of regression predictive models, it is important to choose the best-suited models based on the type of independent and dependent variables, dimensionality in the data, and other essential characteristics of the data. We selected several methods that performed better. In a nutshell, it states that no specific algorithm works best for every problem, and it's especially relevant for machine learning (i.e. predictive modeling). For example, we can't say that neural networks are always better than decision trees or vice-versa. There are many factors at play, such as the size and structure of the dataset. Therefore, this study used several machine learning approaches such as Boosted Decision Tree Regression, Decision Forest Regression, Neural Network, Bayesian Linear Regression, and Linear Regression to predict personalized blood uric acid value based on basic health check-up test results, dietary information, and socio-demographic characteristics. We choose these five specific machine learning algorithms because they are very popular to predict clinical data and they are widely used regression predictive models. These five models are also traditional machine learning models, which perform well for regression tasks [99]. Existing studies also applied these models [106].

Because a regression predictive model predicts a quantity, the skill of the model must be reported as an error in those predictions. There are many evaluation criteria to estimate the

performance of a regression predictive model, but the most common is to calculate the root mean squared error (RMSE).

These five models were chosen for comparison in this study due to their popularity in the medical data prediction. This study has chosen these algorithms to see if the prediction accuracy can be further improved. Details of each model are described below:

4.3.3.1 Linear regression

Linear regression is one of the most well-known and well-understood algorithms in statistics and machine learning. It is a fast yet simple algorithm to try. It is suitable for continuous dependent variables and can be fitted with a linear function (straight line). Linear regression models have been applied to predict medical data [107]. Linear Regression is a very simple machine learning method in which each data point consists of a pair of vectors: the input vector and the output vector. It is the simplest, oldest, and most commonly used correlational method. This method fits a straight line to a set of data points using a series of coefficients multiplied to each input, like a weighting function, and an intercept. The weights are decided within the linear regression function in a way to minimize the mean error. These weight coefficients multiplied by the respective inputs, plus an intercept, give a general function for the outcome, uric acid measurement. Thus, linear regression is easy to understand and quick to implement, even on larger datasets. The disadvantage of this method is that it is inherently linear and does not always fit real-world data [99].

4.3.3.2. Boosted Decision Tree Regression

Gradient boosting methods are a family of powerful machine-learning methods that have shown considerable success in a wide range of practical applications [108]. This model is well suited for making predictions based on clinical data and also exhibits high performance on clinical data [86], [99], [109], [110]. Boosting is a popular machine learning ensemble method [111]. Boosting means that each tree is dependent on prior trees. The algorithm learns by fitting the residual of the trees that preceded it. Thus, boosting in a decision tree ensemble tends to improve accuracy with some small risk of less coverage. In Azure Machine Learning, boosted decision trees use an efficient implementation of the MART gradient boosting algorithm. Gradient boosting is a machine learning technique for regression problems. It builds each regression tree in a step-wise fashion, using a predefined loss function to measure the error in each step and correct for it in the next. Thus, the prediction model is an ensemble of weaker prediction models. In regression problems, boosting builds a series of trees in a step-wise fashion, and then selects the optimal tree using an arbitrary differentiable loss function [112].

Like Random Forest it uses many smaller, weaker models and brings them together into a final summed prediction. However, the idea of boosting is to add new models to the ensemble in a sequence for a number of sequences. In each iteration, a new weak model is trained with respect to the whole ensemble learned up to that new model. These new models, iteratively produced, are built to be maximally correlated with the negative gradient of the loss function that is also associated with the ensemble as a whole. In this approach, a performance function is placed on the GBM in order to find the point at which adding more iterations becomes negligible in benefit, i.e. adding more simple models, in this case, Decision Trees no longer reduces the error by a significant margin. It is at this point that the ensemble sums all of the predictions into a final overall prediction [99].

4.3.3.3. Neural Network

Applying a neural network to the problem can provide much more prediction power compared to a traditional regression. Neural networks (NNs) have the highest accuracy in predicting different issues such as heart attack and heart diseases [113], [114]. It is a widely used machine learning algorithm. The Neural Network is a network of connected neurons. The neurons cannot operate without other neurons, with whom they are connected. Usually, they are grouped in layers and process data in each layer and pass forward to the next layers. The last layer of neurons is making decisions. The basic neural network, which is also known as multi-layer perceptron (MLP), is used for comparison with 1 hidden layer of 500 neurons, which is a reasonable number in neural network-based approaches [115].

4.3.3.4. Decision Forest Regression

Decision forest or Random Forest (RF) has been employed in many biomedicine research [116]–[118]. In the regression problem, the decision forest output is the average value of the output of all decision trees [118]–[120]. Decision forests compare favorably concerning other techniques [121]. This regression model consists of an ensemble of *decision* trees. A collection of trees constitutes a forest. Each tree in a *regression decision forest* outputs a Gaussian distribution as a prediction. Aggregation is performed over the ensemble of trees to find a Gaussian distribution closest to the combined distribution for all trees in the model [122]. This technique generates a number of decision trees during training which is allowed to split randomly from a seed point. This results in a "forest" of randomly generated decision trees whose outcomes are ensembled by the Random Forest Algorithm to predict more accurately than a single tree does alone. One problem with a single decision tree is overfitting, making the predictions seem very good on the training data, but unreliable in future predictions [99]. By using decision forest regression, we can train a model with a relatively small number of samples

and get good results.

4.3.3.5. Bayesian Linear Regression

Bayesian Linear Regression is the Bayesian approach to linear regression analysis. Bayesian regression methods are very powerful, as they not only provide us with point estimates of regression parameters but also deliver an entire distribution over these parameters. In recent years, Bayesian learning has been widely adopted and even proven to be more powerful than other machine learning techniques. Bayesian linear regression allows a fairly natural mechanism to survive insufficient data or poorly distributed data. It allows putting a prior on the coefficients and on the noise so that in the absence of data, the priors can take over. Bayesian linear regression provides us information about which parts of it fit confidently to the data, and which parts are very uncertain. The result of Bayesian linear regression is a distribution of possible model parameters based on the data and the prior. This allows us to quantify uncertainty about the model, if we have fewer data points, the posterior distribution will be more spread out.

In this study, we have used five machine learning algorithms. These regression algorithms have been used in existing studies to predict lung cancer, diabetes, heart attack, heart diseases, breast cancer, etc. issues. Therefore, we have considered the above five regression algorithms best suited for our study.

This study used the Azure machine learning platform, a cloud-based computing platform that allows us to build, test, and deploy predictive analytics solutions [123] to estimate five machine learning algorithms that are widely used to predict medical data.

For evaluating the performance of the models, root mean squared error (RMSE) values from each model were used. The RMSE of a model is the average distance between the model's prediction and the actual outcome [99]. To examine the prediction performance of continuous dependent variables through the regression predictive technique by using machine learning algorithms, the prime evaluation criteria is the root mean squared error (RMSE) [106], [124].

Therefore, as we are predicting the continuous value of blood uric acid, we used the regression predictive technique and evaluated the performance of models by using the RMSE. Like classification the regression task is inductive, with the main difference being the continuous nature of the output [122].

Each model was trained on a 70% training sample to ensure each model was trained uniformly. We split data according to training set ratio =0.7, test set ratio=0.3. We did not use the Cross-Validation method because K-fold Cross-Validation (CV) produces strongly biased performance estimates with small sample sizes [105].

In many studies, researchers often used two validation methods, namely hold-out method, and k-fold cross-validation method, to evaluate the capability of the model. According to the goal of each problem and the size of the data, we can choose different methods to solve the problem. In the hold-out method which is one of the popular validation methods, the dataset is divided into two parts, training set, and test set. The training set is different from the test set. The training set is used to train the machine learning algorithm and the test set is used to evaluate the model [118], [125]. The hold-out method involves portioning the datasets into non-overlapping subsets, where the first subset is entirely used for training and the rest for testing [126]. Instead of k-fold cross-validation, a holdout method is often used [127]–[129]. When given no testing sample independent of the training sample, one can randomly select and holds out a portion of the training sample for testing and constructs a prediction with only the remaining sample. Often one-third of the training sample is set aside for testing and 70% for the training step [130]–[132].

In this study, the hold-out method is used to evaluate the proposed model because it is more suitable for small sample sizes[133], [134]. It is randomly used in most of the machine learning platforms including Azure machine learning studio, a cloud-based computing platform that allows us to build, test, and deploy predictive analytics solutions [123] which we have used in our study. A random train- test split method is the recommended dataset split method tested by the study and ML models in general yield more accurate results when trained with a greater amount of data points (70%:30%) [135]. Many previous studies were also applied 70%:30% random train-test split method from similar fields as ours[135]–[137].

It is common practice to split the data into 70% as training and 30% as testing set. This splitting ratio is large enough to yield statistically meaningful results. Train/Test split is a simple and reliable validation approach. A portion of the data was split before any model development steps and it was used only once to validate the developed model [105].

The data were randomly split into 70% for training the model and 30% for validation. The process was repeated 50 times (iteration) to report performance measures and relevant confidence intervals. For a small dataset like ours, 50 times iteration is enough. Therefore, we used 50 times iteration.

Random split train -test method is the recommended dataset split method tested by the study and ML models in general yield more accurate results when trained with a greater amount of data points (70%:30%) [135]. Other studies were also applied 70%:30% random split train-test method[135]–[137].

The IPO (input-process-output) model for predicting blood uric acid based on socio-demographic characteristics, dietary information, and some basic health checkup test results is shown in **Figure 4.1**.

4.3.4. Ethical approval

The authors obtained ethical approval from the National Research Ethics Committee

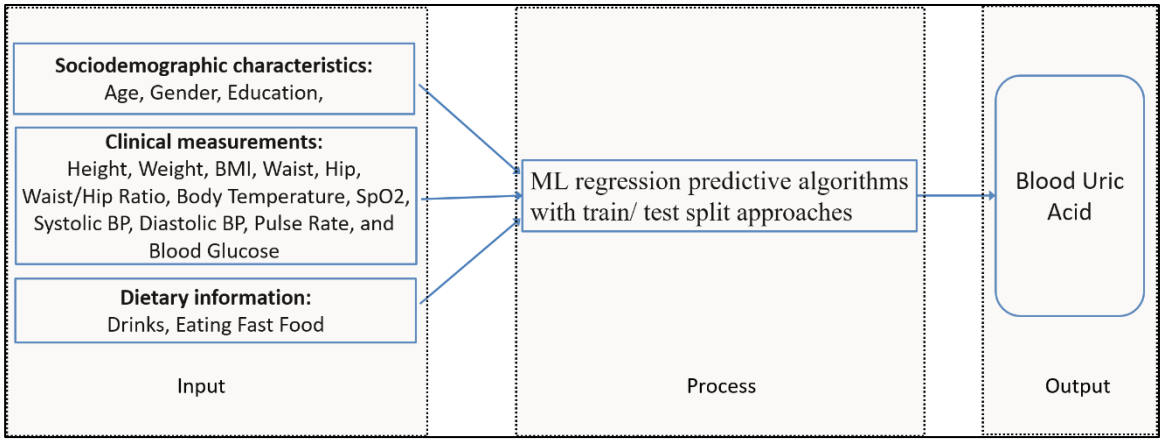


Figure 4.1: The IPO model used for predicting of uric acid after processing 17 inputs by ML algorithms

(NREC) of the Bangladesh Medical Research Council with approval no. 18325022019.

4.4. Results

4.4.1. Description of the study population

Data from a total of 271 employees of Grameen bank complex were collected during the health checkup provided by PHC service. Descriptive statistics were used to describe the baseline characteristics of the participants. The descriptive statistics of the participants are shown in **Table 4.1**.

Table 4.1: Summary statistics of the selected continuous predictors (n = 271)

Number	Variables	Minimum	Maximum	Mean	Std. Deviation
1	Age	34	77	49.61	7.39
2	Height (cm)	140.00	184.00	163.05	7.45
3	Weight (kg)	44.20	114.40	67.52	10.06
4	BMI (kg/m2)	18.39	40.53	25.37	3.20
5	Waist (cm)	63.60	118.00	90.24	7.80
6	Hip (cm)	80.00	127.00	94.54	6.29
7	Waist/Hip Ratio	0.64	1.11	0.96	0.06
8	Body Temperature (° F)	92.12	99.64	96.07	1.15
9	SpO2	93	99	97.67	1.17
10	Systolic BP (mmHg)	92	180	126.68	14.88
11	Diastolic BP (mmHg)	59	108	81.71	8.43
12	Pulse Rate (bpm)	51	123	80.27	11.66
13	Blood uric acid	3.10	11.00	6.63	1.54
14	Blood Glucose (mg/dL)	66.60	392.40	128.02	56.92

The mean age of participants is 49.61, most of the participants are of aged 50 years. According to BMI most of the respondents have BMI =25.37 i.e., most of them are overweight. Because of the range of BMI defined by WHO from 25 – 29.9 as overweight. The uric acid of most of the people is on the borderline (6.63 whereas the normal range <7.0 mg/dL [85]). Therefore, they need to check uric acid regularly.

Table 4.2: Summary statistics of the selected categorical predictors

No.	Categorical variables	Description	Categories/Levels	Frequency	%
1	Gender	Gender of the participant	Male = 1;	225	83.0
			female = 0	46	17.0
2	Education	Education completed by the participant	1 = No education (no school entered);	10	3.7
			2 = Primary school completed;	30	11.1
			3 = Secondary school completed;	11	4.1
			4 = High school completed;	23	8.5
			5 = Vocation school completed;	1	0.4
			6 = College/University completed;	63	23.2
			7 = Higher (Master or Doctor) completed	133	49.1
3	Drinks	Drinking sugar contained drinks (Coke, Fanta, Soda, Fruit Juice, other Sweet/Sugar contained drinks) three or more times a week	Yes=2;	26	9.6
			No=1	245	90.4
4	Eating fast foods	Eating fast foods such as Pizza, Hamburger, Deep Fried Foods (e.g. Singara, Samosa, Moglai Parata, etc.) three or more time a week	Yes=2;	49	18.1
			No=1	222	81.9

83% of respondents are male and most of them have completed College/ University degree. Among 271 respondents 9.6 % reported that they drink sugar contained drinks (Coke, Fanta, Soda, Fruit Juice) three or more times a week and 18.1% reported that they eat fast foods (Pizza, Hamburger, and Deep-fried Foods) three or more time a week.

4.4.2. Prediction performance assessment

To examine the prediction performance of the regression predictive technique by using Ml, the main evaluation criteria used, the root mean squared error (RMSE). The results are shown in **Table 4.3**. The Boosted Decision Tree Regression model showed the best performance among other models.

Table 4.3: Comparison of modeling techniques ranked from best to worst based on RMSE

Model name	Root Mean Squared Error (RMSE)	Mean absolute error (MAE)	Coefficient of determination (R^2)
Neural Network	1.46	1.13	0.04
Decision Forest regression	0.75	0.53	0.75
Linear Regression	1.36	1.06	0.17
Boosted Decision Tree Regression	0.03	0.01	0.99
Bayesian Linear Regression	1.37	1.06	0.16

Note: The Mean Absolute Error (or MAE) is the sum of the absolute differences between predictions and actual values. On the other hand, Root Mean Squared Error (or RMSE) measures the average magnitude of the error by taking the square root of the average of squared differences between prediction and actual observation. That means, it indicates how close the predicted value is to the actual vale. There isn't a cutoff or benchmark in RMSE value. The smaller the value, the better the prediction.

The Boosted Decision Tree Regression is the best predictive model in terms of RMSE in comparison to other models. The Boosted Decision Tree Workflow chart and the partial view of the score model obtained by using the Boosted Decision Tree Regression model are shown in **Figure 4.2** and **Figure 4.3**, respectively.

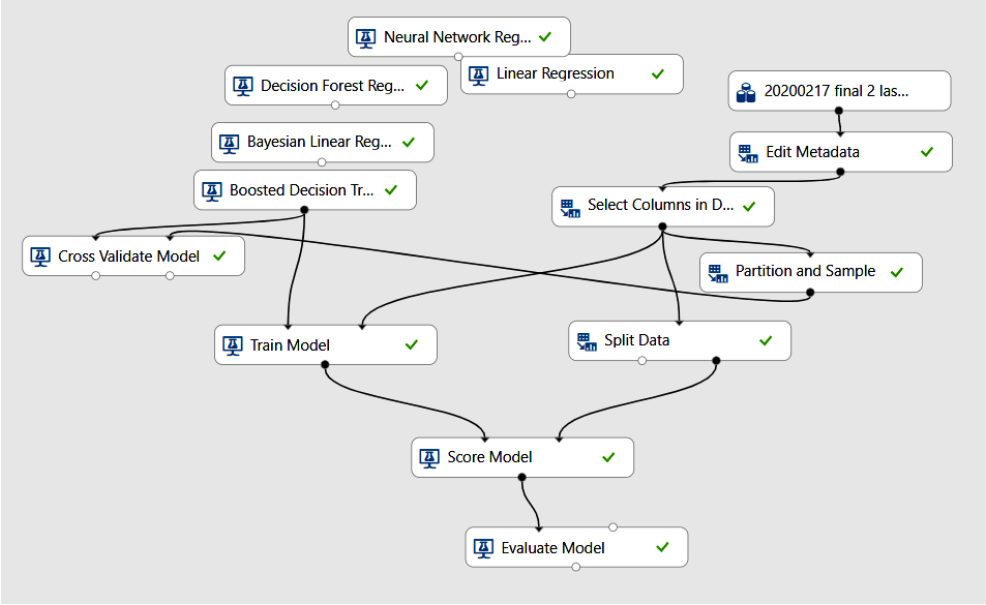


Figure 4.2: Boosted Decision Tree Workflow chart

Score model represents the predicted value of the output or predicting variable. For regression models, the score model generates just the predicted numeric value". Visualizing the Score model module, the result looks like **Figure 4.3**. Scored Labels is the result column in this scoring result. The numbers are the predicted blood uric acid value for each individual.

BodyTemperature	SpO2	BloodPressuresys	BloodPressuredia	PulseRate	Blooduricacid	Bglucose	DrinksC	FastfoodC	Scored Labels
96.62	97	131	88	81	8.1	169.2	1	2	8.07499
96.26	98	126	88	91	7.5	90	1	1	7.488424
94.1	99	140	87	76	5.2	180	1	1	5.199734
96.62	99	124	82	68	6.1	163.8	1	2	6.123245
96.62	96	150	95	93	7.5	108	1	1	7.484407
92.48	99	129	84	78	7.1	151.2	1	1	7.108648
95.36	99	155	86	54	5.7	66.6	1	1	5.704509
98.24	96	129	84	105	6.3	131.4	1	1	6.29644
96.44	99	114	78	91	4.9	226.8	1	2	4.814224
95.54	97	119	71	80	6.3	117	1	1	6.296839

Figure 4.3: Partial view of the score model obtained by the Boosted Decision Tree Regression

4.5. Discussion

Machine learning algorithms can identify the pattern in a dataset that may not be apparent directly. Thus, machine learning can provide useful information and support to the medical staff by identifying patterns that may not be readily apparent [98]. There are several advantages of choosing Machine learning algorithms over conventional statistical methods for designing a

prediction model. 1) ML algorithm can handle noisy information 2) they can model complex, nonlinear, relationships between variables without prior knowledge of a model [138]. Therefore, it is possible to include all information from the dataset during the analysis [82]. Finally, ML can consider all potential interactions between input variables whereas conventional statistical analysis assumed that the input variables are independent [139], though, in real-world many input variables are inter-related in complex ways, whether these ways are known or not. Machine learning algorithms can be used to identify high-risk individual cases and can help medical staff for clinical assessment [139].

Machine learning uses techniques that enable machines to use the experience to improve at tasks. Through machine learning, data feed into an algorithm or model, use this data to train and test a model. Then the model is deployed to do an automated rapid predictive task or to receive the predictions returned by the model. In many clinical studies**,** Gradient boosting machine learning algorithm has been successfully used to predict cardiovascular diseases [86]. The gradient boosting decision tree (GBDT) method by Friedman [140] predicted BMI with accuracy 0.91 [110]. In the current study boosted decision tree regression is found as the best predictive model followed by decision forest regression. Both of these are popular ensemble learning methods.

In this study, a prediction model was designed for improving uric acid prediction by including not only well-known relevant factors of high uric acid, such as age, gender, BMI, but also factors with unknown associations with it. The test items used in PHC service were used as input factors except for the uric acid which is set as an output factor. This study developed a mechanism to predict uric acid with RMSE, 0.03, this RMSE is better than any reported in the literature. Results can provide useful insights for understanding the observed trend in population health and to inform future strategic decision-making for improved health outcomes. By using the prediction model designed by the machine learning approach to test individual uric acid will save the cost and time of doctors and patients as well.

The comparison of the results found from this study to those in previous related works is very important. Most of the previous studies reported performance measurements as a function of classification accuracy, which may not be directly compared to this study with a regression approach to build a predictive model for the continuous variable (uric acid measure).

In contrast to previous uric acid prediction study that predicted uric acid level based on health checkup data archived in a hospital in Korea. The data was collected by using laboratory quality expensive devices from a very specific group of people who participated in an expensive, self-paid comprehensive health checkup program. The data was collected from 38,001 people,

the prediction sensitivity was 0.73 and 0.66 by using the NBC (naive Bayes classification) and RFC (random forest classification) classification prediction models respectively. They used a total of 25 variables available in their database [82].

The current study developed a uric acid prediction model by using machine learning approaches and including personal characteristics, dietary information, and basic clinical measurements. The data that we used in this paper was collected by using portable and cheap devices. Health records of 271 employees, age 34-77 years, male (83%), female (17%) have been collected. We found that uric acid can be predicted with 0.03 RMSE value. Among the five machine learning algorithms, Boosted Decision Tree Regression was found as the most effective one.

4.6. Contribution

This is the first study of predicting laboratory test results of health measurements or health checkup items in Bangladesh. The current study developed a blood uric acid prediction model based on personal characteristics, dietary information, and some basic health checkup test results. It empirically compared five machine learning algorithms: Boosted Decision Tree Regression, Decision Forest Regression, Bayesian Linear Regression, and Linear Regression to predict blood uric acid. This study predicts uric acid based on health checkup data by semi experts with affordable, cheap, portable indicative devices and we found RMSE value was very low, 0.03, which is better than any reported in the literature and was smaller than the previous study [102].

If we can determine uric acid by using the developed ML prediction model, healthcare workers of PHC service do not need to carry the uric acid measuring instruments. The findings can be helpful in achieving SDGs, Universal Health Coverage and thus reducing overall morbidity and mortality. By using the prediction model designed by the machine learning approaches to measure individual blood uric acid will save the cost and time of doctors and patients as well. This prediction model can also be applied to other institutions.

4.7. Conclusion and future works

This study provides a measure in reducing NCDs and hence can be a good component in the concerned national or global plan. We developed a uric acid prediction model based on personal characteristics, dietary information, and some basic clinical measurements related to NCDs. Such a uric acid prediction model is useful for improving awareness among high-risk subjects. The uric acid prediction model can help to provide health services on early detection

and cost-effective management of non-communicable diseases. There are a few limitations in this study. First, the sample size we studied needs to be enlarged for training the prediction model in the future. Second, this study is limited to a particular area among a group of employees who work in a corporate setting. Our prediction model is not confirmed on the data from other institutes. Although the framework achieves high performance on Grameen bank complex data, we believe this model will also fit for predicting uric acid on other corporate people. This study selected validated key features by previous studies rather than using statistical approaches to identify the significant influence of factors on the output variable by using the data. A future study could also include additional features (e.g. work stress, everyday physical activity, eating red meat). This study evaluated only five machine learning algorithms among many other algorithms. We also applied only a random split method (Train/Test Split method) though cross-validation is a good method for training and testing the data set. However, in this study, we didn't consider applying the cross-validation method due to the small dataset. So further study can be considered with extended sample size and cross-validation method. We conclude that this study served as a successful case to open discussions on further applications of this combined approach to wider regions and various health check-up measurements.

Chapter 5
Modification of PHC to Tackle COVID-19 Pandemic Situation

Abstract

This chapter describes a way to redesign the portable health clinic platform as a remote healthcare system to tackle COVID-19 pandemic situation in unreached communities. Medical staffs carry an inordinate risk of infection from patients and many doctors, nurses, and other healthcare workers are affected by COVID-19 worldwide. The unreached communities with non-communicable diseases (NCDs) such as chronic cardiovascular, respiratory, endocrine, digestive, or renal diseases became more vulnerable during this pandemic situation. In both cases, Remote Healthcare Systems (RHS) may help minimize the risk of SARS-CoV-2 transmission. This study used the WHO guidelines and Design Science Research (DSR) framework to redesign the Portable Health Clinic (PHC), an RHS, for the containment of the spread of COVID-19 as well as proposed corona logic (C-Logic) for the main symptoms of COVID-19. Using the distributed service platform of PHC, a trained healthcare worker with appropriate testing kits, can screen high-risk individuals, and help optimize triage to medical services. PHC with its new triage algorithm (C-Logic) classifies the patients whether the patient needs to move to a clinic for a PCR test or not. Through modified PHC service, we can help people to boost their knowledge, attitude (feelings/beliefs), and self-efficacy to execute preventing measures. Our initial examination of the suitability of the PHC and its associated technologies as a key contributor to public health responses designed to " flatten the curve", particularly among unreached high-risk NCD populations in developing countries. Theoretically, this study contributes to design science research by introducing a modified healthcare providing model.

Keywords: COVID-19; Unreached Communities; Developing countries; Portable Health Clinic; Remote Healthcare System

5.1. Introduction

Beginning in the end-2019, COVID-19 outbreak was declared a pandemic by WHO on March 11, 2020 [141], [142]. The main symptoms of COVID-19 are fever, cough, sore throat, and respiratory complications [143]. Respiratory infections can be transmitted through droplets of different sizes, and according to current evidence, COVID-19 virus is primarily transmitted between people through respiratory droplets (with a particle size of >5-10 μm) when a person comes in close contact (within 1 m) with someone who has respiratory symptoms [144], [145]. Moreover, other contact routes, such as the immediate environment around the infected person may also cause the transmission of the virus [146]. In the case of cluster pneumonia of unknown etiology, health workers are recommended droplet and contact precautions when caring for patients, and airborne precautions for aerosol-generating procedures conducted by health workers [147].

SARS-CoV-2 became pandemic virus due to a multitude of factors such as the early spread of the virus by asymptomatic carriers, uncontrolled social behaviors, and insufficient personal protective equipment (PPE) and both the advanced and developing medical systems appear overwhelmed. Public health experts are working at relieving pressure on healthcare facilities so

resources can be focused on COVID-19 patients. The crisis is even more threatening for developing countries with large underserved populations. As cases multiply, governments, irrespective of developed and developing countries, restricted “non-essential” services by declaring a state of emergency, not due to the fear of contagion, but was a procedural protocol in order to contain the virus by mandating social distancing.

The Bangladesh government imposed a nationwide lockdown since March 26, 2020, to curb the spread of the novel coronavirus [148]. Bangladesh with its 165 million inhabitants and a density of 1,265 people per sq. km is in a great crisis as the outbreak could spread further. In Bangladesh, 70% of people live in rural areas where medical facilities are almost absent. Recently, the most serious problems in Bangladesh are the lack of personal protective equipment (PPE) for doctors, or its low quality, as well as too many people staying in close proximity, and sick people hiding their symptoms. The situation has become more vulnerable as there are an estimated 5.2 healthcare workers (doctors and nurses) available per 10,000 people [149]. As of June 13, 2020, at least 78,052 people have been infected [150] among which more than 11% are the healthcare workers [151].

Most private medical facilities in Bangladesh are turning away patients with other health issues amid the coronavirus outbreak even though the government has issued a circular threat of the annulment of their license to operate [152], [153]. This has deprived many non-COVID-19 patients of needed treatment resulting in death from cough, fever, breathing difficulties, and diarrhoea [154].

Older people and people with non-communicable diseases (NCDs) such as cardiovascular disease, diabetes, chronic respiratory disease, and cancer appear to be more vulnerable to becoming severely ill with the COVID-19. The COVID-19 mortality rate in China with the presence of one or more pre-existing NCDs conditions is represented in Table 1. It shows that almost every fatality is associated with pre-existing NCDs, while no pre-existing medical conditions had a case of a fatality rate of only 0.9%. Therefore, pre-existing NCDs related illnesses increase the risk of death. According to data from Italy, almost 99% of deaths from COVID-19 were related to pre-existing diseases, and of these, hypertension accounted for 75%. As such, the public health impact of COVID-19 will include a significant number of NCD-associated mortality.

Table 5.1: Death rates with pre-existing medical conditions in China [141]

Pre-existing conditions	Confirmed Death rates cases	All cases (suspected and asymptomatic) of COVID-19
Cardiovascular disease	13.2%	10.5%
Diabetes	9.2%	7.3%
Chronic respiratory disease	8.0%	6.3%
Hypertension	8.4%	6.0%
Cancer	7.6%	5.6%
No pre-existing conditions		0.9%

The control strategy of large-scale and prolonged lockdowns is bound to increase the morbidity risk for those living with NCDs even more. Disrupting regular exercise and monitoring check-ups and adding to mental stress may further undermine immune systems among such patients, and impact morbidity and mortality rates. Many researchers are focusing on the effect of COVID-19 on mental health [155], while there is growing public awareness of the association of NCDs with COVID-19 mortality rates, and hence, there is also the need to highlight the negative impact of uncontrolled NCDs among populations over the long-term.

Remote Healthcare Services (RHS) appear well-suited to this purpose, providing NCD patients in remote locations access to critical monitoring services without increasing risk of infection by visiting a hospital. Portable Health Clinic (PHC) service, which is an RHS has proven efficacy in providing necessary information and preventive measures for people without access to healthcare facilities [75], [156], [157]. PHC system has been developed in a preventive healthcare approach with a special focus on non-communicable diseases. It appears necessary to modify the strategy-of-use of the PHC to better respond to the healthcare management needs of NCD patients in an emergency created by the pandemic, particularly in developing countries. In a lockdown situation, this platform can be effectively used to control and manage patient triage, thus relieving pressure on hospitals and healthcare facilities.

Challenges of remote healthcare systems during an emergency like disasters, pandemics, etc. implies unique challenges to healthcare delivery [158]. In the context of developing countries, the scenario of using e-Health technology is completely different, especially for rural people who are typically low health-literate and are more at risk for NCDs. Nearly every one of the 205 countries affected by COVID-19 has instituted social distancing measures. Many, including Bangladesh, China, France, India, Italy, Korea, Pakistan, Singapore, Spain, Taiwan, and Thailand have enforced large-scale lockdowns to avoid spikes in cases and to buy time to set up appropriate responses. During such emergencies, RHS platforms assume even greater

relevance, especially for NCD patients who may be turned away from hospitals treating acute patients. The real challenge is providing primary care services to NCD patients within the context of social distancing. Leveraging the PHC and attendant of e-Health technologies, already successfully deployed in support of rural and remote patients, makes this challenge surmountable [159].

Some previous research already confirms the effectiveness of e-Health in emergency response situations, primarily for urban areas in developed countries. But healthcare planners agree on the need to monitor NCD patients in rural populations of developing countries in the pandemic situation [160]. However, some questions have remained unanswered:

- How to redesign RHS such as the PHC platform to achieve the goal more effectively in a pandemic situation like COVID-19?
- How to ensure coverage of underserved rural populations who have comparatively less access to healthcare facilities?
- How can the RHS platform like PHC be adapted to accommodate emergency response situations like COVID-19?

Therefore, this study tries to answer the above research questions and presents the process of designing and developing an RHS based on the general requirements to tackle communicable diseases for allowing both COVID-19 patients and non-patients in Bangladesh. No previous study to date has examined the scopes of designing and developing an RHS based on the general requirements to facilitate primary screening and triaging COVID-19 and primary healthcare services for preventing COVID-19 and controlling NCDs. However, such screening and triaging COVID-19 by an RHS is important for cost-effective check-ups and reducing the risk of transmission for unreached communities with various needs.

5.2. Evaluation of eHealth systems during emergency

Extensive research works are conducted only on the hospital information systems to construct the hospital management information system of infectious diseases. To improve the efficiency and level of infectious disease management of the hospital those researches investigate their risk factors, the rules of emergence, and the control measures for infectious disease management [161]–[163]. But a challenge during the pandemic in progress is to identify the determinants underpinning the spatial and temporal patterns of the epidemic for making preventive strategies by the decision-makers [164]. Along with these, health services for reducing transmission and triaging is also a necessity.

The provision of effective e-Health services likely enhances patients' own ability to manage their NCDs during the COVID-19 outbreak, especially in places where lack of sanitation or availability of PPE increases the risk of contagion. More importantly, e-Health solutions minimize direct contact between the public and healthcare providers and thus promote social distancing without affecting the strength of patient support [165]. Consultancy over video communications has become useful for the delivery of preventive and consultation services. Remote consultancy over the phone or video communication has already shown social, technical, and commercial benefits for the management of NCDs.

The important benefits of telemedicine for the health systems with respect to handling COVID-19, especially on monitoring, surveillance, and detection and the potential for machine learning and artificial intelligence, have been focused very well in many articles starting from one of the very first ones but an opinion from the patients' side is not reported well yet, though it is of importance to draw attention to the ongoing importance of patient involvement when it comes to urgent e-health solutions for COVID-19 [158], [166], [167]. During public health emergency like COVID-19 pandemic, the digital infrastructures remain intact, and doctors can still be in touch with patients but yet, no large-scale telemedicine services for monitoring acute and chronic patients' health status and allowing continuity of care have been considered in the highly affected countries like Italy [168].

With the importance of e-Health becoming formally recognized several governments are reinterpreting regulations to enable remote medical services by licensed practitioners. The governments are supplementing healthcare budgets to counter the impact of the pandemic, such as the Medicare Benefits Schedule [169], and Medicare in the United States expanding the coverage range for the test and treat of COVID-19 without subscribers' expense [170]. This allocation can support a range of e-Health services during the COVID-19 phase, enabling more people to receive healthcare at a significantly lower cost compared to hospital-centric services, including telehealth consultations with general practitioners and specialists. Doctors or nurses manning the e-Health service will be able to guide patients over video communication.

Healthcare systems have had to adapt rapidly to the evolving situation for three main reasons: firstly, there is a need to triage and treat large numbers of patients with respiratory illness [165]; secondly, there is a need to protect the healthcare workforce to ensure they can treat the sick [171], [172]; and thirdly we need to shield the elderly and most vulnerable from becoming infected [173].

5.3. Design Methodology

This study used the WHO guidelines to tackle COVID-19 as a theoretical basis of the designed service to satisfy the general requirements in the service, and also followed Information System Research (ISR) framework to involve the people in the service design and evaluation phase. The guidelines of WHO explains the key components of required healthcare services for COVID-19 disease. According to WHO guidelines [174]–[176], followings are the key components of required healthcare services for COVID-19 disease:

5.3.1. Primary screening and triage

WHO recommends screening and isolation of all patients with suspected COVID-19 at first of point of contact with the health care system, such as outpatients, emergency departments/clinics. Early detection of suspected patients allows for the timely initiation of appropriate prevention and control measures [174], [175].

5.3.2. Prevention and control (isolation and quarantine)

Isolation is a long-established containment response that is designed to prevent further transmission from an individual suspected of exposure to a contagious disease. Suspected infectious individuals not in immediate need of medical attention, maybe effectively quarantined at home, instead of a hospital. In pandemics, it is often impossible to accurately identify cases and carriers of the disease, and hence the closure of premises such as schools, markets, theatres, etc. are declared to physically limit further transmission.

5.3.3. Traceability and privacy

Physical contact, direct or indirect, is the most important channel for the transmission of infectious disease. Contact tracing involves identifying everyone who may have had exposure to an initial case and tracing it to all possible contacts. The privacy of the patients needs to be maintained to avoid any sort of discrimination to the patient or his/her family.

5.4. Results

5.4.1. Redesigned PHC for COVID-19

To design a useful information system based healthcare service based on the WHO guidelines, we resorted to following the directions and guidelines as proposed in Information System Research (ISR) framework [177].

Theorizing in design science research (DSR) is different than other types of science. It has two general modes of DSR activity and theorizing - (i) the interior mode: where theorizing is done to formulate a theory for design and action with prescriptive statement about the way to

design the artifact, (ii) the exterior mode: where analyzing, describing, and predicting are done on what happens to the artifacts in the external environment [177], [178]. We designed our PHC following the theories of the DSR framework. In PHC architecture, all artifacts or medical devices are organized following the prescriptive roles provided by WHO.

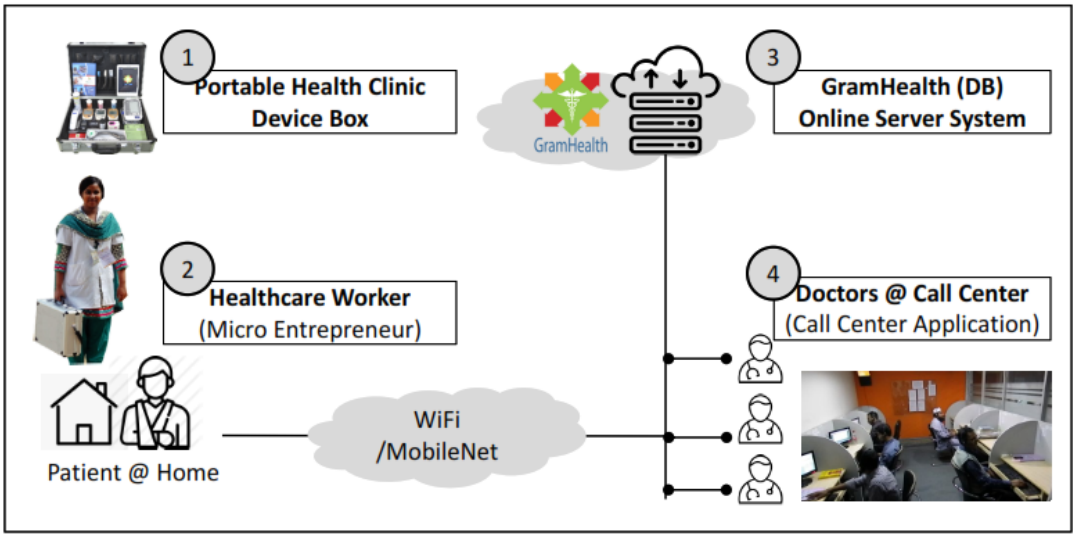


Figure 5.1: Portable Health Clinic (PHC) System Architecture

Portable Health Clinic (PHC) system (shown in **Figure 5.1**) has been developed as an RHS system for the unreached communities with a special focus on non-communicable diseases [179]. A health worker visits a patient with the PHC box to measure the vital information and upload the data with a medical history of the patient to an online server by using the GramHealth Client Application. The remote doctor gets access to this data and makes a video call to the patient for further verification. Finally, the doctor creates an online prescription and preserves it to the online server under each patient's profile. The health worker accesses the system prints the prescription from the server and passes it to the patient with detail explanation instantly. The whole process takes about 15 to 30 minutes per patient. The PHC system introduces a triage system to classify the subjects in four categories, namely, (i) Green or Healthy (ii) Yellow or Suspicious (iii) Orange or Affected and (iv) Red or Emergent, based on the gradual higher risk status of health. The subjects under Orange and Red who are primarily diagnosed as in the high-risk zone need a doctor's consultation.

PHC was initially designed to provide primary health screening services to the unreached community in remote areas. It is time to test its compatibility in emergencies to lessen the mortality and morbidity due to NCDs in developing countries. The prevalence of NCDs such as diabetes, blood pressure, chronic diseases may raise due to mental stress, fear, income loss, physical inactivity, more food consumption, during the lock-down situation at home. In the spread of COVID-19, people cannot go out for physical exercises such as morning or evening

walking, and neither can visit a hospital for NCDs during the lock-down situation.

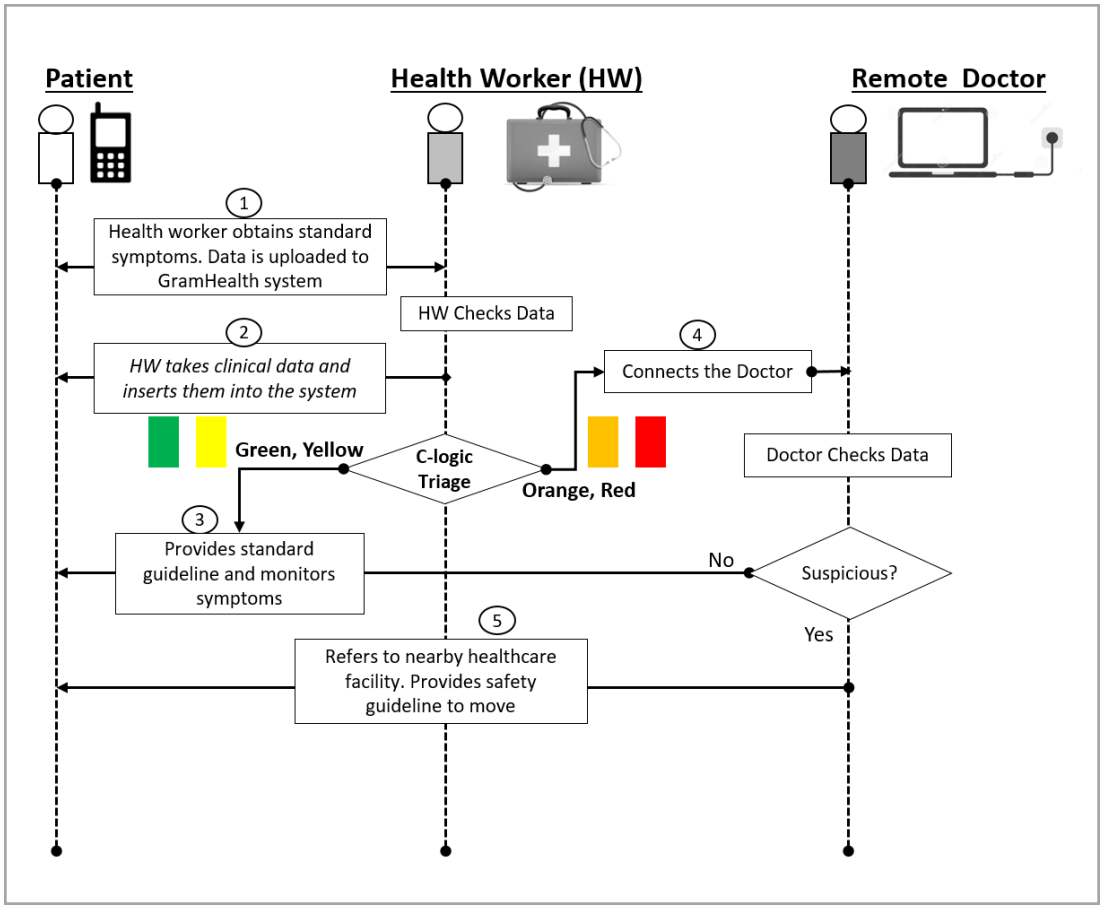


Figure 5.2: Primary Screening and Triaging COVID-19 potential patients by using Portable Health Clinic (PHC)

This PHC system is modified to be used for addressing communicable diseases like COVID-19. The steps are explained in **Figure 5.2**. At first, a potential patient can place a call to the nearby health worker. The health worker can ask questions as per the standard protocol. A patient with a smartphone can fill up a self-check form through the web which ultimately goes to the nearby community health worker. The health worker checks the data and visits the patient with the PHC box for clinical measurements. Although the original PHC box contains various medical sensors, only COVID-19 related sensors will be used. These are, i) Thermometer (OMRON) for measuring body temperature, ii) Pulse Oximeter (OXI METER) for measuring Oxygenation of blood, iii) Digital BP Machine (A&D) for measuring blood pressure, pulse rate and arrhythmia and iv) Glucometer (TERUMO) for measuring blood glucose in case of diabetic patients. After taking the measurements, the triage algorithm at the PHC client device will run to classify the patient into four categories. Red and orange patient will be connected to the remote doctor. On the other hand, green and yellow patients are provided guidelines to monitor symptoms. The orange and red marked patients will be connected with the remote doctor. The doctor will have a video conversation with the patient

for further verification of the status, and checks the data for Red and Orange patients and if suspicious refers to the healthcare facility. **Table 5.2** shows the proposed logic set for COVID-19.

5.4.2. Primary screening and triaging: questionnaire and measurement

Table 5.2. C-Logic: Corona Logic designed for Portable Health Clinic System. In this table, "3 days*" should be replaced in "1 day" and "4 days**" should be replaced in "2 days" for 65 years old or older, NCDs as diabetes, heart failure, COPD, etc, patients who are using hemodialysis, immunosuppressants, and anti-cancer agents. No. 8, SpO2 is optional

No.	**Symptoms**	**Healthy**	**Suspicious**	**Affected**	**Emergent**
		Green	Yellow	Orange (Consultation)	Red (Emergency)
1	Fever	<37.5C	≥37.5C, Continue ≤3 days*	≥37.5C, Continue ≥4 days**	
2	muscle or joint pain	No	Continue ≤3 days*	Continue ≥4 days**	
3	Sore throat	No	Continue ≤3 days*	Continue ≥4 days**	
4	Dyspnea	No	Light to Moderate, Continue ≤3 days*	Light to Moderate, Continue ≥4 days**	
				or Severe	
5	Shortness of Breath	≤15/min	≤20/min	≤25/min	≥26/min
6	Cough	No	Continue ≤3 days*	Continue ≥4 days**	
7	Chillness	No	Continue ≤3 days*	Continue ≥4 days**	
8	*SPO2 (%)*	*≥96%*	*≤95%, With no Symptom*	*≤95%, With Light to Moderate Dyspnea*	*≤95%, With severe Dyspnea*
9	Fatigue	No	Light to Moderate, Continue ≤3 days*	Light to Moderate, Continue ≥4 days**	
				or Severe	
10	Loss of appetite	No	Continue ≤3 days*	Continue ≥4 days**	
11	Diarrhea	No	Continue ≤3 days*	Continue ≥4 days**	
12	Loss of taste	No		Yes	
13	Loss of smell sense	No		Yes	

Unlike the conventional PHC for NCDs, the local health worker collects the primary symptoms of a patient through a standard questionnaire. If the patient is identified as a potential patient, the PHC COVID-19 box will be sent to the patient's home temporarily together with an operation manual so that they can check themselves under the guidance of the health worker. This will save both to avoid infection.

Now, if a patient is identified as a potential COVID-19 carrier by this primary screening using the triage system as shown in Table 2, the patient will be immediately advised to see the

nearby hospital for further investigation and follow up as needed. Otherwise, the health worker will provide a guideline to stay safe at home. Since the community health workers are already known to the patients, patients feel more comfortable and safer under the guidance of them. The privacy of sensitive information of patients will be protected and secured because it is required by an increasing body of legislative provisions and standards [180].

Table 5.3 shows the functionalities of a portable health clinic to meet general requirements.

Table 5.3: Portable Health Clinic functionalities during general mode and emergency mode

Activity	General Mode	Emergency Mode
Symptom Collection	Health Worker	Mobile Phone or App
Clinical Measurements	Health Worker	Patients Self-Test or Health Worker
Medical Consultancy	Remote Doctor	Remote Doctor
ePrescription	GramHealth Application, printed by e-Health worker	GramHealth Application or Medical Facilities

5.4.3. Isolation and quarantine

The high-risk potential patients are dealt with by the hospital and they can go under treatment or isolation in the hospital or home quarantine as per the result of the Polymerase Chain Reaction (PCR) test. On the other hand, the health worker can also guide the remaining patients if they need home quarantine based on the primary screening. Thus, the spreading of the highly contaminating COVID-19 can be efficiently controlled with the utilization of the local health workers.

5.4.4. Traceability and privacy

In PHC service policy, the health workers are usually from the respective localities. So, they know their communities and are in a position to trace with ease and speed, those exposed to direct or indirect contact. Since the PHC reaches people at their doorstep, only those referred by the doctor on-line need to go to the hospital. This process helps maintain privacy as well.

5.5. Discussion

In its existing functional form, deploying the PHC and related RHS technologies for socially distanced populations during a public health emergency, such as the COVID-19 pandemic, is beneficial in reducing the risk of transmission to frontline healthcare professionals. Besides, findings indicate that frontline medical staff experience heightened levels of stress when coming into direct contact with COVID-19 patients. The impact of stress on cardiovascular function is well-established experimentally, independent of known risk factors associated with NCDs

[181]–[185]. The PHC service may create an effective physical separation between the caregiver and the patient without materially diminishing the quality of care or the reliability of care management responses.

In Bangladesh, medical staffs such as doctors, nurses, volunteers who fight coronavirus are being socially excluded, driven from the flats or rooms they rent and banned from his or her buildings. Official reports from China indicate that 71.5% of the frontline healthcare providers treating COVID-19 patients experience high levels of mental stress. Also, 50.4% show signs of depression, 44.6% exhibit anxiety states, and 34.0% suffer from insomnia [186]. Fatalities among healthcare professionals reported from China, Korea, Pakistan, and the United Kingdom may well be causally linked to reduced efficiency as a result of anxiety-induced stress as well as lack of sleep and depressive states [187]. In Japan too, healthcare staff treating the new COVID-19 patients report higher mental stress compared to routine care assignments [188]. PHC and attendant RHS technologies can create the required physical distancing that increases the sense of safety among medical staff and is likely to reduce stress.

The most conclusive method for determining COVID-19 infection utilizes PCR techniques, which require running the patients' DNA sample through specialized equipment in a laboratory environment. At present, therefore, the remote diagnosis of COVID-19 is not possible. However, the PHC can reliably triage individuals presenting with symptoms associated with COVID-19 using a checklist released by the Centres for Disease Control (CDC) [189]. This way, the PHC can help stem the unbridled flow of concerned citizens to healthcare facilities. This reduces the burden on already over-extended healthcare staffs and facilities, but still allows the concerned citizen to receive reliable well-being information from the PHC worker, and retains the human contact so essential to medical care [190]. While conventional telemedicine applications only offer live contact with a medical professional, the PHC system incorporates diagnostic testing for screening NCDs and nutritional status. A unique aspect of the PHC system is its built-in algorithm that compares up to 17 diagnostic parameters in real-time and generates a triage plan that is relayed to the doctor manning the telemedicine call-point. This eliminates any interference by the PHC worker attending the patient by providing the attending doctor with direct control over patient management decisions. PHC can reduce the risk of transmission to frontline healthcare workers, reduced psychosocial stress on frontline healthcare staff, and optimized healthcare resources for more patients who need them most.

As part of its COVID-19 response, the United States Congress has promulgated Public Law No: 116-123, which provides for the temporary removal of restrictions on telehealth services for Medicare beneficiaries [191]. These developments indicate that the PHC system can be

adapted to regulatory and best practice parameters, either by securing the clinical role of the licensed medical practitioner within the delivery model or modulating the level of service provision in ways that do not impinge on best practice guidelines.

In summary, the PHC, even in its present form, can be effectively deployed to eliminate the risk of transmission among frontline healthcare staff and contribute significantly towards reducing pressure on healthcare services and resources. With considered re-alignment of its technical configuration, the PHC can be deployed as an ancillary resource supporting large-scale public health emergencies, exemplified by the COVID-19 pandemic.

The PHC system can be effective in providing:

(1) A primary-level screening mechanism that can demonstrably reduce the burden of NCD-related complications among COVID-19 patients, and directly contribute to the reduction of the incidence of NCDs by timely advice and treatment.

(2) A primary healthcare service platform for under-served populations in remote regions of developing countries, and now mature enough to be adapted to respond to large scale public health emergencies such as COVID-19, to impact reduction of associated mortality and morbidities.

(3) A reliable platform for early detection of NCDs and associated comorbidities among target populations and effectively contribute to a tangible reduction in the burden of disease.

(4) A key ancillary mechanism for controlling patient-to-caregiver transmission of COVID-19 by creating physical distance between all except diagnosed cases and attending clinical staff.

(5) Evidence for health authorities to choose e-Health technologies, such as PHC service, to provide primary healthcare services simultaneously for COVID-19 and NCDs, including video consultation with physicians, preventive health education and awareness at the grassroots, and encourage well-being behaviors.

(6) An effective outreach tool for controlling NCDs, and decreasing the burden of disease on the target community.

(7) A new approach to respond to large scale public health emergencies like COVID-19 and contributing directly to building adaptive resilience among populations at risk.

5.6. Limitations

If the para-professional worker visiting homes is not well-trained in self-disinfection or the access to disinfection facilities is not available between one visit and another, then the contagion can be transmitted by the para-professionals. This is indeed what has happened in nursing homes and assisted living facilities across the United States, for example. This may potentially facilitate the spread of the virus rather than containment.

However, the main challenge for deploying the PHC during large-scale public health emergencies such as COVID-19 is ensuring the patient is amenable to self-checking, guided by the PHC health worker. Initial screening requires 3 simple tests for which a manual is provided. Health workers can also guide online. Another challenge is to ensure access to a facility equipped for a definitive diagnostic test, such as the PCR test in the case of COVID-19 so that the diagnosed patient can be triaged to a hospital for treatment.

5.7. Conclusions

This study touched upon relevant current and future public health implications arising from the COVID-19 outbreak. It provided an overview of how several centralized initiatives have emerged to tackle the situation. Our initial examination of the suitability of the PHC and its associated technologies as a key contributor to public health responses designed to " flatten the curve", particularly among unreached high-risk NCD populations in developing countries, indicate the strong possibility of affirmative impact.

In this study, we re-designed the existing PHC for the containment of the spread of COVID-19 as well as proposed corona logic (C-Logic) for the main symptoms of COVID-19, such as high fever, cough, sore throat, respiratory complications, etc. Through modified PHC service, we can help people to boost their knowledge, attitude (feelings/beliefs), and self-efficacy to execute preventing measures. Knowledge about COVID-19 means what are the causes, sources of infection, what are the symptoms, ways of transmission, and prevention. As it is a new disease and has become a pandemic within a short period, there is a lack of knowledge, especially among rural people. Therefore, it is very important to fill these knowledge gaps timely to prevent and control the spread which will lead to better practice for prevention and control of the contagious disease.

Portable Health Clinic introduced an affordable, usable set of sensors with the transmission facility to convey the clinical data to the remote doctor so that the doctor can make an accurate decision. PHC with its new triage algorithm (Corona Logic) classifies the patients whether the patient needs to move to a clinic for a PCR test or not. As mentioned in the previous sections,

the new model can reduce the risk of transmission and psychological stress on frontline healthcare staff, and optimize healthcare resources for more patients who need them the most. The consultancy service is mostly on introducing nearby hospitals, providing doctor appointments, and interpreting prescriptions.

The salient point is that the same model can work in other countries both rural or urban to bring similar benefits for an emergency to reduce the transmission of diseases. Therefore, the Governments and other healthcare sectors can take initiative to use RHSs such as PHC service to provide primary healthcare services simultaneously for triaging susceptible COVID-19 and supporting NCD patients isolated in various geographical locations.

Theoretically, this study contributes to design science research by introducing a modified healthcare providing model with a new triage logic.

Chapter 6
Conclusions and Future Works

This study discussed the significance of understanding consumer behavior of eHealth systems for better management of NCDs in a developing country especially from the perspective of Bangladesh. First, the study identified the key factors to increase the future use of a PHC system. The key to promoting the future use of a PHC system lies in the three most important factors: perceived usefulness (0.659), intention to use (0.454), and health awareness (0.447). These factors have a positive and direct influence on use.

Second, the study predicted blood uric acid through machine learning approaches. The mean of uric acid measurement was 6.63 mg/dL. That means the uric acid of most of the people is close to the borderline (6.63 mg/dL whereas the normal range <7.0 mg/dL). Therefore, they need to check uric acid regularly. The Boosted Decision Tree Regression model showed the best performance among other models based on the Root Mean Squared Error (RMSE) 0.03, this RMSE is better than any reported in the literature. Such a uric acid prediction model is useful for improving awareness among high-risk subjects. By predicting uric acid, this study can help to save medical costs.

Third, in this study, we re-designed the existing PHC for the containment of the spread of COVID-19 as well as proposed corona logic (C-Logic) for the main symptoms of COVID-19, such as high fever, cough, sore throat, respiratory complications, etc. Through modified PHC service, we can help people to boost their knowledge, attitude (feelings/beliefs), and self-efficacy to execute preventing measures. Knowledge about COVID-19 means what are the causes, sources of infection, what are the symptoms, ways of transmission, and prevention. As it is a new disease and has become a pandemic within a short period, there is a lack of knowledge, especially among rural people. Therefore, it is very important to fill these knowledge gaps timely to prevent and control the spread which will lead to better practice for prevention and control of the contagious disease.

The findings of this research are expected to offer proactively important and practical guidelines to service providers, implementers, and policymakers to promote the use of eHealth technology for regular health checkups. The findings can also contribute to the establishment of combined actions to improve NCDs management in the context of limited resources. Finally, the machine learning prediction model will assist in improving awareness among high-risk subjects. By predicting uric acid, this study can help to save medical costs.

Future works

This study is limited by geographical scaling as the survey was conducted in one country and focused on only 18 institutions. Thus, the results may raise a concern over the

generalizability of the findings, and scope exists to make the findings more generalized by examining additional countries and institutions. Given the cross-sectional design, the present study cannot determine the actual use. Hence, a future study should consider a longitudinal approach through which participants will be interviewed several over a period. In addition, a few variables could be added, such as trust in a PHC system and facilitating conditions, to understand additional insights into the use of eHealth technology by urban corporate people. A future study could include some additional features (e.g. work stress, everyday physical activity, alcohol intake, eating red meat, etc.).

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Appendices

APPENDIX 1: Recommendation letter to the Director of BMRC

九州大学
KYUSHU UNIVERSITY
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744 Moto'oka, Nishi-ku, Fukuoka 819-0395
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January 20, 2019

Director,
Bangladesh Medical Research Council (BMRC)
BMRC Bhaban, Mohakhali, Dhaka-1212, Bangladesh

Subject: Letter of Recommendation for Ms. Masuda Begum Sampa for Ethical Clearance of her study in Bangladesh

Dear Sir/Madam

I am glad to inform you that Ms. Masuda Begum Sampa, a PhD student at Kyushu University, Japan has selected a topic regarding "Consumer Behavior of Remote Healthcare Systems on non-communicable diseases" for her PhD research.

Bangladesh made significant achievements in the area of healthcare such as less child mortality rate, longer life-expectancy at birth (>72 years in 2016). The next challenge is to reduce the morbidity. One of the good ways to reduce morbidity is to have regular health monitoring of the patients. Several initiatives such as eHealth, mHealth exist worldwide to take care of remote patients. However, their behavior has not been significantly studied.

Ms. Sampa selected Bangladesh for her study location. She has her educational background in statistics. We have a good team to support her research. I hope she will be able to produce a good number of research publications from her study.

We would like to follow the regulations set forth by BMRC. Any encouragements from your team would be highly appreciated.

Sincerely,

Ashir Ahmed, PhD
Associate Professor
(Research Supervisor to Ms. Masuda Begum Sampa)

APPENDIX 2: Filled out application form for BMRC's approval (ANNEXURE – A)

BANGLADESH MEDICAL RESEARCH COUNCIL
MOHAKHALI, DHAKA-1212, BANGLADESH
Tel: 8819311, 8828396, Fax: 880-2-8828820
Email: info@bmrcbd.org; Web: www.bmrcbd.org
Application for Ethical Clearance

1. Principal Investigator(s):

Masuda Begum Sampa, MS
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Mobile: +81-80-7989-3966 Telephone (Off.) TEL +81-92-802-3644
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2. External Supervisor(s):

A. Name: Md. Rakibul Hoque, MBA, Ph.D.

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3. Internal Supervisor(s):

D. Name: Ashir Ahmed, Ph.D.

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I. Name: Naoki Nakashima, Ph.D.

Professor, Medical Information Center, Kyushu University Hospital, Maidashi Campus, Fukuoka Japan
Mobile: N/A Telephone (Off./Res): N/A

e-mail: naoki@med.kuushu-u.ac.jp

4. Place of the Study/Institution(s):
(a) Grameen Bank Complex, Dhaka
(b) Ekhlaspur, Matlab Uttor, Chandpur

5. Title of Study:
Longitudinal Study to Understand the Determinants of *Actual Use* of the Portable Health Clinic (PHC) system and How their Influences Change Over Time

6. Type of Study:
Longitudinal.

7. Duration of Study:
36 months

8. Total Cost:
BDT 700,000

9. Funding Agency:
Self-funded

Circle the appropriate answer to each of the following
(If not Applicable write NA)

1. Source of Population:

(a) ILL Participant Yes No
(b) Non ILL Participant Yes No
(c) Minors or persons under guardianship Yes No

2. Does the study involve?

(a) Physical risks To the participants Yes No
(b) Social Risks Yes No
(c) Psychological Risks to participants Yes No
(d) Discomfort to Participants Yes No
(e) Invasion of the body Yes No
(f) Invasion of Privacy Yes
(g) Disclosure of Information damaging to Subject or others Yes No

3. Does the study involve?

(a) Use of records, Yes No
(Hospital, Death, birth or other)
(b) Use of fetal tissue Yes No
Or abor
(c) Use of organs or No
Yes ids

4. Are participants clearly informed about?

(a) Nature and Yes No
purpose of study
(b) Procedures to be Yes No
wed including
alternatives used
(c) Physical risks No
(d) Private questions No
(e) of the
No Yes Body
(f) Benefits to be Yes No

Derived

(g) Right to refuse Yes No
ipate or
to withdraw from study
(h) Confidential Yes No
of data
(i) Compensation where there are risks or loss of working time or privacy is involved in any particular procedure Yes No

5. Will signed consent form/verbal consent be required?

(a) From Participants No
(b) From parent or Yes No
(if participants
are minors)

6. Will precautiouss be taken to protect anonymity of participants Yes No

Note: If the final instrument / questionnaire is not completed prior to review, the following information should be included in the abstract.

1. A description of the areas to be covered in the questionnaire or interview which could be considered either sensitive or which would constitute an invasion of privacy.
2. Examples of the type of specific question to be asked in the sensitive areas.
3. An indication as to whom the questionnaire will be presented to the committee for review.

We agree to obtain approval of the Ethical Review Committee for any change involving the rights and welfare of subjects or any changes of the Methodolog before making any such changes.

_____

Signature

Name of the Principal Investigator: **Masuda Begum Sampa, MS**

Date:

Name of the Co-investigators (In chronological order)	Signature
Dr. Ashir Ahmed Kyushu University, Japan	
Dr. Fumihiko Yokota Kyushu University, Japan	
Dr. Rafiqul Islam Kyushu University, Japan	
Dr. Kimiyo Kikuchi Kyushu University, Japan	
Dr. Mariko Nishikitani Kyushu University, Japan	
Dr. Md. Rakibul Hoque University of Dhaka, Bangladesh	
Dr. Mostafa Zaman Ekhlaspur Center of Health, Bangladesh	
Dr. Muhammad Ismail Hossain University of Dhaka, Bangladesh	
Dr. Naoki Nakashima Kyushu University, Japan	

APPENDIX 3: Documents submitted to BMRC (ANNEXURE – B)

PREPARATION OF AN ABSTRACT

FOR

NATIONAL RESEARCH ETHICS COMMITTEE (NREC)

1. **Describe the requirements in respect of the population and explain the rationale for using population of special groups such as children, Incompetent person or groups whose ability to give voluntary informed consent is questionable.**

Healthcare is a basic human need. According to World Health Organization (WHO), more than quarter of the world's countries including Bangladesh have a critical healthcare workforce shortage. In Bangladesh, only 4.7 doctors are available for 10,000 populations [5]. An eHealth system, which is a healthcare system by using Information and Communication Technology (ICT), is an important way to solve the scarcity of current medical facilities. Therefore, Grameen, Bangladesh and Kyushu University, Japan have developed one of the eHealth systems called Portable Health Clinic (PHC) system to deliver healthcare services.

Portable Health Clinic (PHC) is an eHealth system to provide preventive healthcare services by using ICT (Figure 1). The unique design of this system is that the clinic box is carried and operated by a pre-trained healthcare worker to deliver preventive healthcare services for Non-Communicable Diseases (NCD).

Figure 1: Portable Health clinic (PHC) system

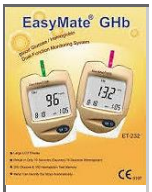
Our aim is to identify key determinants of *actual use* of the PHC system and how their influence changes over time with increasing user experience by using the PHC system.

We have selected people of two areas for interviewing. One is urban area: Grameen bank complex, Dhaka, and the other is rural area: Ekhlaspur village, Matlab Uttar, Chandpur. This study recruited participants from these two areas for several reasons. Institutional people are very busy and most of the time they work sitting in chairs. Therefore, they are more likely to develop NCDs. In addition, there is little chance for physical activities among urban people because of lack of play grounds, parks, workable footpath, and safe road for cycling [37]. Moreover, Grameen bank complex people is easy to follow up because we have strong collaboration with them, therefore participants will be less likely to drop out from the sub-sequent survey. In rural area, Matlab Uttar is a long-running surveillance area that has been ongoing for several decades. About 80% of the people in Matlab die in NCDs [192]. There is also high prevalence of blood pressure in this area [37]. The target population for this study is all population aged 35 years or older because this group is more likely to suffer from NCDs [193].

Instruments or devices which will be used in the PHC system are shown in the following table.

Table 1: Portable Health Clinic: Devices, Strips and Measurements

No.	Name	Manufacturer/ Model	Picture for invasive	Purchased from	Measurement	Invasive/ non-invasive
1	Weighing Scale	Omron HBF-212		Bangladesh	Weight	Non-invasive
2	Digital BP Machine	Omron HEM-7130		Bangladesh	Blood Pressure, Pulse Rate, Arrhythmia	Non-invasive
3	Manual BP Machine with Stethoscope Focal	ALPK2 FOCAL		Bangladesh	Blood Pressure	Non-invasive
4	Digital Thermometer	Omron MC-341		Bangladesh	Body Temperature	Non-invasive
5	Pluse Oxymeter	NB NA		Bangladesh	Blood Oxygen	Non-invasive
6	Steel Scale	NB Dolphines		Bangladesh	Height	Non-invasive

7	Measurement Tape	NB Butterfly		Bangladesh	Hip, Waist, Height	Non-invasive
8	EasyMate GCU (Glucometer with Diabetic Pen)	Bioptik Tech/ET-311		Bangladesh	Blood Glucose	Invasive
9	Glucose Test Strip	Bioptik Tech EasyMate		Bangladesh	Blood Glucose	Non-invasive
10	EasyMate GHb (Hemoglobin Meter)	Bioptik Tech ET-232		Bangladesh	Hemoglobin, Uric Acid	Invasive
11	Hemoglobin Test Strip	EasyTouch		Bangladesh	Hemoglobin	Non-invasive
12	EasyMate GCU (Uric Acid Meter)	Bioptik Tech ET-311		Bangladesh	Uric Acid	Invasive
13	Uric Acid Test Strip	Bioptik Tech		Bangladesh	Uric Acid	Non-invasive
14	Urine Test Strip	Wancheng Uric 2V GP		Bangladesh	Urine Protein, Urine Glucose	Non-invasive

2. **Describe and assess any potential risks - physical, psychological, social, legal or other and assess the likelihood and seriousness of such risks. If methods of research create potential risks, describe other methods, if any, that were considered and why they cannot be used.**

   Some specimen will be taken, like Serum, total cholesterol, Random blood sugar, Urinary salinity, Urinary protein and will do some physical measurement like height, weight, Mid-Upper Arm Circumference (MUAC), hip circumference, waist

circumference from the enrollment day till follow up. From blood draws, patient may feel a minimum pain where the needle is inserted, or get an infection where the blood is taken. An infection does not happen very often, if infection occurs we will provide adequate treatment available in Bangladesh at our expense. No other psychological, social, legal or other potential risks to participants from this study.

3. Describe procedures for protecting against or minimizing potential risks and assessment of their likely effectiveness.

Everyone involved in this research follows the safety procedure described in ref. [63]. In addition, this research will be conducted in line with the ethics guidelines of research in the country.

To overcome potential risks, the following precautiouss are taken:

(a) We will explain the research objectives, possible risks and benefits and then will ask a written consent from all the participants. The consent form is attached.
(b) The questions are designed in a way so that the participants do not feel uncomfortable about their race, gender, or jobs. The interviewers are provided training on manners by the professional surveyors.
(c) Certified and trained healthcare workers will collect blood samples by using certified devices.
(d) Raw data will be digitized and stored in a secure manner so that personal data cannot be leaked.

4. Include a description of the methods for safeguarding confidentiality or protecting anonymity.

(a) Treatment of confidential information

Confidential information obtained by on-site registration, checkups and inquiries is stored in our own local servers. In order to access these data, passwords are required and personal information is protected so that it cannot be accessed except for data managers. During analysis, we will receive data (anonymized data) from which personal identification information such as name, address etc. cannot be identified. There is no possibility of using outside the scope of this research subject.

(b) Method of storage and disposal of samples and information

Information such as date of birth, name and phone number of the participants will be stored to recognize the same person for sub-sequent surveys and destroyed by the Research Supervisor. The filled in questionnaire is kept in a key cabinet within the facility of the Research Supervisor and the key is managed by him. The data of the survey form will be entered to the computer by the chief researcher and the research

staffs. It will be destroyed at the shredder 10 years after the end of the research.

(c) Secondary usage of samples / information

Regarding the possibility of secondary use of the data obtained from the survey, we will obtain written agreement from the participants after being approved by the ethics review committee.

(d) Responding to consultation etc. from the test participants and related persons

The name, address, telephone number, and e-mail address of the researcher in this research will be written in the research manual as a consultation window.

(e) Treatment of test results in individual test participants

Results of medical examination will be disclosed / provided only to the participants.

5. When there are potential risks to the subject, or the privacy of the individual may be involved, the investigator is required to obtain a signed informed consent from the participant. For minors, informed consent must be obtained from the authorized legal guardian or parent of the subject. Describe consent procedures to be followed including how and where informed consent will be obtained.

As mentioned earlier, everyone involved in this research follows the "Helsinki Declaration 2013" [63]. In addition, this research will be conducted in line with the ethics guidelines of research of the country.

The written informed consent will be taken from the participants before asking questions. Who agreed to participate in the survey must give consent with sign or thumb impression in front of a witness. Participants who do not agree to sign/thumb impression in the consent form he/she will not be eligible for the study. Participants should be equal or older than 35 years old.

(a) **If signed consent will not be obtained, explain why this requirement should be waived and provide an alternative procedure such as a verbal consent.**

In this study, we only will allow informed written consent, no verbal consent will be taken. Without written consent he/she will not be the study participant. Moreover, we will also provide a sample of signed/ thumb impression copy to the participant and one copy we will stored for the study purpose.

(b) **If information is to be withheld from a subject, justify this course of action.**

Participants can stop this survey questionnaire anytime without any harms. This is totally voluntary to join in this survey; however, we hope participants will agree to join because their information is very important and can contribute to improve health status in your community. If they want to withheld this information we will delete all the past

records of the participant.

(c) If there is a potential risk to the subject or privacy of the individual or loss of work time is involved in any particular procedure, include a statement in the consent form stating whether any compensation will be available.

From blood draws, a participant may feel a minimum pain where the needle is inserted or get an infection where the blood is taken. An infection does not happen very often. If happen, we will receive free investigations for current illness. Neither participants nor we will pay any money for participating in this study. The participants shall be provided the best possible free treatment for any research related injuries. At this PHC services, a participant can receive following health check-up and doctor's consultations.

After the Health check-up, a participant can consult with remote doctor by skype and receive prescription if necessary. These health check-up and doctor's consultation will be free of charge.

6. If the study involves an interview, describe where and in what context the interview will take place. State approximate length of time required for the interview.

Yes, the study involves an interview. Questionnaire survey will be conducted to collect information about participant's socio-economic condition, and psychological behavior for actually using the PHC system.

(a) Location of the interview and context of the interview: The study will be conducted in two geographical locations in Bangladesh (i) Urban area: Grameen Bank Complex, Mirpur, Dhaka and (ii) Rural area: Ekhlaspur village, Matlab, Chandpur. Survey will be carried out after the health checkup. And the survey will be carried out in Ekhlaspur Center of Health (for rural), and Grameen Complex (for urban).

(b) Duration: Survey has total 47 questions about socio demographic; name, age, gender, having mobile phone, access to internet connection, perceptional questions; perceived usefulness of the PHC system, perceived ease of use, output quality, privacy, health awareness, trust and attitude towards using the PHC system, intention to the actual use of the system. This will take 25-30 minutes per participant. The study is designed to carry out three times a year and will be continued for three years.

7. Assess the potential benefit to be gained by the individual subject as well as the benefits which may accrue to society in general as a result of the work. Indicate how the benefits may outweigh the risks.

It is reasonable to expect that participant will be familiar with eHealth technology and

by using this technology they can understand their health status easily and improve their health status. However, we can't guarantee that they will personally experience benefits from participating in this study. Others may benefit in the future from the information we find in this study.

8. In case of an experimental drugs, provide information about its status of registration for open sale in Bangladesh and in other developed countries.

Not Applicable

9. For experimental 'new' drugs* which are not registered in Bangladesh provide full information about the toxicity studies carried out in animals or human volunteers. Published papers on this regard shall be annexed.

Not Applicable

10. If placebo is to be used justify its uses and why the study cannot be done without its use.

Not Applicable

11. If an experimental 'new' drug* is to be used give a statement regarding its sponsorship and the conditions for such sponsorship.

Not Applicable

12. State if the activity requires the use of records (hospital, medical, birth, death or other), organs, tissues, body fluids, the fetus or the abortus.

Not Applicable

The statement to the participant should include information specified in items 2, 3, 4, 5(c) and 7, as well as indicating the approximate time required for participation in the activity.

**** a 'new' drug means one which is not registered for free and open sale in Bangladesh.***

APPENDIX 4: Documents submitted to BMRC (ANNEXURE – C)

FORMAT FOR SUBMISSION OF A RESEARCH PROPOSAL FOR ETHICAL APPROVAL

- **Project Title:**

Longitudinal Study to Understand Determinants of *Actual Use* of the Portable Health Clinic System and How Their Influence Changes Over Time

- **Summary:**

Due to the scarcity of medical infrastructure including doctors and hospitals, remote healthcare services by using advanced ICT is getting popular around the world including Bangladesh to deliver quality health care services, in low resource environment like rural areas of Bangladesh. Currently Grameen and Kyushu University have developed one of remote healthcare systems called Portable Health Clinic (PHC) system. The unique design of this system is that the clinic box is carried and operated by a pre-trained health care worker. However, longitudinal study of a cohort of consumers in the field of PHC wasn't undertaken before to understand the consistent causal relationship among factors of PHC over time. In order to draw strong inferences about new technology use we need to do longitudinal study. Therefore, the main aim of this study is to identify key determinants of *actual use* of the PHC system and to understand how their influence changes over time with increasing user experience by using the PHC system to explain detailed action sequences that might unfold over time and to provide more information to service providers for formulating appropriate strategies to increase *use* of PHC. The study will conduct face to face survey to collect data among those who have used the system at least once. Structural Equation Modeling (SEM) will be used to identify the cause and effect relationship among factors over time. By analyzing data using Analysis of a Moment Structures (AMOS 25.0) this study will identify most important factors that are key to increase *actual use* of the PHC system. This study will theoretically develop generalize model across time and geographic area by incorporating first and second version of Technology Acceptance Model (TAM) TAM1, TAM2, Unified Theory of Acceptance and Use of Technology (UTAUT) model and other users' acceptance models to identify important factors of actual *use* of the PHC system. This study can theoretically develop a modified eHealth acceptance model. The proposed model through this study can make it possible to offer important practical guidelines to service providers in

enhancing *actual use* of human assisted PHC system. The study can suggest way of increasing health awareness to policy makers and way to build awareness to *use* the system. The study can also contribute to make policy to improve health care situation i.e., reduce morbidity rate in the country.

Keywords— Structural Equation Modeling, Information and Communication Technology, Technology Acceptance Model, Longitudinal study

- **Introduction:**

Though dramatic advances in hardware and software capabilities, low usage of already developed information systems continue and low return from organizational investment has been identified. Therefore, understanding and creating the conditions under which the information system will be accepted by human remains a high priority research issue of information systems research and practice. Better understanding of the determinants of *use* behavior would increase user acceptance and usage of new system [25]. Significant changes have been made in the most of the countries in the world over the last decades in explaining and determining user acceptance of information technology at health care sectors [26]. In addition, due to the scarcity of medical infrastructure including doctors and hospitals, and to expensive access to quality health care services remote healthcare services by using advanced Information and Communication Technology (ICT) is getting popular around the world including Bangladesh.

Currently Grameen, Bangladesh and Kyushu University, Japan have developed one of remote healthcare systems called portable health clinic (PHC) system which is carried and operated by one pre-trained health care lady to deliver health care services to the unreached people in Bangladesh who are deprived of quality health care services where doctors from urban area can consultant with patients.

Due to potential benefits and various eHealth initiatives in place, many recent studies have been done to enhance the acceptance of eHealth services by all citizens. Therefore, through proper study of growing popularity of ICT based health care services, it is possible to enhance the actual *use* of the PHC system. There are four broad categories of factors that can influence consumers' usage of any new product or service - (i) demographic factors (ii) socio-economic factors (iii) cultural factors, and (iv) psychological factors [73]. Understanding factors that influence technology acceptance is essential for its successful adoption [194]. However, there are only few studies conducted in regards to consumer acceptance [195]. A study among 600 families in one particular area in Bangladesh to determine the demographical and socio- economic factors found – consumers' age, occupation and purchasing power

have significant influence on their acceptance of eHealth services from PHC system [34]. But ref. [34] identified temporary and contemporal solutions or dynamics of determinants of acceptance of the PHC system.

Moreover, longitudinal study of a cohort of consumers in the context of Portable Health Clinic (PHC) system wasn't undertaken before to understand the consistent causal relationship among factors of PHC and how their influence changes over time. In order to draw strong inferences about acceptance of new technology we need to do longitudinal study.

- **Objectives:**

General objective:

1. The main aim of this study is to identify key determinants of actual use of the PHC system and to understand how their influence changes over time with increasing user experience by using the PHC system to explain detailed action sequences that might unfold over time.

Specific objectives:

- To identify consistently cited most significant factors in predicting actual use.
- To identify cause and effect relationships among factors over time.
- To explore changing factors of use the system over a 1year period.
- Testing significant differences among 3 times survey per year: survey 1, survey 2, and survey 3 data, to examine whether the respondents' use of PHC service changed over the period.
- Finally, to develop a general decision-making model across time and geographic area for the actual use of PHC system in Bangladesh.

Theoretical basis for building the proposed model:

There have been many previous studies targeted to explore the factors influencing the use behavior of a new technology. The present study reviewed previous literature and develops the proposed model. Theory of Reasoned Action (TRA) is the major theory to explain people's behavior [196].

Based on the reasoned action theory, theory of planned behavior was developed which is an extension of TRA [39].

Based on above models Technology Acceptance Model (TAM) was developed [197]. TAM is the major theory to understand how users come to accept and use a new technology/ system. By 10 years, TAM has become a well-established, robust,

powerful, and parsimonious model for predicting user acceptance. TAM2 model supported well basic TAM relationships and extended TAM model by adding additional determinants of TAM1's perceived usefulness and usage intention constructs. Later Unified Theory of Acceptance and Use of Technology (UTAUT) model was developed by adding facilitating conditions, social influence constructs in the basic technology acceptance model [41].

Based on TAM1, TAM2, UTAUT and other existing user acceptance model we would like to propose a generalized theoretical model that can investigate factors behind actual use of PHC system in Bangladesh. In our proposed model, we incorporated TAM1 [197] , TAM2 [25], and UTAUT [41] model moreover; we are arguing that illness, health awareness, past experience of using any eHealth system, social norm, and user self- efficacy directly affect actual use of Portable Health Clinic (PHC) system.

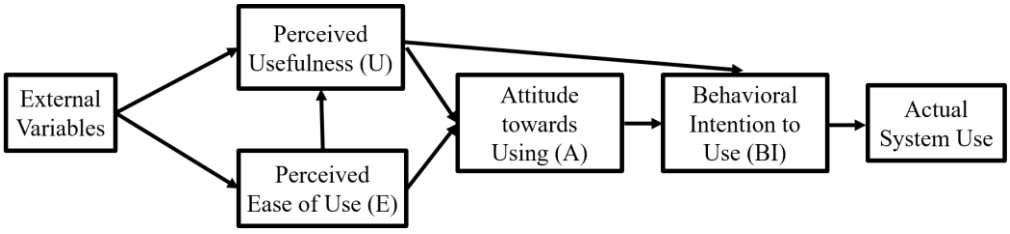


Figure 2: TAM1- First version of TAM [197]

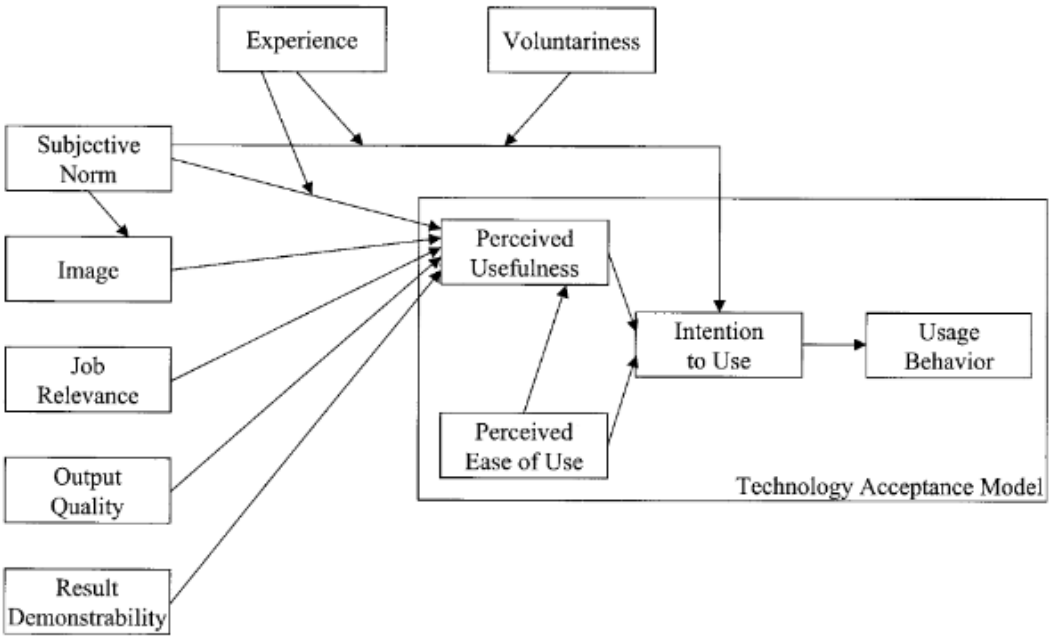


Figure 3: TAM2- a theoretical extension of TAM1 [25].

- **Rationale:**

New methods and tools in healthcare sector is growing gradually due to the continuing innovation in medicine and technologies [1]. Moreover, due to the scarcity of medical infrastructure including doctors and hospitals, remote healthcare services by using advanced Information and Communication Technology (ICT) is getting popular around the world. Remote health care systems such as eHealth, m-health, telemedicine, telemonitoring, electronic health records, and hospital information systems, are getting consideration gradually due to the speedy advancement in Information and Communication Technology (ICT) worldwide [2]. Therefore, for increasing number of technologies in the health care field, the use of technology acceptance model for any new technology is needed to guide implementation process across health care contexts and user groups [2]. By testing an information technology acceptance model, we are able to determine what is the more valued factors by users when it comes to deciding whether to accept the system or not.

Therefore, understanding and creating the conditions under which the ICT based services will be grasped by human remains a high priority research issue of information systems research and practice. Our study works with one kind of eHealth technology, the Portable Health Clinic (PHC) system. Portable health Clinic (PHC) is an eHealth system, co-developed by Kyushu University, Japan and Grameen Communications, Bangladesh to provide preventive health care services by using ICT [2]. The unique design of this system is that the clinic box is carried and operated by a pre-trained health care worker to deliver preventive health care services for Non-Communicable Diseases (NCD).

Due to potential benefits and the various eHealth initiatives in place, many recent studies have been done to enhance the acceptance of eHealth technologies by potential users. Most of the previous studies of adoption of ICT based health services were conducted in developed countries like European countries, USA, Canada, and Australia etc. A study among 600 families in one particular area in Bangladesh to determine the demographical and socio- economic factors found – consumers' age, occupation and purchasing power have significant influence on their acceptance of eHealth services from PHC [34]. However, very few studies focused on acceptance of eHealth technology by urban population in Bangladesh.

A sample of 300 people from both areas (urban and rural) of Bangladesh had been collected by face to face questionnaire survey. Therefore, the purpose of this study is to determine factors that are influencing acceptance of eHealth technology by urban people in Bangladesh.

- **Methodology:**

Study design

Longitudinal study for 3 years.

Study place

(i) Urban: Grameen Bank Complex, Mirpur, Dhaka, and
(ii) Rural: Ekhlaspur village, Matlab, Chandpur.

Study Population

A surey will be conducted among those who come to the PHC service providing point (the location is: Ekhlaspur Center of Health (ECOH), Ekhlaspur Union (6 out of 9 wards, Matlab Uttor, Chandpur, and Grameen Bank Complex, Dhaka) and have received the PHC service. Our survey will be conducted immediately after receiving the healthcare service provided by the PHC system to understand the influence of factors influencing the actual use of PHC system. Therefore, the target population is those who have used the PHC system at least once. In order to remove the confusion, we rephrased the target population criteria as follows:
(I) Participants who live/work at the targeted survey places
(II) Participants who signed the informed written consent form
(III) Participants who are healthy enough to participate in this survey
The target population for this study is of aged 35 years or older because this group is more likely to suffer from NCDs [193]. The target population size is: 300 from both areas.

Sampling, Statistical basis of the sample size, Procedures

There is considerable variation in the opinions observed in the literature in regard to the selection/calculation of optimum sample size in different types of statistical analysis [67]. For example, statistical analysis including structural equation modeling (SEM) recommends sampling of 200 as fair and 300 as good [198]. Hair et al. also recommended a sample size of 200 to test a model using SEM. A 'critical sample size' that can be used in any common estimation procedure for valid results [199]. As per previous studies, a sample size of 300 was selected in this study for data analysis using SEM [200].

The sample was drawn by a simple random sampling procedure. In this study, we informed people first about our PHC system. After initial introduction about PHC system, survey1 will be conducted among those who come to the service point and have received the PHC service at least once. The same respondent will be interviewed

in the post-survey.

Data collection methods

Longitudinal field survey through questionnaire will be conducted to measure factors/ variables. Data will be collected in 3 different points in time per year: First survey (survey 1)- after initial introduction of the PHC system (T1), Second survey (survey 2)- 4 months after the first survey (T2), Third survey (survey 3)- 4 months after the second survey (T3). The same respondent will be interviewed in the post-survey.

Pretesting

Pilot survey was conducted in both areas. 35 respondents were interviewed after receiving the PHC health care service. Furthermore, we have analyzed their responses. Based on feedback from the pilot survey, we have finalized our questionnaire.

Variables in study

The questionnaire contains following two parts of variables:

1) **Part A (Socio-demographic information)**

Name, age, education level, gender, having mobile, having access to internet connection, past experience, and, having any kind of illness etc.

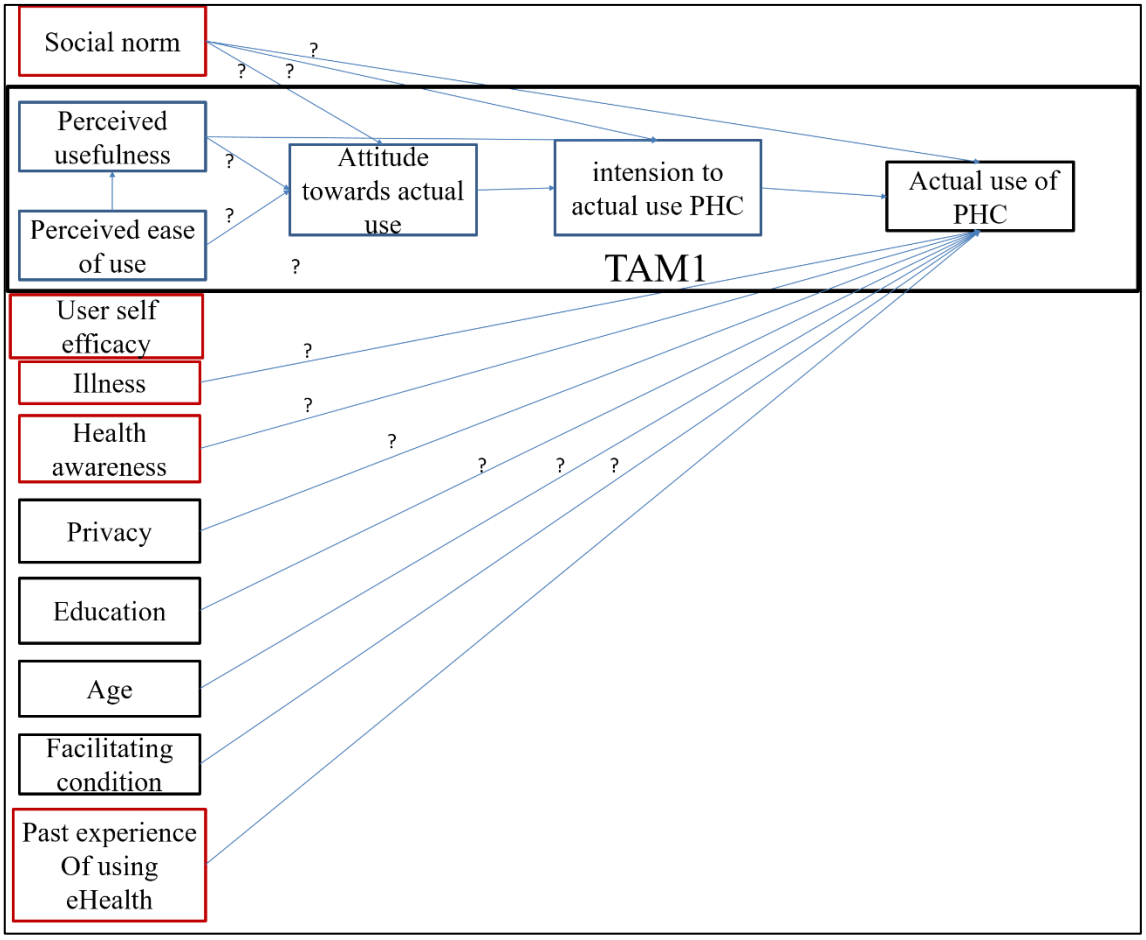
2) **Part-B (Cognitive/ Perceptional factors)**

There are 13 Psychological factors. Every factor will be measured by 3 questionnaire items.

Respondent will read each statement and rate each statement on 5-point Likert scales by putting √ (tick) in the number that best describes she/ he. All statements will be measured on a 5-point Likert scale, where 1 = Strongly disagree, 2 = Disagree, 3= Neither Disagree nor agree, 4 = Agree, and 5 = Strongly agree.

Outcome Variables

Actual use of the Portable Health Clinic (PHC) system.



Note: ? mark means we don't know the value of relationship between variables yet.

Figure 4: Initial hypothetical model

Hypotheses of the study

Based on previous studies we propose following hypotheses:

Hypothesis 1- *Perceived usefulness* will have a positive and direct effect on *actual use* the of the Portable Health Clinic (PHC) system.

Perceived usefulness is defined as the extent to which a person believes that using the system will improve his or her health [25].

Hypothesis 2- *Social norm* will have a positive and direct effect on *actual use* the of the Portable Health Clinic (PHC) system.

Social norm means reference from friends/ family members/ loved one. Social norm consists of two influences: 1. Informational norm to enhance knowledge and 2. normative to conforms expectations of others [47]. In our study we combined subjective norm and moral norm together in social norm. Subjective norms concern the perceived social pressures to undertake or not undertake a behavior [39], [49]. And

moral norms is personal feelings of moral responsibility or obligation to perform a certain behavior which may have a significant contribution to explain the variance of the behavior [39], [201]. So, *Social norm* in this study indicates moral norm, Knowledge and social pressure. Study analyzed energy saving behavior among University students in Vietnam and identified *Social norm* was the most important determinants for energy saving behavior: to avoid AC use (22). Social norm had direct positive influence on waste reduction behavior [202].

Hypothesis 3- *Illness* will have a positive and direct effect on *actual use* of the PHC system.

Hypothesis 4- *Health awareness* will have a positive and direct effect on *actual use of* the PHC system.

Health awareness is measured to assess the degree of readiness to undertake health actions [55]. This construct reflects a persons' readiness to do something for his or her own health [56].

Hypothesis 5- *Privacy* will have a positive and direct effect on *actual use* of the PHC system.

Privacy is defined as the extent to which a respondent believes that PHC system will not compromise his/her privacy [51].

Hypothesis 6- *User self-efficacy* will have a positive and direct effect on *actual use* of the PHC system.

Perceived Self efficacy is defined as the one's belief that PHC can improve/benefit health. Condition [51].

Hypothesis 7- Facilitating condition will have a positive and direct effect on *actual use* of the PHC system.

Facilitating condition is defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system. Or to provide PHC system. This definition captures concepts embodied by three different constructs: perceived behavioral control, facilitating condition, and compatibility [41].

Hypothesis 8- *Past experience of using any eHealth system other than PHC* system will have a positive and direct effect on *actual use* of the PHC system.

Hypothesis 9- Attitude towards using PHC system will have a positive and direct effect on *actual use* of the PHC system.

Attitude towards using PHC system: is defined as a psychological factor which represents an individuals' readiness to perform a certain behavior or action. Attitude is defined as particular behavior is good/bad; useful/a waste of time; rewarding/not rewarding; responsible/not responsible; sensible/not sensible; hygienic/not hygienic [203]. Attitude means individual's positive or negative feeling about performing the

target behavior [197].

Hypothesis 10- *Internet access* will have a positive and direct effect on *actual use* of the PHC system.

Hypothesis 11- *Intention to actual use* will have a positive and direct effect on *actual use* of the PHC system.

The theory of reasoned action (TRA) by ref. [204] has identified that intention to perform behavior as the immediate determinants of behavior.

- **Statistical data analysis method:**

We will apply two well established statistical methods to analyze our data, which are: Exploratory Factor Analysis (by using Statistical Package for Social Sciences (SPSS) 25.0): We will use exploratory factor analysis to measure factors that were used in our proposed research model. Structural Equation Modeling (by using Analysis of a Moment Structures (AMOS) 25.0 software tool): We will use Structural Equation Modeling statistical technique to identify cause and effect relationship among factors.

- **Utilization of Results:**

The result can identify the degree (value) of relationship between statistically significant variables. The study can also offer important practical guidelines to PHC service providers in enhancing *actual use* of PHC service. Results can suggest way of increasing health awareness and to build awareness to *use* PHC service to policy makers. The results of this study can also contribute to make policy to reduce morbidity rate in the country.

For the sake of dissemination of the research findings, manuscripts will be published in peer reviewed journals as well as seminar and symposiums will be arranged within the country as well as outside the country with the approval of the BMRC.

- **Facilities:**

Facilities Available: Portable Health Clinic (PHC) service will be provided by one specific well institute Grameen Communications**.** Interviews will be conducted in the PHC service providing points of the targeted areas. Our PHC health check-up service will provide 16 basic health check-up package (following table shows the health check-up name providing by PHC service) freely. One pre-trained health care worker will operate the PHC system to measure all of these health check-up. We targeted one rural area and one urban area in Bangladesh which are (i) Rural area: Ekhlaspur Union (6 out of 9 wards) at Matlab Uttor upazila, Chandpur and (ii) Urban area: Grameen office building in Dhaka. Matlab is a long-running surveillance site that has been ongoing for several decades. In 2014 in Matlab, about 80% mortality were from NCDs

[205]. It is located in the southern part of Bangladesh. People of Dhaka City have also high tendency to suffer from Non Communicable diseases (NCDs) because of having junk food, noisy, and polluted air.

Initial introduction is provided in the survey areas before starting data collection. Potential users will come to receive the PHC service. After receiving the PHC service, a consent form will be given and data will be collected from those who will consent to take part in the survey.

Therefore, by receiving the PHC service against the NCDs diseases, users can understand earlier the status of NCDs diseases. And they don't need to go far away to check-up and visit the doctor.

Table 2: Health check-up package providing by PHC service

#	**Health Check- up Items**	#	**Health Check- up Items**
1	Height	10	Oxygenation of Blood
2	Weight	11	Body Temperature
3	BMI	12	Blood Glucose
4	Waist	13	Urine Glucose
5	Hip	14	Urine Protein
6	Hip/Waist Ratio	15	Hemoglobin (for female)
7	Blood Pressure	16	Uric Acid
8	Pulse Rate	17	X-ray (optional)
9	Arrhythmia		

Additional facilities available: Additionally, participants who are not agree with face to face interview will be also selected for receiving the PHC health care service.

- **Ethical Implications:**

The study will only be initiated after it has been approved by the Institutional Review Board (IRB) of Bangladesh Medical and Research Council (BMRC) as well as collaborating institutes in Bangladesh. Before enrolment, signed informed consent will be obtained from the participants. The consent form will be written in Bangla in a language and format that will be easily understood by the study participants of even little education. The consent form will be read out to the study participants. Signed consent or the left thumb impression will be obtained from the participants for participation in the study. A copy of the signed consent form will be given to the

participant. There will be some personal questions (age, name, contact address) for respondents in the questionnaires. We will also collect blood and urine samples. So, some precautiouss will be taken to address the risk. Firstly, field researchers will be careful to emphasize the voluntary nature of engagement with the study and should ensure that participants will confirm written consent during the interview. Secondly, the personal questions will be asked in a calm and sensitive manner. Thirdly, during sample collection as much as possible we will take higher protection. Finally, total anonymity across all stages of the study will be maintained and access to raw data will be restricted to researchers only and stored securely.

APPENDIX 5: Documents submitted to BMRC (ANNEXURE – D)

INFORMED CONSENT FORM

- **Interviewer Details:**

Interview will be conducted by experienced data collector from Grameen Communications, Dhaka.

- **Interviewee eligibility:**

The eligibility criteria of the participants,

Adult aged older than or equal to 35 years

Residents who live at the targeted survey areas

Those who provides informed written consent

Those who are healthy enough to be able to participate in this research.

- **Purpose of the Study:**

Non-Communicable Diseases (NCDs) are increasing problem in South-East Asia, particularly in Bangladesh. It is an emerging epidemic and its prevalence was found to be high among population of 35 years old or above. In Bangladesh, only 4.7 doctors are available for 10,000 populations [5]. An eHealth system is an important way to solve the current medical facilities problem. Therefore, Grameen, Bangladesh and Kyushu University, Japan have developed one of the eHealth system called Portable Health Clinic (PHC) system to deliver preventive health care services for Non-Communicable Diseases (NCDs). Acceptance and usage of ICT based health care services is a big challenge still now. Therefore, the aim of this study is to better understand the determinants of *actual use* Portable Health Clinic (PHC) system and how their influence changes over time with increasing experience using the system to make policy for increasing actual use and better and sustainable services in the future.

- **Types of participation of the study respondents:**

If you agree to participate, we will give you a questionnaire. The questionnaire has following two parts:

2) **Part A (Socio-demographic information)**

Name, age, education level, gender, having mobile, having access to internet

connection, past experience, and, having any kind of illness etc.

2) **Part-B (Cognitive/ Perceptional factors)**

There are 13 Psychological factors that are used in the hypothetical model. Every factor will be measured by 3 questionnaire items.

Respondent will read each statement and rate each statement on 5-point Likert scales by putting √ (tick) in the number that best describes she/he. All statements will be measured on a 5-point Likert scale, where 1 = Strongly disagree, 2 = Disagree, 3= Neither Disagree nor agree, 4 = Agree, and 5 = Strongly agree.

It will take 25-30 minutes to complete the questionnaire and another 20 will need to take the health check-up. Data will be collected in 3 different points in time per year: First survey (survey 1)- after initial introduction of the PHC system (T1), Second survey (survey 2)- 4 months after the first survey (T2), Third survey (survey 3)- 4 months after the second survey (T3). The same respondent will be interviewed in the post-survey.

- **Duration, Procedures of the study and participant's involvement:**

This proposed study plan to implement a longitudinal survey with providing PHC health service for consecutive three years. The survey will be continuously conducted three years after getting the ethical permission one in every 4 months at the both targeted areas. The study will be enrolled of total 300 potential users of PHC service. Study participants will be those who have used PHC service at least once. It will include initial introduction of the PHC system, Research Protocol Design and research instrument development, pre-testing, field preparation, mapping, Staff Training & Workshop, PHC health Check-up service, data collection, data entry, Data Cleaning, data processing, data analysis, report writing, Publications and dissemination of survey findings. The study will be implemented immediately after getting the IRB approval from BMRC. The results of the study will raise awareness and actual use of eHealth technology and thereby the finding will reduce morbidity rate in the country.

- **Potential benefits:**

A participant can receive medical examination and the medical checkup results will be distributed immediately so that participant can be known health status immediately.

After the health check-up, participants can consult with remote doctor by skype based on the medical examination results and receive prescription if necessary. These health check-up and doctor's consultation will be free of charge. Participants may benefit in the future from the information we find in this study through decision making based on the findings. At this PHC services, you can receive the following health check-up and doctor's

consultations.

- **Risks, hazards and discomforts:**

There is a possibility of adverse health effects due to health examination. In principle, however, medical equipment used for medical examination was approved by the Pharmaceutical Affairs Law of Japan and Bangladesh. Some medical instruments (pulse oximeter) will remodel the equipment for automatic transmission of data, so it will be out of the approval of the law, but the possibility of affecting health examination is It is considered to be low.
Possible side effects are drugs purchased at a later date by prescription prescribed by remote doctor / consultation by doctor. The prescription is limited to antihypertensive agents against hypertension and minimizes the possibility of side effects. Regarding cardiovascular diseases other than hypertension (arrhythmia etc.) and kidney disease (urine protein positive), complications such as hypoglycemia and medical treatment of the original disease are especially required, so we will not prescribe.

- **Reimbursements:**

The patients will receive free investigations for their current illness. None of the patients will pay any money for participation in this study. The participants shall be provided best possible, free treatment for any research related injuries.

- **Confidentiality:**

We shall assure that the privacy, anonymity and confidentiality of data/information identifying the patient will be strictly maintained. We would keep all the medical information, description of treatment, and results of laboratory tests performed confidential, and stored in a safe place, under lock and key under the responsibility of the principal investigator. None other than the investigators of this research study; possible study monitor; regulatory authorities, such as the Ethical Review Committee (ERC); and any law-enforcing agency in the event of necessity would have access to the information. We want to mention here that data related to the study will not be sent outside the country for analysis. The name or any identification of the patients would not be disclosed while publishing the results of this study.

- **Termination of study participation / Rights to withdraw from participation:**

The participation in the study is totally voluntary and one has the sole authority to decide for or against the participation into the study. Anyone may refuse enrolment of him/her in the study. The participants would also be able to withdraw their consent at

any time during the study, without showing any reason and without any prejudice or penalty or loss of care, benefits or attention.

If you agree to our proposal of enrolling you in our study, please indicate that by putting your signature or your left thumb impression at the specified space below:

Thank you for your cooperation.

- Name of the participant: ----------
- Signature/Thumb print of the participants:----------
- Name of the witness:----------
- Signature of the witness:----------
- Name of the interviewer:----------
- Signature of the interviewer:----------

Name and contact phone number of Principal Investigator:

Masuda Begum Sampa

Ph.: +81-80-7989-3966

APPENDIX 6: Documents submitted to BMRC

(অবহিতক্রমে সম্মতিপত্র)

- সাক্ষাৎকার গ্রহকারীদের যোগ্যতা

  গ্রামীন কম্যুনিকেশনের তত্বাবধানে সংশ্লিষ্ট কাজে অভিজ্ঞ ডাটা কালেক্টরদের দ্বারা ডাটা সংগ্রহ করা হবে।

- সাক্ষাতকারী নির্বাচিত হওয়ার যোগ্যতাঃ অংশগ্রহনকারীদের (রোগী) দের নিম্নলিখিত যোগ্যতা থাকতে হবেঃ

  ৩৫ বছর বা তদুর্ধ বয়স এর হতে হবে
  টার্গেট এরিয়ার বাসিন্দা হতে হবে
  এ ব্যাপারে অবহিত হয়ে লিখিত সম্মতি দিতে হবে
  যারা এই সার্ভে অংশগ্রহণ করার মত সুস্থ আছেন

- গবেষণার উদ্দেশ্যঃ

নন-কম্যুনিক্যাবল ডিজিজ (অসংক্রামক রোগ) দক্ষিন-পূর্ব এশিয়া বিশেষ করে বাংলাদেশের একটি দ্রুত বর্ধনশীল সমস্যা। ধীরে ধীরে এটি মহামারী আকার ধারন করছে, যা ৩৫ উর্ধ মানুষের জন্য অত্যন্ত প্রকট। বাংলাদেশে প্রতি ১০,০০০ মানুষের জন্য মাত্র ৪.৭ জন ডাক্তার রয়েছে। আর এই সমস্যা সমাধানে ই-হেলথ একটি গুরুত্বপূর্ণ উপায় হয়ে উঠতে পারে। এইসব দিক বিবেচনায় গ্রামীন কম্যুনিকেশন, বাংলাদেশ এবং কিয়ুশু বিশ্ববিদ্যালয়, জাপান যৌথভাবে পোর্টেবল হেলথ ক্লিনিক (PHC) সিস্টেম নামে একটি ই-হেলথ সিস্টেম উদ্ভাবন করেছে। কিন্তু এখন পর্যন্ত তথ্য ও যোগাযোগ প্রযুক্তি ব্যবহার করে প্রদত্ত ই-হেলথ এর গ্রহনযোগ্যতা একটি চ্যালেঞ্জের সম্মুখীন। তাই এই গবেষণার উদ্দেশ্য হচ্ছে, পোর্টেবল হেলথ ক্লিনিক এর প্রকৃত গ্রহনযোগ্যতার নির্ণায়কগুলো আরো ভালোভাবে নির্ণয় করা এবং সময়ের পরিক্রমায় সেটি কিভাবে পরিবর্তিত হয় সেটা বের করা।

- গবেষণায় উত্তরদাতার অংশগ্রহনের ধরণঃ

যদি আপনি অংশগ্রহন করতে সম্মত হন, তাহলে আপনাকে একটা প্রশ্নপত্র দেয়া হবে। প্রশ্নপত্রে দুইটি ভাগ আছেঃ

(১) ক বিভাগ

নাম, বয়স, শিক্ষাগত যোগ্যতা, লিঙ্গ, মোবাইল আছে কিনা, ইন্টারনেট আছে কিনা, পূর্ব অভিজ্ঞতা, এবং কোন ধরনের রোগ বালাই আছে কিনা ইত্যাদি।

(২) খ বিভাগ

এই বিভাগে মোট ১৩ টি ফ্যাক্টর আছে, যেগুলো হাইপোথেটিকেল মডেল এ ব্যবহার করা হয়েছে।। প্রতেকটা ফ্যাক্টর এর জন্য সর্বনিম্ন ৩টা প্রশ্ন জিজ্ঞাসা করা হবে। উত্তরদাতা প্রতিটি বাক্য পড়ে ১ থেকে ৫ এর মধ্যে তার মতামত দিবেন।

এই প্রশ্নপত্র সম্পূর্ণ করতে ২৫-৩০ মিনিট সময় লাগবে। প্রতি বছর ৩ বার এই ডাটা সংগ্রহ করা হবেঃ ১) সার্ভে-১ প্রাথমিকভাবে পোর্টেবল হেলথ ক্লিনিক সম্পর্কে জানানোর পরে (T1), ২) সার্ভে-২ প্রথম সার্ভে সম্পন্ন হবার চারমাস পর, ৩) সার্ভে-৩ দ্বিতীয় সার্ভে সম্পন্ন হবার চারমাস পর। একই অংশগ্রহনকারীরই পরের ধারাবাহিক সার্ভেগুলোতে সাক্ষাতকার করা হবে।

- গবেষনার মেয়াদ, গবেষণার পদ্ধতি এবং অংশগ্রহনকারীদের সংযুক্ততাঃ

প্রস্তাবিত গবেষণার উদ্দেশ্য হচ্ছে পোর্টেবল হেলথ ক্লিনিকের ব্যবহারকারীদের উপর টানা তিনবছরের একটি দীর্ঘমেয়াদী সার্ভে পরিচালনা, যা শুরু কর প্রতি চার মাস অন্তর অন্তর **তিনবছর** পর্যন্ত চলবে। একাজে পোর্টেবল হেলথ ক্লিনিকের ৩০০ জন সম্ভাব্য ব্যবহারকারীকে নিবন্ধন করা হবে, যারা অন্ততপক্ষে একবার এই পদ্ধতি ব্যবহার করেছে। পোর্টেবল হেলথ ক্লিনিক এর প্রাথমিক উপক্রমনিকা থেকে শুরু করে গবেষনার প্রটোকল ডিজাইন, আনুষাংগিক যন্ত্রপাতির উদ্ভাবন, প্রাথমিক সমীক্ষা, মাঠপর্যায়ের প্রস্তুতি, তথ্য সংগ্রহ, ডাটা এন্ট্রি, ডাটা প্রসেসিং, ডাটা বিশ্লেশন, রিপোর্ট রাইটিং, প্রকাশনা এবং প্রাপ্ত ফলাফল প্রচারসহ সবকিছুই এই গবেষণার অন্তর্ভুক্ত থাকবে। বাংলাদেশ চিকিৎসা গবেষণা পরিষদের অনুমোদন পাওয়ার পর পরই কাজ শুরু করা হবে। গবেষণার প্রাপ্ত ফলাফল গন সচেতনতা বৃদ্ধি করবে, ই-হেলথ টেকনোলজির প্রকৃত ব্যবহার বাড়িয়ে মৃত্যুহার কমাতে সাহায্য করবে।

- **সম্ভাব্য সুফলঃ**

সার্ভে প্রক্রিয়ায় অংশগ্রহণকারী প্রত্যেকের মেডিকেল চেক-আপ করা হবে এবং চেক-আপ রেজাল্ট সাথে সাথেই জানিয়ে দেয়া হবে, যাতে অংশগ্রহণকারী তার স্বাস্থ্যের অবস্থা জানতে পারেন। চেক-আপ এর পরে অংশগ্রহণকারী ডাক্তারের সাথে স্কাইপে এর মাধ্যমে কথা বলতে পারবেন। বর্ণিত চেক-আপ এবং ডাক্তারের সাথে স্কাইপে কথোপকথন- এই প্রক্রিয়াগুলোর জন্য কোন ফি দেয়া লাগবে না। অংশগ্রহণকারী এই গবেষণালব্ধ ফলাফল থেকে ভবিষ্যতে লাভবান হতে পারবেন বলে আশা করা যায়। আমাদের এই কার্যক্রমের মাধ্যমে আপনি সর্বোচ্চ যে সকল স্বাস্থ্য পরীক্ষা করাতে পারবেন তা হলো:

১) উচ্চতা ২) ওজন ৩) বিএমআই ৪) শরীরের তাপমাত্রা ৫) ব্লাড প্রেশার ৬) কোমরের মাপ ৭) হিপ এর মাপ ৮) কোমর-হিপের অনুপাত ৯) রক্তে অক্সিজেন এর পরিমান ১০) ব্লাড গ্লুকোজ (ডায়াবেটিকস) ১১) ইউরিন গ্লুকোজ ১২) ইউরিন প্রোটিন ১৩) পালস্ রেট ১৪) অ্যারিথমিয়া ১৫) রক্তের হিমোগ্লোবিন পরীক্ষা (শুধুমাত্র মহিলাদের জন্য) ১৬) ইউরিক এসিড পরীক্ষা এবং ১৭)এক্স-রে।

- ঝুকি, বিপদ এবং অস্বস্তিঃ

যে কোন স্বাস্থ্য পরীক্ষায় স্বাস্থ্যগত বিরুপ প্রতিক্রিয়ার সম্ভাবনা থাকে । এক্ষেত্রে, ফারমাসিউটিক্যাল ল অব জাপান এবং বাংলাদেশ কর্তৃক অনুমোদিত যন্ত্রপাতি চেক-আপ এর জন্য ব্যবহার করা হবে । স্বয়ংক্রিয় ডাটা ট্রান্সমিশনের জন্য কিছু কিছু যন্ত্রপাতির রিমডেলড ভার্সন, যেমন পালস অক্সিমিটার, ব্যবহার করা হবে, যা'র অনুমোদন এখনও সম্পন্ন হয়নি। কিন্তু স্বাস্থ্যগত বিরুপ প্রতিক্রিয়ার ঝুকি সর্বনিম্ন সে ব্যাপার নিশ্চিত করা হবে।

ডাক্তারের দেয়া প্রেসক্রিপশন অনুযায়ী যথাসময়ে ঔষধ না কেনা একটি সম্ভাব্য স্বাস্থ্য ঝুকির কারণ, এবং পোর্টেবল হেলথ ক্লিনিকও এর বাইরে নয়। হাইপারটেনশনের রোগিদের জন্য শুধুমাত্র এন্টিহাইপারটেনসিভ এজেন্ট রেকমেন্ড করা হবে যাতে পার্শ্বপ্রতিক্রিয়া কমানো যায়। হাইপারটেনশন ছাড়াও হৃদরোগ, কিডনীকনিত সমস্যা থেকে উদ্ভূত জটিলতা, যেমন হাইপোগ্লাইসেমিয়া এবং অন্যান্য রোগের জন্য বিশেষায়িত ব্যবস্থার প্রয়োজন বলে এসব ক্ষেত্রে কোন প্রেসক্রিপশন দেয়া হবে না।

- পরিশোধ/পূনর্ভরণঃ

রোগী তাদের বরতমান অসুখের জন্য বিনা খরচে প্রয়োজনীয় স্বাস্থ্য পরীক্ষা সেবা পাবে। কোন রোগী এই সারভে কাজে অংশগ্রহণের জন্য কোন টাকা দিবে না। অংশগ্রহণকারীকে এই গবেষণাজনিত কোন সম্ভাব্য অসুস্থতার (ইনজুরি)র জন্য সম্ভাব্য সবচেয়ে ভাল চিকিতসা প্রদান করা হবে।

- গোপনীয়তাঃ

আমরা অংশগ্রনকারীদের ব্যক্তিগত গোপণীয়তা, পরিচয় এবং যে কারো কর্তৃক সনাক্তকরণের সকল তথ্যের নিরাপত্তার নিশ্চয়তা দিচ্ছি। তাদের সব ধরনের চিকিতসা সংক্রান্ত তথ্য, রোগের বিবরণ, স্বাস্থ্যপরীক্ষায় প্রাপ্ত ফলাফল ইত্যাদি প্রধান গবেষক (প্রিন্সিপাল ইনভেস্টিগেটর) এর তত্বাবধানে নিরাপদে সংরক্ষিত ও তালাবদ্ধ থাকবে। এই গবেষণার গবেষকবৃন্দ, তত্বাবধায়ক, নিয়ন্ত্রনকারী কর্তৃপক্ষ যেমন এথিক্যাল রিভিউ কমিটি, আইন প্রয়োগকারী সংস্থা (যদি দরকার পড়ে) ছাড়া আর কারো কাছে এইসব তথ্যাবলী প্রকাশ করা হবে না। উল্লেখ্য, ডাটা বিশ্লেষনের কোন পর্যায়েই গবেষণা সংক্রান্ত তথ্য দেশের বাইরে কোথাও প্রেরন করা হবে না। েই গবেষণার ফলাফল প্রকাশ কয়ার সময় অংশগ্রহনকারীদের কারো নাম বা পরিচয় প্রকাশ করা হবে না।

- গবেষণায় অংশগ্রহণ পরিসমাপ্তি / অংশগ্রহণ থেকে প্রত্যাহারের অধিকারঃ

  গবেষণায় আপনার অংশগ্রহণ সম্পূর্ণ স্বেচ্ছাসেবী এবং গবেষণায় আপনার অংশগ্রহণের সিদ্ধান্ত বা সিদ্ধান্ত প্রত্যাহারের সিদ্ধান্ত আপনার আছে। আপনি গবেষণায় মধ্যে আপনার তালিকাভুক্তি প্রত্যাখ্যান করতে পারেন। আপনি গবেষণার যে কোনও সময় আপনার সম্মতি প্রত্যাহার করতে পারবেন এবং কোনো ক্ষতি বা জরিমানা বা উদ্বেগ, সুবিধা ছাড়া অথবা মনোনিবেশ না করেও তা ছাড়তে পারবেন।

  যদি আপনি আমাদের গবেষণায় আপনাকে নথিভুক্ত করার জন্য আমাদের প্রস্তাবের সাথে একমত হন, দয়া করে নিচের নির্দিষ্ট স্থানে আপনার স্বাক্ষর বা আপনার বাম আঙুলের ছাপ স্থাপন করুন:

  আপনার সহযোগিতার জন্য আপনাকে ধন্যবাদ ।

  - অংশগ্রহণকারীর নাম: ----------
  - অংশগ্রহণকারীদের স্বাক্ষর / আঙুলের ছাপ : ----------
  - স্বাক্ষীর নাম: ----------
  - স্বাক্ষীর স্বাক্ষর: ----------
  - সাক্ষাত্কার গ্রহণকারীর নাম: ----------
  - সাক্ষাত্কার গ্রহণকারীর স্বাক্ষর: ----------

প্রধান গবেষকের নাম এবং যোগাযোগের ফোন নম্বরঃ মাসুদা বেগম সম্পা,
+৮১-৮০-৭৯৮৯-৩৯৬৬

APPENDIX 7: Documents submitted to BMRC (ANNEXURE – E)

- Total Budget: 700,000 BDT
- Detailed Budget:

		Number	Freq.	Unit Cost (BDT)	Total Cost (BDT)
1	Personnel Cost (Professional Scientific Staff, Technical and other Staff. Please mention percentage of time to be devoted by each personnel to this project): Data Collectors Salary (5 Data Collectors x 14 times (rural) x 500 Taka x 5 days	5	14	2500	175000
2	Field Expenses/laboratory Cost (Venue Rental and Arrangements Cost at rural site):	1	14	8000	112000
3	Supplies and Materials (Items & quantity to be specified): Consumables such as strips, cotton, tissue papers	200	14	80	224000
4	Patient Cost (If applicable):	-	-	-	0
5	Travel Cost (Internal travel cost only): Rent a car 10,000 taka round trip	1	14	10000	140000
6	Transportation of Goods:	-	-	-	0
7	Office Stationery (Items & quantity to be specified): papers, pens, pencils. Markers	1	14	2000	28000
8	Data Processing/ Computer Charges (If applicable):	-	-	-	0
9	Printing and Reproduction: for health guideline	1	1	5000	5000
10	Contractual Services (Other than manpower):	-	-	-	0
11	Miscellaneous:				16000
				Grand Total (BDT):	700000

N.B: The above table shows expenses for survey at rural area only. The expenses for urban survey will be borne by Grameen Communication.

APPENDIX 8: Documents submitted to BMRC (SURVEY QUESTIONNAIRE)

Research Theme: Longitudinal Study to Understand Determinants of *Actual Use* of the Portable Health Clinic System and How Their Influence Changes Over Time

Instruction

1. The questionnaires are quantitative nature.

2. All participants can be provided with a summary of the research findings.

Scenario of human assisted Portable Health Clinic system:

Human Assisted Portable Health Clinic system is a modification of eHealth with preventive health care system. Portable Health Clinic box has these following four features: 1. diagnosis tools/instruments are inside this box, 2. there is a data base server system to store and send health check-up data in a central PHC server, 3. doctor call center which is located in the capital city, Dhaka to consult with remote patients over skype, and 4. the Portable Health Clinic box is carried and used by one pre-trained nurse or paramedics.

This system helps to save doctor's time as the doctor does not need to ask questions about patient's health history but can focus on the immediate health problem. From this service people can know about their status/ condition of non- communicable diseases (NCD) such as blood pressure, diabetes, pulse rate etc. without going to doctor's chamber. Therefore, people can save money and time too. This PHC system is also promising to protect patient's privacy. To identify NCD diseases this system will contribute to reduce morbidity rate in the country.

Part A (Socio-demographic information)

1. Do you have mobile phone?

□ Yes □ No

2. Do you have access to internet connection in your mobile, computer, tab etc?

□ Yes □ No

3. Did you use eHealth services other than PHC service before?

□ Yes □ No

4. Do you have any kind of illness?

□ Yes □ No

Part-B (Cognitive/ Perceptional questions)

5. Please read following each statement and rate each statement on 5-point Likert scales by putting √ (tick) in the number that best describes you. All statements will be measured on a 5-point Likert scale, where 1 = Strongly disagree, 2 = Disagree, 3= Neither Disagree nor agree, 4 = Agree, and 5 = Strongly agree.

(1=Strongly Disagree, 2=Disagree, 3= Neither Disagree nor agree, 4= Agree, 5= Strongly agree)

Perceived Usefulness: the extent to which a person believes that using the PHC system will improve his or her health.					
5-1. Using the PHC system would help me to better manage/maintain of my health.	1	2	3	4	5
5-2. I feel using the PHC system increases my productivity.	1	2	3	4	5
5-3. I feel PHC system is useful in my daily life.	1	2	3	4	5
5-4 Using PHC system will enhance my life effectiveness.					
Perceived ease of use: the extent to which a respondent/user believes that using the PHC system is free of effort. In other words, respondent's perception of how easy or difficult it is to use the PHC system.					
5-5. PHC system is clear and understandable to me.	1	2	3	4	5
5-6. To Interact with the PHC system does not require a lot of mental efforts /mental force/ need not to struggle with mind.	1	2	3	4	5
5-7. I did not feel hesitate to use PHC system.	1	2	3	4	5
5-8. I found receiving PHC service is easy.	1	2	3	4	5
5-9. I feel comfortable to use PHC system to share my health information.	1	2	3	4	5
Perceived Output quality: Is defined as how well the system performs the relevant tasks, which we refer to as perception of output quality.					
5-10. The quality of output I get from PHC system is high.	1	2	3	4	5
5-11. I have no problem with the quality of the PHC system's output.	1	2	3	4	5
Perceived result demonstrability: Is defined as the actualness **of the results of using the PHC system.**					
5-12. The results of using the PHC system are possible/ probable to me.	1	2	3	4	5
5-13. I have no difficulty to telling others about the results of using the PHC system.	1	2	3	4	5
Social influence: Reference from friends/ family members/ loved one					
5-14. People who are important to me think that I should use the PHC system. (Other than family members),.	1	2	3	4	5
5-15. My family members prefer to use PHC system.	1	2	3	4	5
5-16. My community people thinks that I should use PHC system.	1	2	3	4	5
5-17. Without cooperation or understanding from family, it is difficult to use PHC system for me.	1	2	3	4	5
Trust on PHC system: means the degree to which an individual believes the PHC system					
5-18. I trust the health care services that is provided by PHC system.	1	2	3	4	5

(health check-up, prescription)					
5-19. I believe that the PHC system keeps its promises to protect patient's privacy.	1	2	3	4	5
5-20. If your trust about PHC system gets broken once, you will stop receiving service.	1	2	3	4	5
5-21. PHC service is reliable to me	1	2	3	4	5
Privacy: is defined as the extent to which a respondent believes that PHC system will not compromise his/her privacy.					
5-22. I believe privacy of PHC participants is protected.	1	2	3	4	5
5-23. I believe personal information stored in PHC system is safe.	1	2	3	4	5
5-24. I believe PHC systems to keep participants information secure.	1	2	3	4	5
Health awareness: Health awareness is measured to assess the degree of readiness to undertake health actions.					
5-25. I consider myself very health conscious.	1	2	3	4	5
5-26. I think that I take into account health a lot in my life.	1	2	3	4	5
5-27. I think that other people pay more attention to their health than I do.	1	2	3	4	5
5-28. I want to improve my health condition.	1	2	3	4	5
5-29. I want to expand money for my health.	1	2	3	4	5
Perceived Self efficacy (SE): Is defined as the belief in one's capability to receive PHC service. Or judgement of one's capability to receive PHC service.					
5-30. I think I will use PHC service for health check-up.	1	2	3	4	5
5-31. I will follow PHC prescription..	1	2	3	4	5
5-32. By using PHC system I can prevent seriousness of diseases (silent killers e.g. diabetes, stroke, heart-failure, kidney-failure).	1	2	3	4	5
Facilitating condition: defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system. Or to provide PHC system. This definition captures concepts embodied by three different constructs: perceived behavioral control, facilitating condition, and compatibility.					
5-33. A specific institute exists to providing PHC health care service.	1	2	3	4	5
5-34. I have the knowledge necessary to receive the PHC system. (Explanation: It can prevent NCD diseases)	1	2	3	4	5
5-35. PHC health care service is compatible with other health care service I use.	1	2	3	4	5
5-36. I feel happy because the PHC system is operated by one pre-trained nurse.	1	2	3	4	5
Attitude towards using PHC system: is defined as a psychological factor which represents an individuals' readiness to perform a certain behavior or action. Attitude is defined as particular behavior is good/bad; useful/a waste of time; rewarding/not rewarding; responsible/not responsible; sensible/not sensible; hygienic/not. Attitude means "Individual's positive or negative feeling about performing the target behavior.					
5-37. PHC system using saves my time.	1	2	3	4	5
5-38. PHC system is workable to prevent NCD diseases.	1	2	3	4	5
5-39. Using PHC system is a good idea.	1	2	3	4	5
5-40. I feel good to receive PHC service.	1	2	3	4	5

Intention to use PHC at the next time					
5-41. I intend to use PHC system in the future.	1	2	3	4	5
5-42. If PHC system is available, I will always use it.	1	2	3	4	5
5-43. It is worth to receive PHC service.	1	2	3	4	5
Actual use of PHC system					
5-44. PHC system is a pleasant experience.	1	2	3	4	5
5-45. I spend time to know about PHC system.	1	2	3	4	5
5-46. Using PHC system causes many advantages.	1	2	3	4	5
5-47. I like to use PHC system.					

APPENDIX 9: Questionnaire for Survey (Bangla Version)

প্রশ্নমালা

গবেষণার বিষয়: PHC **স্বাস্থ্যসেবা সম্পর্কে মানুষের অভিমত**

নোটঃ প্রশ্ন কারী প্রথমে একটি সম্মতি পত্র উত্তরদাতাকে দিবেন। প্রশ্ন কারী উত্তরদাতাকে প্রশ্ন শুরু করার আগে PHC সম্পর্কে একটা ব্যাখা প্রদান করবেন।

ক বিভাগ

১. আপনার কি মোবাইল ফোন আছে?

□ হ্যাঁ □ না

২. আপনি কি ইন্টারনেট ব্যবহার করেন?

□ হ্যাঁ □ না

৩. আপনি কি PHC স্বাস্থ্যসেবা ব্যতিত অন্য কোন ই-স্বাস্থ্যসেবা পূর্বে ব্যবহার করেছেন?

□ হ্যাঁ □ না

৪. আপনার কি কোন প্রকার শারিরীক অসুস্থতা আছে?

□ হ্যাঁ □ না

খ বিভাগ

৫.নীচের প্রশ্নগুলির জন্য ১ থেকে ৫ এর মধ্যে আপনার মতামত দিবেন √ (টিক) দিয়ে।

১.সম্পূর্ণরুপে অসম্মতি ২. অসম্মতি ৩. সিদ্ধান্তহীন ৪. সম্মতি ৫. সম্পূর্ণরুপে সম্মতি

[A] Perceived Usefulness (5-1 to 5-4)					
5-1. PHC স্বাস্থ্যসেবা আমার শরীর স্বাস্থ্য / (সুস্বাস্থ্য বজায়) ভাল রাখতে সাহায্য করবে। (ব্যাখ্যাঃ PHC স্বাস্থ্যসেবা নিলে আপনি উচ্চ রক্ত চাপ , ডায়বেটিস, ইত্যাদি রোগ বালাই প্রতিরোধ ও নিয়ন্ত্রণ এ রাখতে পারবেন । আপনি আপনার স্বাস্থ্য সম্পর্কে আগে থেকে সচেতন হতে পারবেন এবং সুস্থ থাকতে পারবেন। সুতরাং আপনার শরীর ভাল থাকবে। আপনি কতটুকু সম্মত ১ থেকে ৫ এর মধ্যে বলুন)	১	২	৩	৪	৫
5-2. PHC স্বাস্থ্যসেবা আমার উৎপাদনশীলতা বৃদ্ধি/ (বেশি কাজ -কর্ম) করতে সাহায্য করবে। (ব্যাখাঃ PHC স্বাস্থ্যসেবা আপনার সময় রক্ষা করবে কারন আপনাকে ডাক্তার দেখাতে এবং চেক-আপ করতে দূরে যেতে হবে না)	১	২	৩	৪	৫

5-3. PHC স্বাস্থ্যসেবা দৈনন্দিন জীবনে উপকারী। (ব্যাখাঃ PHC স্বাস্থ্যসেবার মাধ্যমে যে সব সেবা পাবেন সেগুলি দৈনন্দিন জীবনে উপকারী কারণ আপনি আপনার শরীরে রোগ বালাই আছে কিনা জানতে পারবেন বিভিন্ন টেস্ট এর মাধ্যমে ও নিয়ন্ত্রণ এ রাখার পরামর্শ পাবেন)	১	২	৩	৪	৫
5-4. PHC স্বাস্থ্যসেবা আমার জীবনে কর্ম দক্ষতা বৃদ্ধি করবে । (ব্যাখাঃ কাজ করার সামর্থ্য/ কাজে দক্ষতা বৃদ্ধি করবে)	১	২	৩	৪	৫
[**B**] **Perceived ease of use** (**5-5 to 5-9**)					
9-5. PHC স্বাস্থ্যসেবা আমার কাছে স্পষ্ট ও বোধগম্য। (ব্যাখাঃ PHC স্বাস্থ্যসেবা ১৫ টা টেস্ট/ চেক-আপ প্রদান করে যেমনঃ : body temperature, blood pressure, pulse rate, blood glucose, blood grouping, urinary sugar টেস্ট , etc এই টেস্ট গুলি কেন করে আপনি জানেন ও বুঝেন).	১	২	৩	৪	৫
9-6. PHC স্বাস্থ্যসেবা ব্যবহার করার জন্য আমার বেশি মানসিক চাপ নেয়ার প্রয়োজন হয় নাই। (ব্যাখাঃ আপনার PHC স্বাস্থ্যসেবা ব্যবহার করার জন্য কোন টেনশন করতে হয় নাই)	১	২	৩	৪	৫
9-7. PHC স্বাস্থ্যসেবা ব্যবহার করার জন্য আমার ইতঃস্তত বোধ করতে হয় নাই। (ব্যাখাঃ PHC স্বাস্থ্যসেবা নিব কি নিব না এরকম দুটানায় ভুগতে হয় নাই)	১	২	৩	৪	৫
9-8. PHC স্বাস্থ্যসেবা গ্রহণ করা আমার কাছে সহজ। (ব্যাখাঃ PHC স্বাস্থ্যসেবা প্রশিক্ষিত নার্সের এর মাধ্যমে প্রদান করা করা হয় এবং সেবা নেওয়ার জন্য বেশি দূরে যেতে হয় না, টাকা লাগে না)	১	২	৩	৪	৫
9-9. স্বাস্থ্য সংক্রান্ত তথ্য PHC সিস্টেম এর সাথে শেয়ার করতে আমি স্বাচ্ছন্দ্য বোধ করি। (ব্যাখাঃ স্বাস্থ্য তথ্য PHC সিস্টেম এর ডাক্তার, নার্স দের সাথে শেয়ার করতে স্বাচ্ছন্দ্য বোধ করি কারন ডাক্তার মুখোমুখি থাকে না এবং স্বাস্থ্য তথ্য গোপন থাকে)	১	২	৩	৪	৫
[C] Perceived Output quality (5-10 to 5-11)					
9-10. PHC স্বাস্থ্যসেবা আমার কাছে খুব ভাল মনে হইছে।	১	২	৩	৪	৫
9-11. PHC স্বাস্থ্যসেবার মাধমে আমি যে সার্ভিস পাইছি তাতে আমার কোন সমস্যা নাই। (ব্যাখাঃ শারিরীক পরীক্ষা, ঔষধ নির্দেশিকা ইত্যাদিতে আপনার কোন সমস্যা নাই)	১	২	৩	৪	৫
[D] Perceived Result demonstrability (5-12 to 5-13)					
9-12. PHC স্বাস্থ্যসেবার মাধ্যমে পাওয়া টেস্ট এর রেজাল্ট আমার কাছে বাস্তবিক মনে হয়। (ব্যাখাঃ শারিরীক পরীক্ষার রেজাল্ট যেমন উচ্চ রক্ত চাপ মাপার পরে যে রেজাল্ট পাইছেন আপনার কাছে কতটুকু সম্ভাব্য মনে হয়? সব গুলি টেস্ট এর রেজাল্ট চিন্তা করে উত্তরদাতা উত্তর দিবে)	১	২	৩	৪	৫
9-13. অন্য মানুষ কে এই ডাক্তারী সেবার (টেস্টের রেজাল্ট, প্রেসক্রিপশন) রেজাল্ট এর কথা বলে বুঝাতে আমার কোনো সমস্যা নাই। (ব্যাখাঃ যে টেস্ট গুলি করছি এর রেজাল্ট গুলি এবং যে প্রেসক্রিপশন পাইছি সেই গুলি আপনি নিজে বুঝে অন্য মানুষকে বলতে পারবেন)	১	২	৩	৪	৫
[E] Social influence (5-14 to 5-17)					
9-14. যেসব মানুষ আমার কাছে গুরুত্বপূর্ণ তারা মনে করেন যে আমার PHC স্বাস্থ্যসেবা ব্যবহার করা উচিত। (ব্যাখাঃ পরিবারের সদস্যবৃন্দের বাইরের লোকজন)	১	২	৩	৪	৫
9-15. আমার পরিবারের লোকজন আমার PHC স্বাস্থ্যসেবা ব্যবহার করা পছন্দ করেন।	১	২	৩	৪	৫

9-16. আমার আশে-পাশের/সমাজের লোকজন মনে করেন যে, আমার PHC স্বাস্থ্যসেবা ব্যবহার করা উচিত। (ব্যাখাঃ প্রতিবেশী, পাড়া, গ্রামের লোকজন)	১	২	৩	৪	৫
9-17. পরিবারের সঙ্গে বুঝা-পড়া ছাড়া আমার জন্য PHC স্বাস্থ্যসেবা/ ডাক্তারী- সেবা ব্যবহার করা কঠিন।	১	২	৩	৪	৫
[F] Trust on PHC system (5-18 to 5-21)					
9-18. PHC স্বাস্থ্যসেবায় আমার বিশ্বাস/আস্থা আছে। (ব্যাখাঃ শারিরীক পরীক্ষা, ঔষধ নির্দেশিকা ইত্যাদি)	১	২	৩	৪	৫
9-19. আমি বিশ্বাস করি PHC স্বাস্থ্যসেবা ব্যবহারকারীদের ব্যক্তিগত গোপনীয়তা বজায় রাখার অংগীকার রক্ষা করে। (ব্যাখাঃ PHC স্বাস্থ্যসেবার অংগীকারকে (একজনের তথ্য অন্য জন কে বলবে না, প্রথমেই PHC সম্পর্কে বলার সময় এই কথা বলা আছে অর্থাৎ অংগীকার করছে । এই অংগীকার টা আপনি কতটুকু বিশ্বাস করেন)	১	২	৩	৪	৫
9-20. PHC স্বাস্থ্যসেবার উপর আমার বিশ্বাস/আস্থা একবার নষ্ট হয়ে গেলে, আমি এই সেবা নেয়া বন্ধ করে দিব। (ব্যাখাঃ একবার আপনার বিশ্বাস/আস্থা কোন কারনে নষ্ট হয়ে গেলে)	১	২	৩	৪	৫
9-21. PHC স্বাস্থ্যসেবা আমার কাছে নির্ভরযোগ্য মনে হয়।	১	২	৩	৪	৫
[G] Privacy (5-22 to 5-23)					
9-22. আমি বিশ্বাস করি PHC স্বাস্থ্যসেবা ব্যবহারকারীদের ব্যক্তিগত গোপনীয়তা বজায় রাখবে।	১	২	৩	৪	৫
9-23. আমি বিশ্বাস করি PHC স্বাস্থ্যসেবা'র কাছে সংরক্ষিত ব্যক্তিগত তথ্য নিরাপদ থাকবে। (ব্যাখাঃ যেমন ব্যাংক এ টাকা নিরাপদ থাকে অন্য কেউ চুরি করতে পারে না তেমনি PHC স্বাস্থ্যসেবা'র কাছে দেওয়া তথ্য অন্য কেউ চুরি করতে পারবে না)	১	২	৩	৪	৫
9-24. PHC স্বাস্থসেবার কাছে অংশগ্রহনকারীদের তথ্যাবলী সুরক্ষিত থাকবে বলে আমি বিশ্বাস করি। (ব্যাখাঃ PHC স্বাস্থসেবার কাছে অংশগ্রহনকারীদের তথ্যাবলী অন্য কোন কাজে ব্যবহার করা হবে না)	১	২	৩	৪	৫
[H] Health awareness (5-25 to 5-29)					
9-25. আমি নিজেকে অনেক বেশি স্বাস্থ্য সচেতন বলে মনে করি। (ব্যাখাঃ স্বাস্থ্য সচেতন বলতে স্বাস্থ্য ভাল রাখার চেষ্টা করা, রোগ বালাই হলে ডাক্তার এর কাছে যাওয়া, ভাল খাবার খাওয়া, ব্যায়াম করা)	১	২	৩	৪	৫
9-26. আমার মনে হয় স্বাস্থ্য আমার জীবনের অনেক বড় একটা বিষয়। (ব্যাখাঃ স্বাস্থ্য অনেক গুরুত্বপূর্ণ)	১	২	৩	৪	৫
9-27. আমার মনে হয় অন্যান্য মানুষ শরীর-স্বাস্থ্যকে আমার চেয়ে বেশি গুরুত্ব দিয়ে দেখে।	১	২	৩	৪	৫
9-28. আমি আমার শরীর-স্বাস্থ্যের উন্নতি করতে চাই। (ব্যাখাঃ রোগ বালাই প্রতিরোধ ও নিয়ন্ত্রণে রাখতে চাই)	১	২	৩	৪	৫
9-29. আমি আমার স্বাস্থ্যের প্রয়োজনে টাকা খরচ করতে রাজি। (ব্যাখাঃ অসুখ হলে ডাক্তার এর কাছে গিয়ে টেস্ট করা, ওষুধ কিনা)	১	২	৩	৪	৫
[I] Perceived Self efficacy (5-30 to 5-32)					
9-30. PHC স্বাস্থ্যসেবা গ্রহণের জন্য প্রস্তুত থাকব। (ব্যাখাঃ সময়মত সার্ভিস সেন্টারে উপস্থিত থাকব, অপেক্ষা করব, প্রয়োজনীয় কাগজপত্র যেমন আইডি কার্ড যত্ন করে রেখে দিব)	১	২	৩	৪	৫
9-31. আমি PHC স্বাস্থ্যসেবার মাধ্যমে পাওয়া ঔষধ নির্দেশিকা মেনে চলব। (ব্যাখাঃ পরামর্শ মেনে চলব)	১	২	৩	৪	৫

9-32. PHC স্বাস্থ্যসেবা ব্যবহারের মাধ্যমে আমি আমার স্বাস্থ্য সম্পর্কে অবগত হতে চাই। (ব্যাখাঃ নিরব ঘাতক, যেমন, ডায়াবেটিস, স্ট্রোক, হার্ট-ফেইলিওর, কিডনি-ফেইলিওর ইত্যাদি আছে কিনা এবং কোন পর্যায়ে আছে জানতে চাই)	১	২	৩	৪	৫
[J] Facilitating condition (5-33 to 5-36)					
9-33. PHC স্বাস্থ্যসেবা দেয়ার জন্য একটা সুনির্দিষ্ট প্রতিষ্ঠান আছে। (ব্যাখাঃ যেমন গ্রামিন কমিউনিকেশন থেকে এই সেবা প্রদান করা হয়)	১	২	৩	৪	৫
9-34. PHC স্বাস্থ্যসেবা নেয়ার মত প্রয়োজনীয় জ্ঞান আমার আছে। (আপনার মতামত ১ থেকে ৫ এর মধ্যে বলুন,)	১	২	৩	৪	৫
9-45. PHC স্বাস্থ্যসেবা অন্যান্য প্রথাগত স্বাস্থ্যসেবার মতই সার্ভিস দিতে পারে। (আপনার মতামত ১ থেকে ৫ এর মধ্যে বলুন,)	১	২	৩	৪	৫
9-36. PHC স্বাস্থ্যসেবা একজন প্রশিক্ষিত নার্স দিয়ে পরিচালিত হওয়ায় আমি খুশি। ব্যা(খাঃ আপনার মতামত ১ থেকে ৫ এর মধ্যে বলুন,)	১	২	৩	৪	৫
[K] Attitude towards using PHC system (5-37 to 5-40)					
9-37. PHC স্বাস্থ্যসেবা ব্যবহার করলে আমার সময় বাচবে। (ব্যাখাঃ হাতে সময় থাকে কারন ডাক্তার দেখাতে দূরে যেতে হবে না)	১	২	৩	৪	৫
9-38. PHC স্বাস্থ্যসেবা রোগ প্রতিরোধে কাজ/ সাহায্য করবে। ব্যাখাঃ আপনি কতটুকু সম্মত ১ থেকে ৫ এর মধ্যে বলুন,)	১	২	৩	৪	৫
9-39. PHC স্বাস্থ্যসেবা ব্যবহার করা একটা ভালো চিন্তা/ উদ্যোগ। ব্যাখাঃ আপনি কতটুকু সম্মত ১ থেকে ৫ এর মধ্যে বলুন,)	১	২	৩	৪	৫
9-40. PHC স্বাস্থ্যসেবা ব্যবহার করতে আমার ভাল লেগেছে। ব্যাখাঃ আপনি কতটুকু সম্মত ১ থেকে ৫ এর মধ্যে বলুন,)	১	২	৩	৪	৫
[L] Intention to use PHC at the next time (5-41 to 5-43)					
9-41. ভবিষ্যতে আমার PHC স্বাস্থ্যসেবা ব্যবহার করার ইচ্ছা আছে। (ব্যাখাঃ ইচ্ছা কতটুকু ১ থেকে ৫ এর মধ্যে বলুন। যেমনঃ যদি বলে একদম ইচ্ছা নাই তাহলে ১ এ টিক দিতে হবে, একটু ইচ্ছা থাকলে ২, এর থেকে একটু বেশি থাকলে ৩ এই রকম ঈচ্ছার লেভেল শুনে টিক দিতে হবে ১ থেকে ৫ এর মধ্যে বলুন)	১	২	৩	৪	৫
9-42. যদি PHC স্বাস্থ্যসেবা পাওয়া যায়, আমি সব সময় ব্যবহার করব। (ব্যাখাঃ আপনি কতটুকু সম্মত ১ থেকে ৫ এর মধ্যে বলুন. । একবার ও ব্যবহার করব না =১, সব সময় ব্যবহার করব =৫,)	১	২	৩	৪	৫
9-43. PHC স্বাস্থ্যসেবা ব্যবহার করা আমার কাছে লাভজনক মনে হয়। ((ব্যাখাঃ আপনি উপকৃত হবেন। আপনি কতটুকু সম্মত ১ থেকে ৫ এর মধ্যে বলুন)	১	২	৩	৪	৫
[M] Actual use of PHC system (5-44 to 5-47)					
9-44. PHC স্বাস্থ্যসেবা ব্যবহার করা একটি মজার অভিজ্ঞতা।	১	২	৩	৪	৫
9-45. PHC স্বাস্থ্যসেবা সম্পর্কে জানতে আমি সময় ব্যয় করি। (ব্যাখাঃ ইন্টারনেট, পত্রিকা, পরিচিত মানুষ জন, লিফ লেট, এড, ইত্যাদি থেকে PHC স্বাস্থ্যসেবা সম্পর্কে খুজি এবং জানার চেস্টা করি)	১	২	৩	৪	৫

9-46. PHC স্বাস্থ্যসেবা ব্যবহারের অনেক সুবিধা আছে। (ব্যাখাঃ সুবিধা যেমন স্বাস্থ্য তথ্য জমা রাখতে পারে, খরচ কম, বেশী দূরে যেতে হয় না।)	১	২	৩	৪	৫
9-47. PHC স্বাস্থ্যসেবা ব্যবহার করা আমি পছন্দ করি। (ব্যাখাঃ PHC স্বাস্থ্যসেবা ব্যবহার করতে আমার ভাল লেগেছে।)	১	২	৩	৪	৫

APPENDIX 10: Ethical Clearance from BMRC

বাংলাদেশ চিকিৎসা গবেষণা পরিষদ
Bangladesh Medical Research Council
BMRC

Ref: BMRC/NREC/2016-2019/159 Date: 29/07/2019

National Research Ethics Committee

Registration Number: 183 25 02 2019

Principal Investigator:
Masuda Begum Sampa
Doctoral Student
Graduate School of Information Science and
Electrical Engineering
Kyushu University, Fukuoka
819-0395, Japan.

Title of the Project:
"Longitudinal Study to understand the determinants of Actual Use of the Portable Health Clinic (PHC) system and How their Influences Change Over Time"

Duration of Project: 36 Months

Budget: BDT- 7,00,000/-
In words: Seven Lac Taka Only.

Subject: Ethical Clearance

With reference to your application on the above subject, this is to inform you that above mentioned Research Title has been registered and approved by the National Research Ethics Committee (NREC).

(Dr. Mahmood-uz-jahan)
Director

BMRC Bhaban, Mohakhali, Dhaka-1212, Bangladesh.
Phone: +88 02 9848396, PABX : +88 02 9849311, Fax : +88 02 9848820, E-mail: info@bmrcbd.org. Web: www.bmrcbd.org

THE ETHICAL GUIDELINES TO BE FOLLOWED BY THE PRINCIPAL / CO-INVESTIGATORS

- ❒ The rights and welfare of individual volunteers are adequately protected.
- ❒ The methods to secure informed consent are fully appropriate and adequately safeguard the rights of the subjects (in the case of minors, consent is obtained from parents or guardians).
- ❒ The Investigator(s) assume the responsibility of notifying the National Research Ethics Committee (NREC) if there is any change in the protocol involving a risk to the individual volunteers.
- ❒ To report immediately to the NREC if any evidence of unexpected or severe adverse effect is noted on subjects under the study.
- ❒ Principal Investigator will facilitate supervision of the project by the BMRC authority time to time.
- ❒ This approval is subject to Principal Investigator's reading and accepting the BMRC ethical principles and guidelines currently in operation.
- ❒ You are requested to submit a report to the BMRC half yearly and after completion of the research work.

Checked by: GN

APPENDIX 11: SOP for Data Collection

APPENDIX

(A) CONSENT FORMS & QUESTIONNAIRES

1. SURVEY-1: Socio Demographic, Health Related, Behavioral | 30 Questions
2. SURVEY-1(b): Need Assesment for PHC Health Check up | 6 Questions
3. SURVEY-2: PHC Consumer Behaviour Survey | 47 Questions

(B) STRUCTURE & TEAM COMPOSITION, ROLES & RESPONSIBILITIES

1. List of Organizations and their Roles
2. List of Advisory Committee
3. List of Project Technical Staffs and their Roles
4. Team Structure for Rural Health Checkup Survey

CONSENT FORMS AND QUESTIONNAIRES
SURVEY-1 (ENGLISH VERSION)

This questionnaire survey will be conducted at participant's home at a different time of the PHC services. Hello. My name is …… I am from Grameen Communications. We are conducting an interview survey for our collaborative research with Kyushu University, Japan. The purpose of this research is to better understand about your health conditions, health needs, and your health behaviors for next 3 years (until 2021 March 31).

It will take about 30-45 minutes to complete this questionnaire. Your information, such as your name, telephone numbers, addresses, or anything personal should be confidential and will be protected by Grameen Communication staff. Any information of this questionnaires will not be shared with anyone other than members of our survey research team. You can stop this questionnaire anytime without any harms. This is totally voluntary to join in this survey, however we hope you will agree to join because your information is very important and can contribute to improve health status in your community. After completion of this questionnaire, you will be asked to participate in health check-up services called "Portable Health Clinic" in some other date. At this PHC services, you can receive following health check-up and doctor's consultations.

#	HEALTH CHECK UP ITEMS	#	HEALTH CHECK UP ITEMS
1	Height	10	Oxygenation of Blood
2	Weight	11	Body Temperature
3	BMI	12	Blood Glucose
4	Waist	13	Urine Glucose
5	Hip	14	Urine Protein
6	Hip/Waist Ratio	15	Hemoglobin (for female)
7	Blood Pressure	16	Uric Acid
8	Pulse Rate	17	X-ray
9	Arrhythmia		

After the health check-up, you can consult with remote doctor by skype and receive prescription if necessary. These health check-up and doctor's consultation will be free of charge. We would greatly appreciate your support on participating in this research. Would you kindly agreed to participate in this research for next 3 years until 2021 March?

a. Yes, I agree to participate in this research
b. No, I will not participate in this research

Participant's name										
Signature										
Date	d	d	-	m	m	-	y	y	y	y

SURVEY-1

SOCIO DEMOGRAPHIC, HEALTH RELATED, BEHAVIORAL | 30 QUESTIONS

This survey will be conducted at the participants' home in Ekhlaspur and in office for Grameen employees before the PHC checkup

Interview Date (Enter date when survey actually completed)	**Day** d d	**Month** m m	**Year** y y y y
Interview Place (Please circle one) Enter center or village name, ward No., house No. as appropriate.	**1-1. Ekhlaspur** **1-2. Ward#**_____ **1-3. House#**_____	**2. Grameen Bank Complex** **Name of the Organization** _____ _____	
Interviewers Name (As per National Identification card or Academic Certificate)	_____		

Name of Respondent (Patients/Participants) (As per National Identification card or Birth Certificate or Academic Certificate or Passport or Driving License)	_____
Age and Gender (As per National Identification card or Birth Certificate).	**Age** d d **Years** **Gender** **Male** **Female**
Respondent Barcode ID (Randomly Auto generated number from GramHealth: PHC System).	
Mobile Phone # Enter 11digit mobile phone number (reassure the participant on the confidential nature of this information and that this is only needed for follow up).	- - -
Address (Enter center or village name, ward No., house No. as appropriate).	_____ _____

QUESTION ABOUT PATIENT'S BASIC INFORMATION (Q 01-Q 05)

No.	Questions	Answers	
1	What is your current occupation? *The purpose of this question is to help answer other questions such as whether people in different kinds of occupations may be confronted with different risk factors.* *Select appropriate answer.*	• Government Employee • Non-Government Employee • Self-employed business • Employed by private company • Agriculture (including Farmer) • Student • House-work • Retired • Others _____	1 2 3 4 5 6 7 8 9
2	What education did you complete? *(If a person attended a few months of the first year of Secondary School but did not complete the year, select "Primary School completed". If a person only attended a few years of primary school, select "No education").* *Select appropriate answer.*	• No education (no school entered) • Primary school completed • Secondary school completed • High school completed • Vocation school completed • College/University completed • Higher (Master or Doctor) completed • Others _____	1 2 3 4 5 6 7 8
3	Can you read Bangla? *Select appropriate answer.*	• No • Little bit • Yes	1 2 3
4	What is your marital status? *Select appropriate answer.*	• Never married • Current married or living together • Divorced/separated • Widowed	1 2 3 4
5	What is your monthly family expenditure? *Select the appropriate value for the monthly household expenditure.*	• Taka 0 – 5,000 • Taka 5,001-10,000 • Taka 10,001-20,000 • Taka 20,001-50,000 • Taka 50,001 or more • Don't know	1 2 3 4 5 6

QUESTIONS ABOUT DIET/NUTRITION (Q 06-Q 14)

Q.#	Questions	Coding	Code	Skip
6	Have you tried to limit any of the following things in your diet in the past 30 days? Have you tried to limit the amount of [READ ITEM] in your diet, yes or no? *Read out all the answer options. Select the appropriate answer.*	• Sugar • Fat (oil, butter, gee, etc.) • Cholesterol • Calories • Fast food (Pizza, Hamburger, French Fries, etc.) • Others_____	1 2 3 4 5 6	
7	Have you gained over 10kg weight after the age of 20? *Select appropriate answer.*	• No • Yes • Don't know	1 2 3	
8	Have you gained or lost over 3kg weight in the last one year? *Select appropriate answer.*	• No • Yes • Don't know	1 2 3	

9	Do you eat dinner within 2 hours before bedtime three or more times a week? *Ask the participants to think about their usual food habit and select appropriate response.*	• No • Yes • Don't know	1 2 3
10	Do you drink sugar contained drinks (Coke, Fanta, Soda, Fruit Juice, other Sweet/Sugar contained drinks) three or more times a week? *Ask the participants to think about their usual food habit and select appropriate response.*	• No • Yes • Don't know	1 2 3
11	Do you eat fast foods such as Pizza, Hamburger, Deep Fried Foods (e.g. Singara, Samosa, Moglai Parata, etc.) three or more time a week? *Ask the participants to think about their usual food habit and select appropriate response.*	• No • Yes • Don't know	1 2 3
12	Do you skip breakfast three or more times a week? *Ask the participants to think about their usual food habit and select appropriate response.*	• No • Yes • Don't know	1 2 3
13	Do you eat faster than others in your similar age and sex? *Ask the participants to think about their usual food habit and select appropriate response.*	• No • Yes • Don't know	1 2 3
14	Do you want to improve your eating habits (less sugar, less fat, less calories, etc.) to be healthier? *Read out all the answer options. Select the appropriate response.*	• No • Yes within 6 months • Yes, within a month • Already trying to improve less than 6 months • Already trying to improve more than 6 months	1 2 3 4 5

QUESTIONS ABOUT PHYSICAL ACTIVITIES (Q 15-Q 18)

15	In the past 30 days, on an average how long did you usually walk outside per day? (walking outside besides other daily works such as agricultural, farming, or cleaning). *Ask the participant to consider total time they spent on walking beside their daily activities. Read out all answer options and select the appropriate response.*	• More than 1 hour per day • Less than 1 hour per day • Don't go outside for walk • Don't know	1 2 3 4
16	In the past 30 days, did you do any types of physical activities at least for 10 minutes continuously? (Multiple choices) *Ask the participants to think what types of physical activities they did in last month. Read out all answer options and select the appropriate response.*	• Cleaning house • Agricultural work including gardening • Farming work • Any sports (Cricket, Badminton, Soccer, Tennis, Volleyball, Swimming, etc.) • Bicycle (cycling) • Walking • Running/jogging • Dancing • None of these above	1 2 3 4 5 6 7 8 9

		• Others _____	10
17	Do you walk faster than other people of your same age and sex? *Select the appropriate response.*	• No • Yes • Don't know	1 2 3
18	Do you want to improve your physical activity (exercise) habits to be healthier? *Read out all answer options and ask the participants how much they have willingness to rectify their physical activities. Select the appropriate response.*	• No • Yes, within 6 months • Yes, within a month • Already trying to improve less than 6 months • Already trying to improve more than 6 months	1 2 3 4 5

QUESTIONS ABOUT DEPRESSION/MENTAL STATE (Q 15-Q 18)

19	In the last one month, how often you could not sleep properly at night? *Read out and explain all answer options to the participants and select appropriate response.*	• Never • Rarely (1-5 days per month) • Sometimes (6-10 days per month) • Most of the times (11-29 days per month) • Always (everyday)	1 2 3 4 5
20	In the last one month, how often you had to stop doing your usual activities (work, school or any other job) due to stress, depression, anxiety, or sadness? *Read out and explain all answer options to the participants and select appropriate response.*	• Never • Rarely (1-5 days per month) • Sometimes (6-10 days per month) • Most of the times (11-29 days per month) • Always (everyday)	1 2 3 4 5
21	What do you do when you are stressed or depressed? *Ask the participants to explain in details.*	Please specify _____	
22	What are the causes of your stress or depression? *Ask the participants to explain in details.*	Please specify _____	

QUESTIONS ON ORAL HEALTH (Q 23–Q 28)

23	How often do you brush your teeth every day? *Read out all answer options to the participants and select appropriate response.*	• Not brush • One time a day • Two times a day • Three or more times a day	1 2 3 4
24	Do you brush your teeth before you go to sleep at night? *Read out all answer options to the participants and select appropriate response.*	• Never • Rarely • Sometimes • Most of the times • Always	1 2 3 4 5
25	What do you usually use for your brushing?	• Tooth brush (Brand) • Hand • Tree branch	1 2 3

	Read out all answer options to the participants and select appropriate response.	• Tooth powder • Do not use tooth brush • Others, please specify _____	4 5 6
26	Have you visited any dental clinic or dentist in the last 6 months? *Select appropriate response.*	• No • Yes • Don't know	1 2 3
27	Do you have pain in your teeth, jaw or any parts in your mouth? *(Multiple choices)* *Read out and explain all answer options to the participants and select appropriate response.*	• No • Yes If yes, what kind of pain? • Sore pain • Burning pain • Swelling pain • Pain in throat (Sore throat) • Pain in tongue • Pain in jaw • Pain by lump in mouth • Pain by ticking in mouth • Other kind of pain, please specify _____	1 2 2-1 2-2 2-3 2-4 2-5 2-6 2-7 2-8 2-9
28	How many teeth have you lost? *Select appropriate response.*	• No loss of my tooth (complete tooth) • One tooth lost • Two teeth lost • Three teeth lost • Four teeth lost • Five or more tooth lost	1 2 3 4 5 6

QUESTIONS ABOUT EYE (VISION) HEALTH (Q 29-Q 30)

29	Do you have any vision difficulties seeing or reading with your eyes? *Read out and explain all answer options to the participants and select appropriate response.*	• No • Yes (please specify) • Blurriness • Double vision • Burning, itchy, watery eyes • Difficult to see or read far (long distance) • Difficult to see or read close (short distance) • Difficult to see or read at night (in dark) • Others _____	1 2
30	Do you have any eye related diseases? *Read out and explain all answer options to the participants and select appropriate response.*	• No • Yes (Please specify) • Glaucoma • Cataracts • Diabetic retinopathy • Others _____	1 2

SURVEY-1 (b)
NEED ASSESMENT FOR PHC HEALTH CHECK UP - 06 QUESTIONS
This survey will be conducted after PHC health check-up

1	Have you ever had any of following health check-up? **(Multiple choice)** *Select the appropriate response. Ask the participant to only consider advice from a doctor or any health worker. If they didn't do any health check-up yet, ask them to explain the reason.*	• Blood test (blood glucose, blood sugar) • Blood test (blood cholesterol) • Blood test (others_____) • Urine test • Blood pressure • Oral/dental check • Eye check • Ear check • Mental health check • Bone check • Pregnancy or maternal & child care check • Other check-up (_____) • None of the above (never had) **If never, why?**_____	1 2 3 4 5 6 7 8 9 10 11 12 13
2	**How satisfied about today's health check-up?** *Select appropriate answer.*	• Very satisfied • Satisfied • Neutral • Not Satisfied (Why? Reasons) _____	1 2 3 4
3	**Which health check-up services are you most interested in?** **(Multiple choice)** *This is one of the most important questions, so please ask carefully.* *Read out all answer options to the participants and select appropriate response.*	• Blood test (blood glucose, blood sugar) • Blood test (blood cholesterol) • Blood test (others) • Urine test • Blood pressure • Oral/dental check • Eye check • Ear check • Mental check • Bone check • Pregnancy or maternal & child care check • Other check-ups _____	1 2 3 4 5 6 7 8 9 10 11 12
4	What additional services (besides health check-up services) do you want or do you need? *(Multiple choice)* *Read out and explain all answer options to the participants and select appropriate response ask them to explain.*	• On-site direct face to face doctor's consultation • Remote doctor's consultation (remotely by skype [telemedicine]) • Remote doctor prescription (no need to come to a clinic and can get a prescription) • Your personal health data application (inside your mobile phone, so you can see your health data anytime) • Any other services Please specify_____	1 2 3 4 5
5	How much will you pay for total health check-up at one time doctor visit? *Read out and explain all answer options to the participants and select appropriate response ask them to explain.*	• Free (Never want to pay) • Less than 200 Taka (basic check-up) • 200-500 Taka (advance check-up) • 501 or more Taka (more advanced check-up)	1 2 3 4
6	How much will you pay for today's health checkup (if you need to pay)?	• Free (Never want to pay) • Less than 200 Taka (basic check-up) • 200-500 Taka (advance check-up) • 501 or more Taka (more advanced check-up)	1 2 3 4

Read out and explain all answer options to the participants and select appropriate response ask them to explain.

SURVEY-2

PHC CONSUMER BEHAVIOUR SURVEY

Understanding Determinants of Actual Use of Portable Health Clinic System and How Their Influence Changes Over Time Instruction

1. The questionnaires are quantitative nature.
2. All participants can be provided with a summary of the research findings.

Scenario of human assisted Portable Health Clinic system:

Human Assisted Portable Health Clinic system is a modification of eHealth with preventive health care system. Portable Health Clinic box has these following four features: 1. diagnosis tools/instruments are inside this box, 2. there is a data base server system to store and send health check-up data in a central PHC server, 3. doctor call center which is located in the capital city, Dhaka to consult with remote patients over skype, and 4. the Portable Health Clinic box is carried and used by one pre-trained nurse or paramedics.

This system helps to save doctor's time as the doctor does not need to ask questions about patient's health history but can focus on the immediate health problem. From this service people can know about their status/ condition of non- communicable diseases (NCD) such as blood pressure, diabetes, pulse rate etc. without going to doctor's chamber. Therefore, people can save money and time too. This PHC system is also promising to protect patient's privacy. To identify NCD diseases this system will contribute to reduce morbidity rate in the country.

PART A （SOCIO-DEMOGRAPHIC INFORMATION)

1. Do you have a mobile phone?
□ Yes □ No
2. Do you have access to internet connection in your mobile, computer, tab etc?
□ Yes □ No
3. Did you use eHealth services other than PHC service before?
□ Yes □ No
4. Do you have any kind of illness?
□ Yes □ No

PART B - COGNITIVE/ PERCEPTIONAL QUESTIONS)

5. Please read following each statement and rate each statement on 5-point Likert scales by putting √ (tick) in the number that best describes you. All statements will be measured on a 5-point Likert scale, where 1 = Strongly disagree, 2 = Disagree, 3= Neither Disagree nor agree, 4 = Agree, and 5 = Strongly agree.

(1=Strongly Disagree, 2=Disagree, 3= Neither Disagree nor agree, 4= Agree, 5= Strongly agree)

Perceived Usefulness: **the extent to which a person believes that using the PHC system will improve his or her health.**					
5-1. Using the PHC system would help me to better manage/maintain of my health.	1	2	3	4	5

5-2. I feel using the PHC system increases my productivity.	1	2	3	4	5
5-3. I feel PHC system is useful in my daily life.	1	2	3	4	5
5-4 Using PHC system will enhance my life effectiveness.					
Perceived ease of use: **the extent to which a respondent/user believes that using the PHC system is free of effort. In other words, respondent's perception of how easy or difficult it is to use the PHC system.**					
5-5. PHC system is clear and understandable to me.	1	2	3	4	5
5-6. To Interact with the PHC system does not require a lot of mental efforts /mental force/ need not to struggle with mind.	1	2	3	4	5
5-7. I did not feel hesitate to use PHC system.	1	2	3	4	5
5-8. I found receiving PHC service is easy.	1	2	3	4	5
5-9. I feel comfortable to use PHC system to share my health information.	1	2	3	4	5
Perceived Output quality: **Is defined as how well the system performs the relevant tasks,** **which we refer to as perception of output quality.**					
5-10. The quality of output I get from PHC system is high.	1	2	3	4	5
5-11. I have no problem with the quality of the PHC system's output.	1	2	3	4	5
Perceived result demonstrability: **Is defined as the actualness of the results of using the PHC system.**					
5-12. The results of using the PHC system are possible/ probable to me.	1	2	3	4	5
5-13. I have no difficulty to telling others about the results of using the PHC system.	1	2	3	4	5
Social influence: **Reference from friends/ family members/ loved one**					
5-14. People who are important to me think that I should use the PHC system. (Other than family members),.	1	2	3	4	5
5-15. My family members prefer to use PHC system.	1	2	3	4	5
5-16. My community people thinks that I should use PHC system.	1	2	3	4	5
5-17. Without cooperation or understanding from family, it is difficult to use PHC system for me.	1	2	3	4	5
Trust on PHC system: **means the degree to which an individual believes the PHC system**					
5-18. I trust the health care services that is provided by PHC system. (health check-up, prescription)	1	2	3	4	5
5-19. I believe that the PHC system keeps its promises to protect patient's privacy.	1	2	3	4	5
5-20. If your trust about PHC system gets broken, you will stop receiving service.	1	2	3	4	5
5-21. PHC service is reliable to me	1	2	3	4	5
Privacy: **is defined as the extent to which a respondent believes that PHC system will not compromise his/her privacy.**					
5-22. I believe privacy of PHC participants is protected.	1	2	3	4	5
5-23. I believe personal information stored in PHC system is safe.	1	2	3	4	5
5-24. I believe PHC systems to keep participants information secure.	1	2	3	4	5
Health awareness: **Health awareness is measured to assess the degree of readiness to undertake health actions.**					
5-25. I consider myself very health conscious.	1	2	3	4	5
5-26. I think that I take into account health a lot in my life.	1	2	3	4	5
5-27. I think that other people pay more attention to their health than I do.	1	2	3	4	5
5-28. I want to improve my health condition.	1	2	3	4	5
5-29. I want to expand money for my health.	1	2	3	4	5
Perceived Self efficacy (SE): **Is defined as the belief in one's capability to receive PHC service.** **Or judgement of one's capability to receive PHC service.**					
5-30. I think I will use PHC service for health check-up.	1	2	3	4	5

5-31. I will follow PHC prescription..	1	2	3	4	5
5-3**2**. By using PHC system I can prevent seriousness of diseases (silent killers e.g. diabetes, stroke, heart-failure, kidney-failure).	1	2	3	4	5
Facilitating condition: **defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system. Or to provide PHC system. This definition captures concepts embodied by three different constructs: perceived behavioral control, facilitating condition, and compatibility.**					
5-3**3**. A specific institute exists to providing PHC health care service.	1	2	3	4	5
5-3**4**. I have the knowledge necessary to receive the PHC system. (Explanation: It can prevent NCD diseases)	1	2	3	4	5
5-**35**. PHC health care service is compatible with other health care service	1	2	3	4	5
5-**36**. I feel happy because the PHC system is used by one pre-trained nurse.	1	2	3	4	5
Attitude towards using PHC system: **is defined as a psychological factor which represents an individuals' readiness to perform a certain behavior or action. Attitude is defined as particular behavior is good/bad; useful/a waste of time; rewarding/not rewarding; responsible/not responsible; sensible/not sensible; hygienic/not. Attitude means "Individual's positive or negative feeling about performing the target behavior.**					
5-37. PHC system using saves my time.	1	2	3	4	5
5-38. PHC system is workable to prevent NCD diseases.	1	2	3	4	5
5-39. Using PHC system is a good idea.	1	2	3	4	5
5-**40**. I feel good to receive PHC service.	1	2	3	4	5
Intention to use PHC at the next time					
5-4**1**. I intend to use PHC system in the future.	1	2	3	4	5
5-42. If PHC system is available, I will always use it.	1	2	3	4	5
5-43. It is worth to receive PHC service.	1	2	3	4	5
Actual use of PHC system					
5-44. PHC system is a pleasant experience.	1	2	3	4	5
5-45. I spend time to know about PHC system.	1	2	3	4	5
5-46. Using PHC system causes many advantages.	1	2	3	4	5
5-47. I like to use PHC system.					

CONSENT FORM FOR SURVEY-1 (BANGLA VERSION)

পোর্টেবল হেলথ ক্লিনিক (পিএইচসি) সেবার অনুমতিপত্র

এই সমীক্ষাটি পিএইচসি সার্ভিস চলাকালীন বিভিন্ন সময়ে অংশগ্রহণকারীর বাড়িতে পরিচালিত হবে।

আসসালামু আলাইকুম। আমার নাম .....। আমি গ্রামীণ কমিউনিকেশানস থেকে এসেছি। আমরা জাপানের কিউশু বিশ্ববিদ্যালয়ের সহযোগিতায় একটি গবেষণার জন্য সাক্ষাৎকারমূলক একটি সমীক্ষা পরিচালনা করছি। এই গবেষণার উদ্দেশ্য আগামী ৩ বছরের জন্য অর্থাৎ ৩১ মার্চ, ২০২১ পর্যন্ত আপনার স্বাস্থ্যের অবস্থা নিরীক্ষণ, প্রয়োজন অনুযায়ী ডাক্তারের পরামর্শ প্রদান, পর্যবেক্ষণ ও তদনুযায়ী একটি আদর্শ স্বাস্থ্য ব্যবস্থপনার ধারণা লাভ করা।

এই প্রশ্নাবলী সম্পূর্ণ করতে ৩০-৩৫ মিনিট সময় লাগবে। আপনার ব্যক্তিগত তথ্যাদি যেমন আপনার নাম, টেলিফোন নম্বর, ঠিকানা ও অন্যান্য তথ্যসমূহ গ্রামীণ কমিউনিকেশানস-এর কর্মকর্তা দ্বারা গোপনীয় এবং সুরক্ষিত রাখা হবে। এই প্রশ্নাবলীর কোন তথ্য আমাদের সমীক্ষা গবেষণা দলের সদস্যদের ছাড়া অন্য কারো কাছে প্রকাশ করা হবে না। আপনি যে কোন মুহূর্তে সমীক্ষাটি বন্ধ করতে পারবেন। এটি একটি সম্পূর্ণ স্বেচ্ছাসেবামূলক সমীক্ষা যেখানে আমরা আশা করি আপনি অংশগ্রহণ করতে সম্মত হবেন কারণ আপনার তথ্য অত্যন্ত গুরুত্বপূর্ণ এবং আপনার সমাজের মানুষের স্বাস্থ্যের অবস্থা উন্নত করতে এটি অবদান রাখতে পারে। এই প্রশ্নাবলি শেষ করার পরে আপনাকে অন্য যে কোন তারিখে "পোর্টেবল হেলথ ক্লিনিক" নামক পরীক্ষামূলক স্বাস্থ্যসেবায় অংশগ্রহণ করতে অনুরোধ করা হবে।

এই পিএইচসি সেবায়, আপনি নিম্নলিখিত স্বাস্থ্য পরীক্ষা এবং ডাক্তারের পরামর্শ গ্রহণ করতে পারবেন। আমাদের এই কার্যক্রমের মাধ্যমে আপনি সর্বোচ্চ যে সকল স্বাস্থ্য পরীক্ষা করাতে পারবেন তা হলো:

১) উচ্চতা
২) ওজন
৩) বিএমআই
৪) শরীরের তাপমাত্রা
৫) ব্লাড প্রেশার
৬) কোমরের মাপ
৭) হিপ এর মাপ
৮) কোমর-হিপের অনুপাত
৯) রক্তে অক্সিজেন এর পরিমান

১০) ব্লাড গ্লুকোজ (ডায়াবেটিকস)
১১) ইউরিন গ্লুকোজ
১২) ইউরিন প্রোটিন
১৩) পালস্ রেট
১৪) অ্যারিথমিয়া
১৫) রক্তের হিমোগ্লোবিন পরীক্ষা (শুধুমাত্র মহিলাদের জন্য)
১৬) ইউরিক এসিড পরীক্ষা এবং
১৭) এক্স-রে।

উল্লেখ্য যে, উক্ত কার্যক্রম মার্চ-২০২১ পর্যন্ত চলমান থাকবে বলে আমরা আশা রাখি। গ্রামহেলথ সিষ্টেমের মাধ্যমে সকল স্বাস্থ্য পরীক্ষা সম্পাদনের পর কোন রোগীর সফটওয়্যারে নির্দেশিত রঙ "সবুজ" কিংবা "হলুদ" নির্দেশ করলে তাকে প্রতি (৬) ছয় মাস অন্তর পুনরায় চিকিৎসা প্রদান করা হবে। অন্যদিকে "কমলা" কিংবা "লাল" রঙ নির্দেশিত হলে প্রতি (৩) তিন মাস অন্তর গ্রামহেলথ চিকিৎসা ব্যবস্থার মাধ্যমে স্বাস্থ্যসেবা প্রদান করা হবে। তবে সকল সেবা গ্রহণকারীকেই আমাদের গ্রামহেলথঃ পিএইচসি সেবা কেন্দ্রে এসে নির্ধারিত তারিখ ও সময় অনুযায়ী স্বাস্থ্যসেবা গ্রহণ করতে হবে। এছাড়াও ডাক্তারের সাথে পরামর্শের প্রয়োজন হলে ইন্টারনেটের মাধ্যমে গ্রামহেলথ কল সেন্টারের ঢাকার বিশেষজ্ঞ ডাক্তারের সাথে কথা বলার সুযোগ থাকবে।
এছাড়াও এই প্রকল্প চলাকালীন পুরো সময়ে আপনি আপনার যে কোন স্বাস্থ্য সমস্যায় আমাদের স্বাস্থ্যকেন্দ্রে এসে স্কাইপের মাধ্যমে ঢাকায়ে অবস্থানরত ডাক্তারের সাথে পরামর্শ করতে পারবেন এবং প্রয়োজন অনুসারে প্রেসক্রিপশন নিতে পারবেন। এই স্বাস্থ্য পরীক্ষা এবং ডাক্তারের পরামর্শ বিনামূল্যে দেয়া হবে। আমরা এই গবেষণায় অংশগ্রহণ করার জন্য আপনার সহযোগিতা কামনা করছি।

আপনি কি অনুগ্রহ করে আগামী ৩ বছরের জন্য অর্থাৎ মার্চ-২০২১ সাল পর্যন্ত এই গবেষণায় অংশগ্রহন করতে সম্মত আছেন?

ক) হ্যাঁ, আমি এই গবেষণায় অংশ নিতে সম্মত আছি

খ) না, আমি এই গবেষণায় অংশগ্রহণ করব না

অংশগ্রহণকারীর নামঃ	

স্বাক্ষরঃ	
তারিখঃ	d d - m m - y y y y

SURVEY-1
SOCIO DEMOGRAPHIC, HEALTH RELATED, BEHAVIORAL | 30 QUESTIONS

This survey will be conducted at the participants' home in Ekhlaspur and in office for Grameen employees before the PHC checkup
এই সমীক্ষাটি পিএইচসি সেবা প্রদানের আগে অংশগ্রহণকারীর বাড়ীতে অথবা গ্রামীণ ব্যাংক কমপ্লেক্স এ পরিচালিত হবে।

সাক্ষাৎকারের তারিখ (সমীক্ষাটি সম্পন্ন হওয়ার সঠিক তারিখটি উল্লেখ করুন)	দিন d d	মাস m m	সাল y y y y
সাক্ষাৎকারের স্থান (দয়া করে যেকোনো একটি গোল করুন) উপযুক্ত কেন্দ্র অথবা গ্রামের নাম, ওয়ার্ড নাম্বার, বাড়ি নাম্বার উল্লেখ করুন।	১- ১ এখলাসপুর ১-২ ওয়ার্ড নং #_____ ১-৩ বাসা নং #_____	২ গ্রামীণ ব্যাংক কমপ্লেক্স ২-১ প্রতিষ্ঠানের নাম _____	
সাক্ষাৎকার গ্রহণকারীর নাম (জাতীয় পরিচয়পত্র অথবা একাডেমিক সার্টিফিকেট অনুযায়ী)	_____		

উত্তরদাতার নাম রোগী/অংশগ্রহনকারী (জাতীয় পরিচয়পত্র অথবা জন্ম নিবন্ধনপত্র অথবা একাডেমিক সার্টিফিকেট অথবা পাসপোর্ট অথবা ড্রাইভিং লাইসেন্স অনুযায়ী)	_____	
জন্মতারিখ ও লিঙ্গ (জাতীয় পরিচয়পত্র অথবা জন্ম নিবন্ধনপত্র অনুযায়ী)	জন্মতারিখঃ দিন /মাস / সাল ___/___/____ (_____ বয়স)	লিঙ্গঃ (পুরুষ/মহিলা নির্বাচন করুন) পুরুষ _____ মহিলা _____
উত্তরদাতার বারকোড আইডি # গ্রামহেলথঃ পিএইচসি সিস্টেম থেকে স্বয়ংকৃতভাবে প্রাপ্ত নাম্বার		
মোবাইল ফোন # ১১-ডিজিট সম্বলিত মোবাইল ফোন নাম্বার উল্লেখ করুন। তথ্যের গোপনীয়তা সম্পর্কে এবং এই তথ্য শুধুমাত্র স্বাস্থ্যসেবার জন্য ব্যবহৃত হবে এই সম্পর্কে অংশগ্রহণকারীকে আশ্বস্ত করুন		

স্থায়ী ঠিকানা উপযুক্ত কেন্দ্র অথবা গ্রামের নাম, ওয়ার্ড নাম্বার, বাড়ি নাম্বার উল্লেখ করুন।	

রোগীর প্রাথমিক তথ্য

১	আপনার বর্তমান পেশা কি? (এই প্রশ্নটির উদ্দেশ্য হল বিভিন্ন পেশায়ে কর্মরত ব্যক্তির বিভিন্ন ঝুঁকির সম্মুখীন হওয়ার সম্ভাবনা আছে কিনা এধরণের প্রশ্নের উত্তর দিতে সাহায্য করা।) (সঠিক উত্তর বাছাই করুন।)	সরকারি কর্মচারী বেসরকারি কর্মচারী নিজস্ব ব্যবসা বেসরকারি প্রতিষ্ঠানে কর্মরত কৃষিকাজ (কৃষক সহ) ছাত্র গৃহস্থালীর কাজ অবসরপ্রাপ্ত অন্যান্য _____	১২৩ ৪ ৫ ৬ ৭ ৮ ৯
২	আপনার শিক্ষাগত যোগ্যতা কি? (যদি একজন ব্যক্তি মাধ্যমিক স্কুলে প্রথম বছরের কয়েক মাস পড়াশুনা করে থাকেন কিন্তু শেষ করেননি তাহলে “প্রাথমিক স্কুল পাস” নির্বাচন করুন। যদি একজন ব্যক্তি প্রাথমিক স্কুলে শুধুমাত্র কয়েক বছর পড়াশুনা করেন থাকেন, তাহলে “নিরক্ষর (প্রাতিষ্ঠানিক শিক্ষা নাই) নির্বাচন করুন। সঠিক উত্তর বাছাই করুন।)	নিরক্ষর (প্রাতিষ্ঠানিক শিক্ষা নাই) প্রাথমিক স্কুল পাস মাধ্যমিক স্কুল পাস উচ্চ মাধ্যমিক স্কুল পাস কারিগরি স্কুল পাস স্নাতক (কলেজ/বিশ্ববিদ্যালয়) উচ্চতর শিক্ষা (মাস্টার্স / ডক্টরেট) অন্যান্য _____	১ ২ ৩ ৪ ৫ ৬ ৭ ৮
৩	আপনি কি বাংলা পড়তে পারেন? (সঠিক উত্তর বাছাই করুন।)	না অল্প হ্যাঁ	১ ২ ৩
৪	আপনার বৈবাহিক অবস্থা কি? (সঠিক উত্তর বাছাই করুন।)	অবিবাহিত বিবাহিত তালাকপ্রাপ্ত বিধবা/বিপত্নীক	১ ২ ৩ ৪
৫	আপনার পরিবারের মাসিক আয় কত? (পরিবারের মাসিক ব্যয় নির্বাচন করুন।)	০ – ৫,০০০ টাকা ৫,০০১-১০,০০০ টাকা ১০,০০১-২০,০০০ টাকা ২০,০০১-৫০,০০০ টাকা ৫০,০০১ টাকার বেশি জানি না	১ ২ ৩ ৪ ৫ ৬

খাদ্য তালিকা/পুষ্টি সম্পর্কিত

৬	আপনি কি গত এক মাসে কখনো আপনার খাদ্য তালিকা থেকে নিম্নলিখিত জিনিসগুলি সীমিত করার চেষ্টা করেছেন?	চিনি চর্বি (তেল, মাখন, ঘি ইত্যাদি) কোলেস্টেরল ক্যালরি ফাস্টফুড (পিৎজা, হ্যামবার্গার, ফ্রেঞ্চ ফ্রাই ইত্যাদি)	১ ২ ৩ ৪ ৫

	(অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিক উত্তর নির্বাচন করুন।)	অন্যান্য_____	৬
৭	আপনার বয়স ২০ বছর অতিক্রম করার পর আপনার ওজন কি ১০ কেজির বেশি বেড়েছে? (সঠিক উত্তর নির্বাচন করুন।)	না হ্যাঁ জানি না	১ ২ ৩
৮	গত এক বছরে আপনার ওজন কি ৩ কেজি কমেছে অথবা বেড়েছে? (সঠিক উত্তর নির্বাচন করুন।)	না হ্যাঁ জানি না	১ ২ ৩
৯	আপনি কি সপ্তাহে তিন বার অথবা তার বেশি রাতের খাবার ঘুমানোর ২ ঘণ্টা পূর্বে খান? (অংশগ্রহণকারীদের তাদের দৈনন্দিন খাদ্যাভ্যাস সম্পর্কে জিজ্ঞাসা করুন এবং সঠিক উত্তর নির্বাচন করুন।)	না হ্যাঁ জানি না	১ ২ ৩
১০	আপনি কি চিনি আছে এমন পানীয় (কোক, ফান্টা, সোডা, ফলের রস, অন্যান্য মিষ্টি/চিনি জাতীয় পানীয়) সপ্তাহে তিন বার অথবা তার বেশি পান করেন? (অংশগ্রহণকারীদের তাদের দৈনন্দিন খাদ্যাভ্যাস সম্পর্কে জিজ্ঞাসা করুন এবং সঠিক উত্তর নির্বাচন করুন।)	না হ্যাঁ জানি না	১ ২ ৩
১১	আপনি কি সপ্তাহে তিন বার অথবা তার বেশি ফাস্টফুড জাতীয় খাবার যেমন পিৎজা, হ্যামবার্গার, ডুবো তেলে ভাজা খাবার (যেমন সমুচা, সিঙ্গারা, মোগলাই পরোটা) খান? (অংশগ্রহণকারীদের তাদের দৈনন্দিন খাদ্যাভ্যাস সম্পর্কে জিজ্ঞাসা করুন এবং সঠিক উত্তর নির্বাচন করুন।)	না হ্যাঁ জানি না	১ ২ ৩
১২	আপনি কি সপ্তাহে তিন বার অথবা তার বেশি সকালের খাবার খাওয়া বাদ দেন? (অংশগ্রহণকারীদের তাদের দৈনন্দিন খাদ্যাভ্যাস সম্পর্কে জিজ্ঞাসা করুন এবং সঠিক উত্তর নির্বাচন করুন।)	না হ্যাঁ জানি না	১ ২ ৩
১৩	আপনি কি আপনার সমবয়সী ও সমলিঙ্গের মানুষের চেয়ে দ্রুত খাবার খান? (অংশগ্রহণকারীদের তাদের দৈনন্দিন খাদ্যাভ্যাস সম্পর্কে জিজ্ঞাসা করুন এবং সঠিক উত্তর নির্বাচন করুন।)	না হ্যাঁ জানি না	১ ২ ৩
১৪	আপনি কি সুস্থ্য থাকার জন্য খাদ্যাভ্যাস (কম চিনি, কম চর্বি, কম ক্যালরি ইত্যাদি) উন্নত করতে চান? (অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিক উত্তর নির্বাচন করুন।)	না হ্যাঁ ৬ মাস এর মাঝে হ্যাঁ ১ মাস এর মাঝে ইতিমধ্যে উন্নত করার চেষ্টা করছি (৬ মাস এর কম) ইতিমধ্যে উন্নত করার চেষ্টা করছি (৬ মাস এর বেশি)	১ ২ ৩ ৪ ৫

শারীরিক কার্যক্রম

১৫	গত এক মাসে আপনি প্রতিদিন গড়ে কত ঘণ্টা বাইরে হাঁটতে বের হয়েছেন? (বাইরে হাঁটা প্রতিদিনের অন্যান্য কাজ যেমন- কৃষিকাজ, চাষাবাদ, পরিস্কার পরিচ্ছন্নতা ইত্যাদি ব্যতীত) (অংশগ্রহণকারীকে জিজ্ঞাসা করুন তিনি দৈনন্দিন কাজের পাশাপাশি মোট কত সময় হাঁটার জন্য ব্যয় করেন? অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিক উত্তর নির্বাচন করুন।)	প্রতিদিন ১ ঘণ্টার বেশি প্রতিদিন ১ ঘণ্টার কম বাইরে হাঁটতে যাই না জানি না	১ ২ ৩ ৪

১৬	গত এক মাসে, আপনি কোন কাজে নিয়মিতভাবে অন্তত ১০ মিনিট করেছেন? (প্রযোজ্য ক্ষেত্রে একাধিক উত্তর গ্রহনযোগ্য) (অংশগ্রহণকারীদের জিজ্ঞাসা করুন গত এক মাসে তারা কি ধরণের শারীরিক কার্যক্রম করেছেন? অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিক উত্তর নির্বাচন করুন।)	ঘর পরিস্কার করা কৃষিকাজ করা সাথে বাগান করা চাষাবাদ করা যে কোন খেলাধুলা (ক্রিকেট, ব্যাডমিন্টন, ফুটবল, টেনিস, ভলিবল, সাঁতার ইত্যাদি) সাইক্লিং হাঁটা দৌড়ানো নাচ কোনটিই না অন্যান্য _____	১ ২ ৩ ৪ ৫ ৬ ৭ ৮ ৯ ১০
১৭	আপনি কি আপনার সমবয়সী এবং সমলিঙ্গের মানুষের চেয়ে জোরে হাঁটেন? (সঠিক উত্তর নির্বাচন করুন।)	না হ্যাঁ জানি না	১ ২ ৩
১৮	আপনি কি সুস্থ্য থাকার জন্য আপনার প্রতিদিনের শারীরিক কার্যক্রম উন্নত করতে চান? (অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং দৈনন্দিন কার্যকলাপ উন্নত করার জন্য তাদের ইচ্ছা সম্পর্কে জিজ্ঞাসা করুন। সঠিক উত্তর নির্বাচন করুন।)	না হ্যাঁ ৬ মাসের মধ্যে হ্যাঁ ১ মাসের মধ্যে ইতিমধ্যে উন্নতি করার চেষ্টা করছি (৬ মাসের কম) ইতিমধ্যে উন্নতি করার চেষ্টা করছি (৬ মাসের বেশি)	১ ২ ৩ ৪ ৫

বিষণ্নতা/ মানসিক অবস্থা সম্পর্কিত

১৯	গত এক মাসে কতবার আপনি রাতে ঠিকমত ঘুমাতে পারেননি? (অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিকভাবে ব্যাখ্যা করুন। সঠিক উত্তর নির্বাচন করুন।)	কখনো না খুবই কম (মাসে ১-৫ দিন) মাঝে মাঝে (মাসে ৬-১০ দিন) বেশিরভাগ সময় (মাসে ১১-২৯ দিন) সবসময় (প্রতিদিন)	১ ২ ৩ ৪ ৫
২০	গত এক মাসে কতবার আপনাকে মানসিক চাপ, বিষণ্নতা, উদ্বেগ ও হতাশার কারনে স্বাভাবিক কাজকর্ম (দৈনন্দিন স্বাভাবিক কাজকর্ম) বন্ধ করতে হয়েছে? (অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিকভাবে ব্যাখ্যা করুন। সঠিক উত্তর নির্বাচন করুন।)	কখনো না খুবই কম (মাসে ১-৫ দিন) মাঝে মাঝে (মাসে ৬-১০ দিন) বেশিরভাগ সময় (মাসে ১১-২৯ দিন) সবসময় (প্রতিদিন)	১ ২ ৩ ৪ ৫
২১	আপনি যখন উদ্বিগ্ন অথবা বিষণ্ন থাকেন তখন কী করেন? (অংশগ্রহণকারীদের বিস্তারিতভাবে ব্যাখ্যা করতে বলুন।)	দয়া করে বিস্তারিত বলুন _____	
২২	আপনার উদ্বেগ ও বিষণ্নতার কারণ কী? (অংশগ্রহণকারীদের বিস্তারিতভাবে ব্যাখ্যা করতে বলুন।)	দয়া করে বিস্তারিত বলুন _____	

মুখ গহ্বরের স্বাস্থ্য সম্পর্কিত

২৩	আপনি দিনে কতবার দাঁত ব্রাশ করেন? (অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিক উত্তর নির্বাচন করুন।)	ব্রাশ করিনা দিনে একবার দিনে দুইবার দিনে তিন বার অথবা তার বেশি	১ ২ ৩ ৪
২৪	আপনি কি রাতে ঘুমানোর আগে দাঁত ব্রাশ করেন? (অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিক উত্তর নির্বাচন করুন।)	কখনো না খুব কম মাঝে মাঝে বেশীরভাগ সময় সবসময়	১ ২ ৩ ৪ ৫

২৫	আপনি সাধারণত ব্রাশ করার জন্য কী ব্যবহার করেন? (অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিক উত্তর নির্বাচন করুন।)	টুথব্রাশ আঙ্গুল গাছের ডাল দাঁত মাজার পাউডার টুথব্রাশ ব্যবহার করিনা অন্যান্য, দয়া করে বিস্তারিত বলুন _____	১ ২ ৩ ৪ ৫ ৬
২৬	আপনি কি গত ৬ মাসে কোন দাঁতের ক্লিনিক অথবা দাঁতের ডাক্তারের কাছে গিয়েছিলেন? (সঠিক উত্তর নির্বাচন করুন।)	না হ্যাঁ জানি না	১ ২ ৩
২৭	আপনার কি দাঁত, চোয়াল অথবা মুখের কোন অংশে ব্যাথা করে? (প্রযোজ্য ক্ষেত্রে একাধিক উত্তর গ্রহনযোগ্য) (অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিকভাবে ব্যাখ্যা করুন। সঠিক উত্তর নির্বাচন করুন।)	না হ্যাঁ যদি হ্যাঁ, কি ধরণের ব্যাথা? ক্ষতজনিত ব্যাথা জ্বালা করা ব্যাথা ফুলে যাওয়া ব্যাথা গলায়ে ব্যাথা (গলা ব্যাথা) জিহবায় ব্যাথা চোয়ালে ব্যাথা মুখে ফোঁড়া জনিত ব্যাথা Pain by ticking in mouth অন্য রকম ব্যাথা _____	১ ২ ২-১ ২-২ ২-৩ ২-৪ ২-৫ ২-৬ ২-৭ ২-৮ ২-৯
২৮	আপনার কয়টি দাঁত পড়েছে? (সঠিক উত্তর নির্বাচন করুন।)	কোন দাঁত পড়েনি (সব দাঁত আছে) একটি দাঁত পড়েছে দুইটি দাঁত পড়েছে তিনটি দাঁত পড়েছে চারটি দাঁত পড়েছে পাঁচ অথবা তার বেশি দাঁত পড়েছে	১ ২ ৩ ৪ ৫ ৬

চক্ষু (দৃষ্টি) স্বাস্থ্য সম্পর্কিত

২৯	আপনার কি চোখ দিয়ে দেখতে অথবা পড়তে সমস্যা হয়? (অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিকভাবে ব্যাখ্যা করুন। সঠিক উত্তর নির্বাচন করুন।)	না হ্যাঁ (দয়া করে বিস্তারিত বলুন) ১. ঝাপসা দেখা ২. দুটি করে দেখা ৩. জ্বালা করা, চুলকানো, চোখ দিয়ে পানি পড়া ৪. দূরে দেখতে অথবা পড়তে সমস্যা হওয়া ৫. কাছে দেখতে অথবা পড়তে সমস্যা হওয়া ৬. রাতে দেখতে অথবা পড়তে সমস্যা হওয়া (অন্ধকারে) ৭. অন্যান্য _____	১ ২
৩০	আপনার কি চোখ সংশ্লিষ্ট কোন রোগ আছে? (অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিকভাবে ব্যাখ্যা করুন। সঠিক উত্তর নির্বাচন করুন।)	না হ্যাঁ (দয়া করে বিস্তারিত বলুন) ১. গ্লুকোমা ২. ছানি ৩ ডায়াবেটিক রেটিনোপ্যাথি ৪. অন্যান্য _____	১ ২

SURVEY-1 (b)
NEED ASSESMENT FOR PHC HEALTH CHECK UP - 06 QUESTIONS

This survey will be conducted after PHC health check-up এই সমীক্ষাটি পিএইচসি সেবা প্রদানের পর জিজ্ঞাসা করতে হবে।

	স্বাস্থ্য পরীক্ষার প্রয়োজন সম্পর্কিত প্রশ্ন	পি এইচ সি স্বাস্থ্য সেবা প্রদানের পরে প্রশ্ন (০১-০৬) জিজ্ঞাসা করতে হবে।	
১	আপনি কি কখনো নিম্নলিখিত স্বাস্থ্য পরীক্ষা করিয়েছেন? (প্রযোজ্য ক্ষেত্রে একাধিক উত্তর গ্রহনযোগ্য) (সঠিক উত্তর নির্বাচন করুন। অংশগ্রহণকারীকে শুধুমাত্র ডাক্তার বা কোনও স্বাস্থ্য কর্মীর পরামর্শ বিবেচনা করতে বলুন। যদি তারা কোনও স্বাস্থ্য পরীক্ষা না করে থাকে তবে তাদেরকে ব্যাখ্যা করার জন্য অনুরোধ করুন।)	রক্ত পরীক্ষা (রক্তের গ্লুকোজ, রক্তের সুগার) রক্ত পরীক্ষা (রক্তের কোলেস্টেরল) রক্ত পরীক্ষা (অন্যান্য_____) প্রস্রাব পরীক্ষা রক্ত চাপ মুখ/দাঁত পরীক্ষা চক্ষু পরীক্ষা কান পরীক্ষা মানসিক স্বাস্থ্য পরীক্ষা হাড়ের পরীক্ষা গর্ভকালীন অথবা মাতৃ ও শিশু সেবা পরীক্ষা অন্যান্য পরীক্ষা (_____) উপরের কোনটি নয় (কখনো নয়) যদি না কেন?_____	১ ২ ৩ ৪ ৫ ৬ ৭ ৮ ৯ ১০ ১১ ১২ ১৩
২	আজকের স্বাস্থ্য পরীক্ষা কি সন্তোষজনক ছিল? (সঠিক উত্তর নির্বাচন করুন।)	খুবই সন্তোষজনক সন্তোষজনক নিরপেক্ষ সন্তোষজনক নয় (কেন? কারণ _____ _____	১ ২ ৩ ৪
৩	কোন স্বাস্থ্য পরীক্ষা সেবায় আপনি সবচেয়ে বেশি আগ্রহী? (প্রযোজ্য ক্ষেত্রে একাধিক উত্তর গ্রহনযোগ্য) এটি একটি অতি গুরুত্বপূর্ণ প্রশ্ন তাই দয়া করে সতর্কতার সাথে জিজ্ঞাসা করুন। (অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিক উত্তর নির্বাচন করুন।)	রক্ত পরীক্ষা (রক্তের গ্লুকোজ, রক্তের সুগার) রক্ত পরীক্ষা (রক্তের কোলেস্টেরল) রক্ত পরীক্ষা (অন্যান্য_____) মূত্র পরীক্ষা রক্তচাপ মুখ/ দাঁত পরীক্ষা চক্ষু পরীক্ষা কান পরীক্ষা মানসিক স্বাস্থ্য পরীক্ষা হাড়ের পরীক্ষা গর্ভকালীন অথবা মাতৃ ও শিশু সেবা পরীক্ষা অন্যান্য পরীক্ষা (_____)	১ ২ ৩ ৪ ৫ ৬ ৭ ৮ ৯ ১০ ১১ ১২
৪	কোন অতিরিক্ত সেবাটি (স্বাস্থ্য সেবা পরীক্ষা ব্যাতীত) আপনি চান অথবা আপনার প্রয়োজন? (প্রযোজ্য ক্ষেত্রে একাধিক উত্তর গ্রহনযোগ্য)	সরাসরি ডাক্তারের সাথে পরামর্শ দূরবর্তী ডাক্তারের পরামর্শ (স্কাইপের মাধ্যমে [টেলিমডিসিন])	১ ২

	(অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিকভাবে ব্যাখ্যা করুন। সঠিক উত্তর নির্বাচন করুন এবং অংশগ্রহণকারীদের ব্যাখ্যা করতে বলুন।)	দূরবর্তী ডাক্তারের প্রেসক্রিপশন (ক্লিনিকে না এসেই ডাক্তারের প্রেসক্রিপশন পেতে পারেন।) আপনার ব্যক্তিগত স্বাস্থ্য তথ্য অ্যাপ্লিকেশন (আপনার মোবাইল ফোনের মাধ্যমে যেকোন সময় আপনি জানতে পারেন) অন্য কোন সেবা নির্ধারন করুন_____	৩ ৪ ৫
৫	আপনি একবার পরিপূর্ণ স্বাস্থ্য পরীক্ষার জন্য ডাক্তার দেখাতে কত টাকা খরচ করবেন? (অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিকভাবে ব্যাখ্যা করুন। সঠিক উত্তর নির্বাচন করুন এবং অংশগ্রহণকারীদের ব্যাখ্যা করতে বলুন।)	বিনামূল্যে (কখনোই টাকা দিতে চাই না) ২০০ টাকার কম (প্রাথমিক চেক আপ) ২০০-৫০০ টাকা (উন্নত চেক আপ) ৫০১ অথবা এর বেশি টাকা (আরও উন্নত চেক আপ)	১ ২ ৩ ৪
৬	আজকের স্বাস্থ্য পরীক্ষার জন্য আপনি কত টাকা খরচ করবেন (যদি খরচ করতে হয়) (অংশগ্রহণকারীদের বিকল্প উত্তরগুলো পড়ে শোনান এবং সঠিকভাবে ব্যাখ্যা করুন। সঠিক উত্তর নির্বাচন করুন এবং অংশগ্রহণকারীদের ব্যাখ্যা করতে বলুন।)	বিনামূল্যে (কখনোই টাকা দিতে চাই না) ২০০ টাকার কম (প্রাথমিক চেক আপ) ২০০-৫০০ টাকা (উন্নত চেক আপ) ৫০১ অথবা এর বেশি টাকা (আরও উন্নত চেক আপ)	১ ২ ৩ ৪

SURVEY-2
PHC CONSUMER BEHAVIOUR SURVEY
Understanding Determinants of Actual Use of Portable Health Clinic System and How Their Influence Changes Over Time Instruction

গবেষণার বিষয়: PHC স্বাস্থ্যসেবা সম্পর্কে মানুষের অভিমত

নোটঃ প্রশ্ন কারী প্রথমে একটি সম্মতি পত্র উত্তরদাতাকে দিবেন। প্রশ্ন কারী উত্তরদাতাকে প্রশ্ন শুরু করার আগে PHC সম্পর্কে একটা ব্যাখা প্রদান করবেন।

ক বিভাগ

১. আপনার কি মোবাইল ফোন আছে?
□ হ্যাঁ □ না

২. আপনি কি ইন্টারনেট ব্যবহার করেন?
□ হ্যাঁ □ না

৩. আপনি কি PHC স্বাস্থ্যসেবা ব্যতিত অন্য কোন ই-স্বাস্থ্যসেবা পূর্বে ব্যবহার করেছেন?
□ হ্যাঁ □ না

৪. আপনার কি কোন প্রকার শারিরীক অসুস্থতা আছে?
□ হ্যাঁ □ না

খ বিভাগ

৫.নীচের প্রশ্নগুলির জন্য ১ থেকে ৫ এর মধ্যে আপনার মতামত দিবেন √ (টিক) দিয়ে।

১.সম্পূর্ণরূপে অসম্মতি ২. অসম্মতি ৩. সিদ্ধান্তহীন ৪. সম্মতি ৫. সম্পূর্ণরূপে সম্মতি

[A] Perceived Usefulness					
৫-১. PHC স্বাস্থ্যসেবা আমার শরীর স্বাস্থ্য / (সুস্বাস্থ্য বজায়) ভাল রাখতে সাহায্য করবে। (PHC স্বাস্থ্যসেবা নিলে আপনি উচ্চ রক্ত চাপ , ডায়বেটিস, ইত্যাদি রোগ বালাই প্রতিরোধ ও নিয়ন্ত্রণ এ রাখতে পারবেন । আপনি আপনার স্বাস্থ্য সম্পর্কে আগে থেকে সচেতন হতে পারবেন এবং সুস্থ থাকতে পারবেন। সুতরাং আপনার শরীর ভাল থাকবে। আপনি কতটুকু সম্মত ১ থেকে ৫ এর মধ্যে বলুন)	১	২	৩	৪	৫
৫-২. PHC স্বাস্থ্যসেবা আমার উৎপাদনশীলতা বৃদ্ধি/ (বেশি কাজ -কর্ম) করতে সাহায্য করবে। (PHC স্বাস্থ্যসেবা আপনার সময় রক্ষা করবে কারন আপনাকে ডাক্তার দেখাতে এবং চেক-আপ করতে দূরে যেতে হবে না)	১	২	৩	৪	৫
৫-৩. PHC স্বাস্থ্যসেবা দৈনন্দিন জীবনে উপকারী। (PHC স্বাস্থ্যসেবার মাধ্যমে যে সব সেবা পাবেন সেগুলি দৈনন্দিন জীবনে উপকারী কারণ আপনি আপনার শরীরে রোগ বালাই আছে কিনা জানতে পারবেন বিভিন্ন টেষ্ট এর মাধ্যমে ও নিয়ন্ত্রণ এ রাখার পরামর্শ পাবেন)	১	২	৩	৪	৫
৫-৪. PHC স্বাস্থ্যসেবা আমার জীবনে কর্ম দক্ষতা বৃদ্ধি করবে । (কাজ করার সামর্থ্য/ কাজে দক্ষতা বৃদ্ধি করবে)	১	২	৩	৪	৫
[B] Perceived ease of use					
৫-৫. PHC স্বাস্থ্যসেবা আমার কাছে স্পষ্ট ও বোধগম্য।	১	২	৩	৪	৫

(PHC স্বাস্থ্যসেবা ১৫ টা টেস্ট/ চেক-আপ প্রদান করে যেমনঃ : body temperature, blood pressure, pulse rate, blood glucose, blood grouping, urinary sugar টেস্ট , etc এই টেস্ট গুলি কেন করে আপনি জানেন ও বুঝেন).					
৫-৬. PHC স্বাস্থ্যসেবা ব্যবহার করার জন্য আমার বেশি মানসিক চাপ নেয়ার প্রয়োজন হয় নাই। (আপনার PHC স্বাস্থ্যসেবা ব্যবহার করার জন্য কোন টেনশন করতে হয় নাই)	১	২	৩	৪	৫
৫-৭. PHC স্বাস্থ্যসেবা ব্যবহার করার জন্য আমার ইতঃস্তত বোধ করতে হয় নাই। (PHC স্বাস্থ্যসেবা নিব কি নিব না এরকম দুটানায় ভুগতে হয় নাই)	১	২	৩	৪	৫
৫-৮. PHC স্বাস্থ্যসেবা গ্রহণ করা আমার কাছে সহজ। (PHC স্বাস্থ্যসেবা প্রশিক্ষিত নার্সের এর মাধ্যমে প্রদান করা করা হয় এবং সেবা নেওয়ার জন্য বেশি দূরে যেতে হয় না, টাকা লাগে না)	১	২	৩	৪	৫
৫-৯. স্বাস্থ্য সংক্রান্ত তথ্য PHC সিস্টেম এর সাথে শেয়ার করতে আমি স্বাচ্ছন্দ্য বোধ করি। (স্বাস্থ্য তথ্য PHC সিস্টেম এর ডাক্তার, নার্স দের সাথে শেয়ার করতে স্বাচ্ছন্দ্য বোধ করি কারন ডাক্তার মুখোমুখি থাকে না এবং স্বাস্থ্য তথ্য গোপন থাকে)	১	২	৩	৪	৫
[C] Perceived Output quality					
৫-১০. PHC স্বাস্থ্যসেবা আমার কাছে খুব ভাল মনে হইছে।	১	২	৩	৪	৫
৫-১১. PHC স্বাস্থ্যসেবার মাধমে আমি যে সার্ভিস পাইছি তাতে আমার কোন সমস্যা নাই। (শারিরীক পরীক্ষা, ঔষধ নির্দেশিকা ইত্যাদিতে আপনার কোন সমস্যা নাই)	১	২	৩	৪	৫
[D] Perceived Result demonstrability					
৫-১২. PHC স্বাস্থ্যসেবার মাধ্যমে পাওয়া টেস্ট এর রেজাল্ট আমার কাছে বাস্তবিক মনে হয়। (শারিরীক পরীক্ষার রেজাল্ট যেমন উচ্চ রক্ত চাপ মাপার পরে যে রেজাল্ট পাইছেন আপনার কাছে কতটুকু সম্ভাব্য মনে হয়? সব গুলি টেস্ট এর রেজাল্ট চিন্তা করে উত্তরদাতা উত্তর দিবে)	১	২	৩	৪	৫
৫-১৩. অন্য মানুষ কে এই ডাক্তারী সেবার (টেস্টের রেজাল্ট, প্রেসক্রিপশন) রেজাল্ট এর কথা বলে বুঝাতে আমার কোনো সমস্যা নাই। (যে টেস্ট গুলি করছি এর রেজাল্ট গুলি এবং যে প্রেসক্রিপশন পাইছি সেই গুলি আপনি নিজে বুঝে অন্য মানুষকে বলতে পারবেন)	১	২	৩	৪	৫
[E] Social influence					
৫-১৪. যেসব মানুষ আমার কাছে গুরুত্বপূর্ণ তারা মনে করেন যে আমার PHC স্বাস্থ্যসেবা ব্যবহার করা উচিত। (পরিবারের সদস্যবৃন্দের বাইরের লোকজন)	১	২	৩	৪	৫
৫-১৫. আমার পরিবারের লোকজন আমার PHC স্বাস্থ্যসেবা ব্যবহার করা পছন্দ করেন।	১	২	৩	৪	৫
৫-১৬. আমার আশে-পাশের/সমাজের লোকজন মনে করেন যে, আমার PHC স্বাস্থ্যসেবা ব্যবহার করা উচিত। (প্রতিবেশী, পাড়া, গ্রামের লোকজন)	১	২	৩	৪	৫
৫-১৭. পরিবারের সঙ্গে বুঝা-পড়া ছাড়া আমার জন্য PHC স্বাস্থ্যসেবা/ ডাক্তারী- সেবা ব্যবহার করা কঠিন।	১	২	৩	৪	৫
[F] Trust on PHC system					
৫-১৮. PHC স্বাস্থ্যসেবায় আমার বিশ্বাস/আস্থা আছে। (শারিরীক পরীক্ষা, ঔষধ নির্দেশিকা ইত্যাদি)	১	২	৩	৪	৫
৫-১৯. আমি বিশ্বাস করি PHC স্বাস্থ্যসেবা ব্যবহারকারীদের ব্যক্তিগত গোপনীয়তা বজায় রাখার অংগীকার রক্ষা করে। (PHC স্বাস্থ্যসেবার অংগীকারকে (একজনের তথ্য অন্য জন কে বলবে না, প্রথমেই PHC সম্পর্কে বলার সময় এই কথা বলা আছে অর্থাৎ অংগীকার করছে । এই অংগীকার টা আপনি কতটুকু বিশ্বাস করেন)	১	২	৩	৪	৫
৫-২০. PHC স্বাস্থ্যসেবার উপর আমার বিশ্বাস/আস্থা নষ্ট হয়ে গেলে, আমি এই সেবা নেয়া বন্ধ করে দিব। (একবার আপনার বিশ্বাস/আস্থা কোন কারনে নষ্ট হয়ে গেলে)	১	২	৩	৪	৫
৫-২১. PHC স্বাস্থ্যসেবা আমার কাছে নির্ভরযোগ্য মনে হয়।	১	২	৩	৪	৫
[G] Privacy					
৫-২২. আমি বিশ্বাস করি PHC স্বাস্থ্যসেবা ব্যবহারকারীদের ব্যক্তিগত গোপনীয়তা বজায় রাখবে।	১	২	৩	৪	৫
৫-২৩. আমি বিশ্বাস করি PHC স্বাস্থ্যসেবা'র কাছে সংরক্ষিত ব্যক্তিগত তথ্য নিরাপদ থাকবে।	১	২	৩	৪	৫

(যেমন ব্যাংক এ টাকা নিরাপদ থাকে অন্য কেউ চুরি করতে পারে না তেমনি PHC স্বাস্থ্যসেবা'র কাছে দেওয়া তথ্য অন্য কেউ চুরি করতে পারবে না)					
৫-২৪. PHC স্বাস্থসেবার কাছে অংশগ্রহনকারীদের তথ্যাবলী সুরক্ষিত থাকবে বলে আমি বিশ্বাস করি। (PHC স্বাস্থসেবার কাছে অংশগ্রহনকারীদের তথ্যাবলী অন্য কোন কাজে ব্যবহার করা হবে না)	১	২	৩	৪	৫

[H] Health awareness

৫-২৫. আমি নিজেকে অনেক বেশি স্বাস্থ্য সচেতন বলে মনে করি। (স্বাস্থ্য সচেতন বলতে স্বাস্থ্য ভাল রাখার চেষ্টা করা, রোগ বালাই হলে ডাক্তার এর কাছে যাওয়া, ভাল খাবার খাওয়া, ব্যায়াম করা)	১	২	৩	৪	৫
৫-২৬. আমার মনে হয় স্বাস্থ্য আমার জীবনের অনেক বড় একটা বিষয়। (স্বাস্থ্য অনেক গুরুত্বপূর্ণ)	১	২	৩	৪	৫
৫-২৭. আমার মনে হয় অন্যান্য মানুষ শরীর-স্বাস্থ্যকে আমার চেয়ে বেশি গুরুত্ব দিয়ে দেখে।	১	২	৩	৪	৫
৫-২৮. আমি আমার শরীর-স্বাস্থ্যের উন্নতি করতে চাই। (রোগ বালাই প্রতিরোধ ও নিয়ন্ত্রণে রাখতে চাই)	১	২	৩	৪	৫
৫-২৯. আমি আমার স্বাস্থ্যের প্রয়োজনে টাকা খরচ করতে রাজি। (অসুখ হলে ডাক্তার এর কাছে গিয়ে টেষ্ট করা, ওষুধ কিনা)	১	২	৩	৪	৫

[I] Perceived Self efficacy

৫-৩০. PHC স্বাস্থ্যসেবা গ্রহণের জন্য প্রস্তুত থাকব। (সময়মত সার্ভিস সেন্টারে উপস্থিত থাকব, অপেক্ষা করব, প্রয়োজনীয় কাগজপত্র যেমন আইডি কার্ড যত্ন করে রেখে দিব)	১	২	৩	৪	৫
৫-৩১. আমি PHC স্বাস্থ্যসেবার মাধ্যমে পাওয়া ঔষধ নির্দেশিকা মেনে চলব। (ব্যাখাঃ পরামর্শ মেনে চলব)	১	২	৩	৪	৫
৫-৩২. PHC স্বাস্থ্যসেবা ব্যবহারের মাধ্যমে আমি আমার স্বাস্থ্য সম্পর্কে অবগত হতে চাই। (নিরব ঘাতক, যেমন, ডায়াবেটিস, স্ট্রোক, হার্ট-ফেইলিওর, কিডনি-ফেইলিওর ইত্যাদি আছে কিনা এবং কোন পর্যায়ে আছে জানতে চাই)	১	২	৩	৪	৫

[J] Facilitating condition

৫-৩৩. PHC স্বাস্থ্যসেবা দেয়ার জন্য একটা সুনির্দিষ্ট প্রতিষ্ঠান আছে। (যেমন গ্রামিন কমিউনিকেশন থেকে এই সেবা প্রদান করা হয়)	১	২	৩	৪	৫
৫-৩৪. PHC স্বাস্থ্যসেবা নেয়ার মত প্রয়োজনীয় জ্ঞান আমার আছে। (আপনার মতামত ১ থেকে ৫ এর মধ্যে বলুন,)	১	২	৩	৪	৫
৫-৩৫. PHC স্বাস্থ্যসেবা অন্যান্য প্রথাগত স্বাস্থ্যসেবার মতই সার্ভিস দিতে পারে। (আপনার মতামত ১ থেকে ৫ এর মধ্যে বলুন)	১	২	৩	৪	৫
৫-৩৬. PHC স্বাস্থ্যসেবা একজন প্রশিক্ষিত নার্স দিয়ে পরিচালিত হওয়ায় আমি খুশি। (আপনার মতামত ১ থেকে ৫ এর মধ্যে বলুন)	১	২	৩	৪	৫

[K] Attitude towards using PHC system

৫-৩৭. PHC স্বাস্থ্যসেবা ব্যবহার করলে আমার সময় বাচবে। (হাতে সময় থাকে কারন ডাক্তার দেখাতে দূরে যেতে হবে না)	১	২	৩	৪	৫
৫-৩৮. PHC স্বাস্থ্যসেবা রোগ প্রতিরোধে কাজ/ সাহায্য করবে। (আপনি কতটুকু সম্মত ১ থেকে ৫ এর মধ্যে বলুন)	১	২	৩	৪	৫
৫-৩৯. PHC স্বাস্থ্যসেবা ব্যবহার করা একটা ভালো চিন্তা/ উদ্যোগ। (আপনি কতটুকু সম্মত ১ থেকে ৫ এর মধ্যে বলুন)	১	২	৩	৪	৫
৫-৪০. PHC স্বাস্থ্যসেবা ব্যবহার করতে আমার ভাল লেগেছে। (আপনি কতটুকু সম্মত ১ থেকে ৫ এর মধ্যে বলুন)	১	২	৩	৪	৫

[L] Intention to use PHC at the next time

৫-৪১. ভবিষ্যতে আমার PHC স্বাস্থ্যসেবা ব্যবহার করার ইচ্ছা আছে। (ইচ্ছা কতটুকু ১ থেকে ৫ এর মধ্যে বলুন। যেমনঃ যদি বলে একদম ইচ্ছা নাই তাহলে ১ এ টিক দিতে হবে, একটু ইচ্ছা থাকলে ২, এর থেকে একটু বেশি থাকলে ৩ এই রকম ঈচ্ছার লেভেল শুনে টিক দিতে হবে ১ থেকে ৫ এর মধ্যে বলুন)	১	২	৩	৪	৫
৫-৪২. যদি PHC স্বাস্থ্যসেবা পাওয়া যায়, আমি সব সময় ব্যবহার করব।	১	২	৩	৪	৫

(আপনি কতটুকু সম্মত ১ থেকে ৫ এর মধ্যে বলুন। একবার ও ব্যবহার করব না =১, সব সময় ব্যবহার করব =৫)					
৫-৪৩. PHC স্বাস্থ্যসেবা ব্যবহার করা আমার কাছে লাভজনক মনে হয়। (আপনি উপকৃত হবেন। আপনি কতটুকু সম্মত ১ থেকে ৫ এর মধ্যে বলুন)	১	২	৩	৪	৫
[M] Actual use of PHC system					
৫-৪৪. PHC স্বাস্থ্যসেবা ব্যবহার করা একটি মজার অভিজ্ঞতা।	১	২	৩	৪	৫
৫-৪৫. PHC স্বাস্থ্যসেবা সম্পর্কে জানতে আমি সময় ব্যয় করি। (ইন্টারনেট, পত্রিকা, পরিচিত মানুষ জন, লিফ লেট, এড, ইত্যাদি থেকে PHC স্বাস্থ্যসেবা সম্পর্কে খুজি এবং জানার চেষ্টা করি)	১	২	৩	৪	৫
৫-৪৬. PHC স্বাস্থ্যসেবা ব্যবহারের অনেক সুবিধা আছে। (সুবিধা যেমন স্বাস্থ্য তথ্য জমা রাখতে পারে, খরচ কম, বেশী দূরে যেতে হয় না)	১	২	৩	৪	৫
৫-৪৭. PHC স্বাস্থ্যসেবা ব্যবহার করা আমি পছন্দ করি। (PHC স্বাস্থ্যসেবা ব্যবহার করতে আমার ভাল লেগেছে)	১	২	৩	৪	৫

Appendix 2:
Structure & Team Composition, Roles & Responsibilities

Table 1: List of Organizations and their Roles

Name of Organization	Major Roles
Toyota Motor Corporation, Aichi, Japan	Provide financial support, advise on research plan, exchange knowledge on Toyota's healthcare related research activities and outcomes
Kyushu University, Fukuoka, Japan	Provide knowledge on community requirements in rural and urban areas in developing countries, develop and provide appropriate technologies on remote healthcare systems, consumer behavior analysis to ensure quality healthcare services for unreached communities.
Grameen Communications, Dhaka, Bangladesh	Design and implement experiments in the specified locations in Bangladesh. Develop/customize software system for collecting, cleaning, verifying healthcare data. Liaising with local supporters, recruiting human resources.
University of Dhaka	Check questionnaire, analyze data, prepare report
Ekhlaspur Center of Health, Chandpur, Bangladesh	Provide space for rural healthcare service, share knowledge on cohort study, assist processing ethical clearance

Table 2: List of Advisory Committee

#	Name	Affiliation	Role
1	Hiroshi Okajima	Group Manager, R&D and Engineering Management Div., Toyota Motor Corporation	Approve budget. Check
2	Keijiro Araki	Dean, Faculty of Information Science and Electrical Engineering, Kyushu University	Approve the joint research agreement.
3	Nazneen Sultana	Managing Director, Grameen Communications, Bangladesh	Approve the joint research agreement.
4	Mostafa Zaman	Founder, Ekhlaspur Center of Health, Chandpur, Bangladesh	Provide technical knowledge
5	Shibli Rubayat	Dean, Faculty of Business Studies (FBS), University of Dhaka, Bangladesh	Recommend and engage researchers from Unversity of Dhaka
6	Naoki Nakashima	Professor, Kyushu University Hospital	Provide technical knowledge

Table 3: List of Project Technical Staffs and their Roles

#	Name	Role	Affiliation
1	Ashir Ahmed	Principal Researcher (KU)	Kyushu University
2	Saeko Miyaoka	Principal Researcher (TMC)	Toyota Motor Corporation
3	Nazneen Sultana	Principal Researcher (GC)	Grameen Communications
4	Fumihiko Yokota	Co-investigator	Kyushu University
5	Hideo Ikai		Toyota Motor Corporation
6	Rafiqul Islam Maruf		Kyushu University Hospital
7	Rajib Chakrabarty	Co-investigator (Local Project Manager)	Grameen Communications
8	Muhammad Ismail Hossain	Research Collaborator	University of Dhaka
9	Md. Rakibul Hoque		
10	Asma Islam	Healthcare worker	Grameen Communications
11	Sharmin Akter		
12	Md. Raihan Morshed	Surveyor & Data Collector	
13	Md. Musfiqur Rahman		
14	Md. Mahmudur Rahman	Data Quality Checker	
15	Md. Jiaur Rahman	Healthcare worker Trainer, Report Printing and Explanation to Patient	
16	Md. Tutul Hossain	ICT Assistant	
17	Md. Rahat Hossain	Surveyor & Data Collector	
18	Raisa Tasneem		
19	Md. Foyez Ahmed	Local Coordinator	
20	Morshedul Islam Shawon	Data Quality Checker	
21	Kazi Mozaher Hossein	Data analyst and coordinator	Kyushu University
22	Nazmul Hossain	Data Analyst	
23	Mehdi Hasan	Co-researcher	
24	Masuda Begum Sampa		
25	Ryo Takahashi	Data digitization and analysis	
26	Dai-ichi Koike	Data digitization and analysis	
27	Tomohito Shimura	Data Analyst	
28	Jahidul Islam	Local Data Collector	Ekhlaspur Center of Health
29	Nazrul Islam		
30	Sayedul Islam		
31	Golam Rosul		

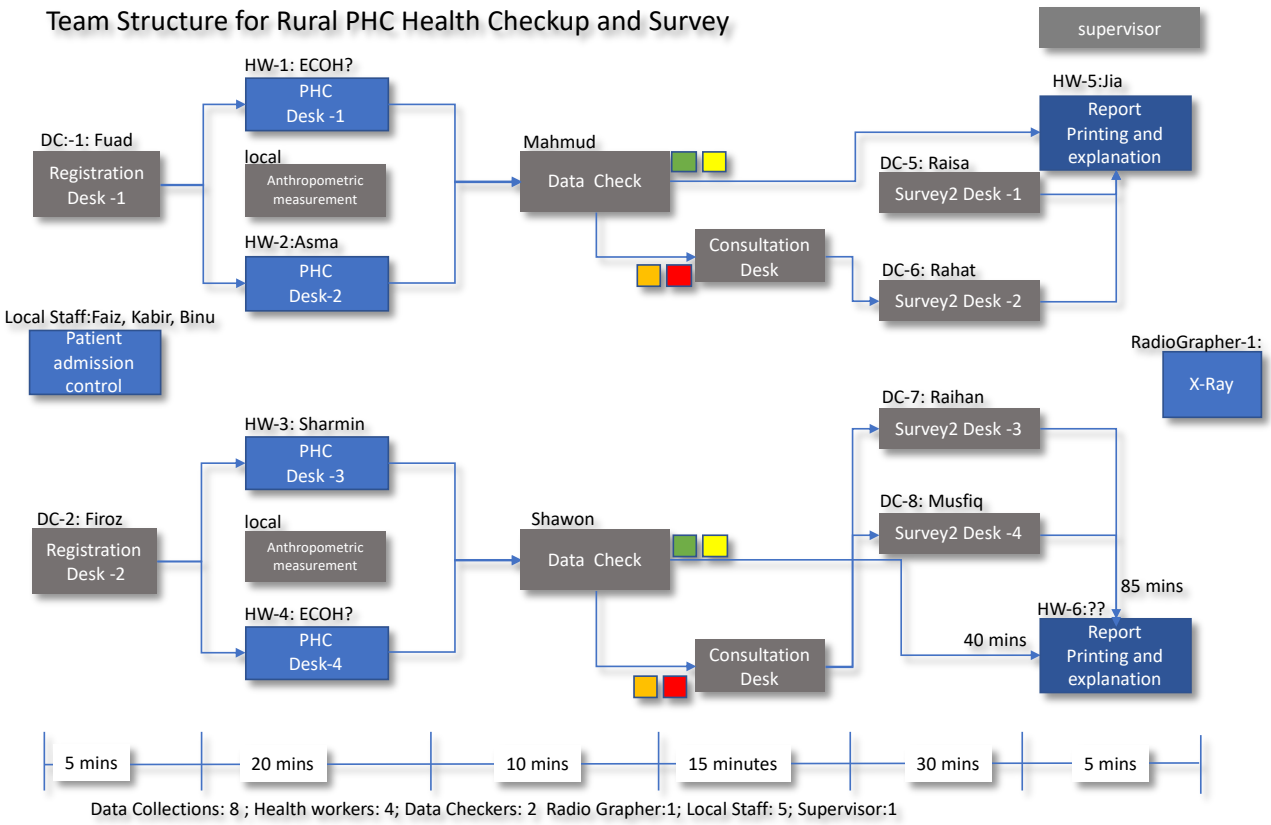


Figure 1:Team Structure for Rural Health Checkup Survey

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List of Publications

Journals:

1. Blood Uric Acid Prediction Model through Machine Learning Approaches- Masuda Begum Sampa, Md. Nazmul Hossain, Md. Rakibul Hoque, Rafiqul Islam, Fumihiko Yokota, Mariko Nishikitan, and Ashir Ahmed; ***Journal of Medical Internet Research***, https://preprints.jmir.org/preprint/18331 JMIR Publications, 2020. doi. 10.2196/preprints.18331.
   [Preprint]
2. Redesigning Portable Health Clinic Platform as a Remote Healthcare System to Tackle COVID-19 Pandemic Situation in Unreached Communities- Masuda Begum Sampa, Rakibul Hoque, Rafiqul Islam, Mariko Nishikitani,Naoki Nakashima, Fumihiko Yokota, Kimiyo Kikuchi, Mad. Moshiur Rahman, Raiz Shah, and Ashir Ahmed; ***International Journal of Environmental Research and Public Health (IJERPH)***, vol. 17, issue 4709, pp. 1-14, 2020. doi:10.3390/ijerph17134709.
3. Impacts of anthropometric, biochemical, socio-demographic, and dietary habits factors on the health status of Urban Corporate People in a Developing Country- Masuda Begum Sampa, Rakibul Hoque and Md. Nazmul Hossain; ***Healthcare***, Vol. 8, Issue 188, pp. 1-13, 2020. doi:10.3390/healthcare8030188.
4. A systematic Review to Identify Influencing Factors and Directions for Future Researches about Adoption of ICT Based Health Services-- Masuda Begum Sampa, Rafiqul Islam, Fumihiko Yokota, Mariko Nishikitani, Akira Fukuda and Ashir Ahmed. ***Journal of Decision Science,*** Vol. 3, pp. 44-52, 2020.
5. Influence of Factors on the Adoption and *Use* of ICT-Based eHealth Technology by Urban Corporate People—Masuda Begum Sampa, Md. Nazmul Hossain, Md. Rakibul Hoque, Rafiqul Islam, Fumihiko Yokota, Mariko Nishikitani, Akira Fukuda and Ashir Ahmed. ***Journal of Service Science and Management***, Vol. 13, pp. 1-19, 2020. doi: 10.4236/jssm.2020.131001
6. Factors Affecting Rural Patients' Primary Compliance with e-Prescription: A Developing Country Perspective-- Md. Nazmul Hossain, Masuda Begum Sampa, Fumihiko Yokota, Akira Fukuda, Ashir Ahmed. ***Journal of Telemedicine and e-Health,*** Vol. 25(5), pp. 391-398, 2018. doi: 10.1089/tmj.2018.0081.

Book Chapters:

1. Portable health clinic: concept, design, implementation and challenges- Ashir Ahmed, Mehdi Hasan, Masuda Begum Sampa, Kazi Mozaher Hossein, Yasunobu Nohara, and Naoki Nakashima In: Roy P. K., Nakashima N., Ahmed A., Ro S.-C. and Soshino Y. (eds) ***Mobile Technologies for Delivering Healthcare in Remote, Rural or Developing Regions***. IET Publishing, 2020.

2. Theoretical Framework of a Longitudinal Study to Understand Determinants of Use of Portable Health Clinic (PHC)-- Masuda Begum Sampa, Md. Nazmul Hossain, Md. Rakibul Hoque, Fumihiko Yokota, Akira Fukuda and Ashir Ahmed. In: Streitz N., Konomi S. (eds) Distributed, Ambient and Pervasive Interactions. HCII 2019. ***Lecture Notes in Computer Science, vol 11587. Springer***, Chamhttps, pp. 323-332, 2019. doi.org/10.1007/978-3-030-21935-2_24.

Conferences:

1. Predicting risk levels of NCDs among urban corporate by using machine learning methodology- Masuda Begum Sampa, Md. Nazmul Hossain, Md. Rakibul Hoque, Rafiqul Islam, Fumihiko Yokota, Mariko Nishikitani, Akira Fukuda, and Ashir Ahmed. Presented in the 3rd International Conference on Healthcare, SDGs and Social Business, 19-21 November 2019, Kyushu University School of Medicine, Fukuoka, Japan.
2. Association between health status and anthropometric measurements: An Evidence with Portable Health Clinic System- Masuda Begum Sampa, Fumihiko Yokota, Mariko Nishikitani, Akira Fukuda, and Ashir Ahmed. Presented in the International Symposium "Decision Science for Future Earth" on 1 August 2019 at Jonathan KS Choi Culture Center, ITO campus, Kyushu University, Fukuoka, Japan.
3. The theoretical framework of a longitudinal study to understand determinants of use of Portable health clinic (PHC)- Masuda Begum Sampa; Md. Nazmul Hossain; Md. Rakibul Hoque; Fumihiko Yokota; Akira Fukuda and Ashir Ahmed. Presented in the HCI International 2019, 26-31 July, Orlando, Florida, USA.
4. Longitudinal Study to Understand the Determinants of Actual Use of Human Assisted Portable Health Clinic System- Masuda Begum Sampa, Nazmul Hossain, Rakibul Hoque, Fumihiko Yokota, Akira Fukuda, and Ashir Ahmed. Presented in the WSSF 2nd International Conference on Healthcare, SDGs and Social Business, April 26-28, 2018, Fukuoka, Japan.
5. The longitudinal study of Psychological Factors Influencing the use of the Remote Health Care Systems in Rural Bangladesh - Masuda Begum Sampa, Nazmul Hossain, Fumihiko Yokota, Akira Fukuda, and Ashir Ahmed. Presented in Square-ACI International Conference on Biotechnology in Health & Agriculture 2017, December 29-30, 2017, Dhaka, Bangladesh.