GiveMed: A Webportal for Medicine Distribution among Poverty-stricken People

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***Abstract*— A noticeable number of people living in extreme poverty still remain high in Bangladesh. It is becoming challenging for the poor or low-income people to pay for their health purpose. Thus they suffered from various diseases and as a result the death rate is increasing day by day. On the other hand, there are many people who have plenty of leftover medicines even after finishing those medicines consumption. In this paper, we have proposed a medicine distribution web portal, named 'GiveMed'. The GiveMed is a platform for the donors who want to donate their unused medicines to the poor or low-income people who need those medicines. This system will contribute to reduce the cost for national health services by making the proper use of unused medicines; and to help the poor or low-income people to get better health services. The portal was also evaluated with 16 participants (including doctors, donor, NGO personnel and low-income people) and found that the portal is highly effective, efficient, satisfiable and useful system.**

***Index Terms*—Web portal, electronic health service, ICT, medicine distribution.**

I. Introduction

Health is a vital issue for the human race. In recent times, people's concern regarding health issues has increased exponentially. For developing countries, health care is a fundamental need. Due to the scarcity of doctors and physicians, people of the developing countries have less access to health care services. Thus, health care is a very challenging in these countries.

Bangladesh is one of the developing countries. Bangladesh has expanded the health service systems and infrastructure in the government and non-government sectors. Moreover to get the better health services in context of Bangladesh following challenges are playing key roles:

1) Bangladesh is a densely populated country. The population of Bangladesh is about 165 millions as of May 8,2017. The population density of Bangladesh is 1266 per km [1].
2) According to World Health Organization (WHO), there is an estimated 3.05 physicians and 1.07 nurses per 10,000 population (estimates based on MoHFW HRD 2011) [2]. The ratio of doctor to population is 1:1500 in urban areas whereas 1:15000 in rural areas [3].
3) Illiteracy is also a fact for this country where illiteracy rate of Bangladesh was 40% in 2013 [4]. Due to the illiteracy, major proportion of our population still remains unaware of the ICT uses. According to BTRC about 67.245 million people use the internet and most of them live in the urban areas [5].
4) Poverty erodes good health status of a populace and further deepens individual and national poverty while creating a public health concern for the society. About 13% of the total population live below the national poverty line (average income US $2 per day) [6]. Another study conducted by World Bank in 2016 mentioned that Bangladesh's extreme poverty rate has dropped to 12.9 percent [7]. However, Bangladesh is also making progress in reducing its poverty rate & there is a big chance of overcoming extreme poverty rate by 2030 [6].

Due to these challenges, people living below the poverty line do not want to pay for health care purposes. Moreover "cost of the medicines" is a key concern for them; thus they are unable to buy medicines and suffer from various kinds of diseases, and many people give their lives. People living above the poverty line are capable to buy many kinds of medicines when needed and may also preserve medicines after their use.

In this paper, we aimed to develop a web portal, which can help to collect unused medicines from donors, and to distribute to the poor or low-income people. Authorized doctors can recommend medicines for poor or low-income people using this portal.

The rest of the paper is organized as follows. Background study of our work is presented in Section II. In Section III, we discuss about the need findings, conceptual design and the development of the portal. The result of evaluation of our system is demonstrated in Section IV. The discussion, implications and idea for future work are presented in the final Section V.

II. Related Works

This section briefly discuss the works related to ICT based health services and electronic health services for poor/low-income or unprivileged people.

Leisinger [8] highlighted the constraints of the poor people to get access to medicine and health services in the developing countries, that includes high drug prices, low income etc. to ensure and improve health of the underprivileged people. In this work, he also suggested to make a collaboration among government organization, NGOs and individuals to ensure public health. In another study, Islam et al. [9] found that

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educational, financial and administrative factors influenced the peoples' participation in health services especially in the rural areas. They also found that rural health complexes did not have sufficient medical equipment's and government's allocation.

The opportunities and challenges of the developing countries to reinforce the Health Management Information System (HMIS) are discussed in a study [10]. They highlighted some opportunities like increasing the use of internet, ICT based application development, and adoption of telemedicine, while some of the challenges are affordability and accessibility to ICT, political issues, data quality and utilization. In another study, Ruxwana et al. [11] found that perceived usefulness and ease of use affecting people's acceptance of the e-health supports in rural clinics in the Eastern Cape Province of South Africa. Some other studies have been conducted on e-health and m-health services to evaluate their prospective. A study conducted by Prentza [12] showed the architecture of congestive heart failure (CHF) application, an e-Vital application in which patient can measure their blood pressure, weight, pulse using comfortable wearable devices and send their readings to the doctor for further diagnosis sitting at home. But these applications leave the question of their affordability, accessibility to the poor and low income people. In study [13], Karim et al. showed the present status of m-health applications development in Bangladesh. They also evaluate the related applications through clustering, extracting and analyzing features to provide the open issues, opportunities that pratitiotners may consider in future to develop mHealth application for the users from Bangladesh. Some other studies like [14]–[17] talked about the current status, challenges, potentialities and initiatives of the ICT health services (e-health, m-health) in developing countries including Bangladesh. Their findings showed that existing ICT health services are not up to the mark to meet the needs of the people specially the low-income, illiterate and under privileged people. They also acknowledged that the difficulties and barriers of *a*ccessibility and *q*uality can be overcome and brought positive influences in the improvement of public health.

In study [18], Khuman developed a web portal called Drugmatch which is capable to match the requirements of drugs of a patient with the donor's donated medicine's information. There are some related ICT portals which work on medicine support and health services are shown in Table I.

In sum, earlier works mainly focus on understanding the challenges, opportunities of ICT usage in health sector to improve health services in context of developing countries like Bangladesh . A limited number of tools/web portals have been developed to provide health support. Each of these tools has merits and demerits in their own use of context but unfortunately (to the best of our knowledge) no such ICT tool is developed in Bangladesh to support low-income or poor people to take health treatment. Thus, this work is aimed to develop a web portal to provide health services for the low-income unprivileged people by providing free medicines. This web portal will bring all stakeholders like NGOs or government health institute, low-income/poor patients, doctors, and donors under an umbrella to provide more effective health services to the low-income patients in Bangladesh.

TABLE I: List of ICT Tools for Medicine Donation

Serial	Portal Name	Objectives
1.	projectc.u.r.e [19]	Delivers the medical supplies to poor people from the donated money.
2.	GiveIndia [20]	Take money donations to make fund for poor people's medical diagnosis.
3.	Friendship [21]	Donates medicine in different countries including Bangladesh.
4.	SIRUM [22]	Distributes medicines bought from the donated money to the eligible safety-net clinic or pharmacy to help the patient who is unable to afford medicine cost.
5.	MedShare [23]	Takes medicines and medical equipment from the donors and delivers to the poor.
6.	Wyoming Department of Healt [24]	Handles a medicine donation program to help people of Wyoming.

III. Design and Development of Web Portal

In this section, we have discussed how the system is designed and developed. We have followed three sequential steps that include- (a) finding the users' needs, (b) develop the conceptual design, and (c) develop the web portal.

A. Need Finding

To attain our aim for developing the web portal, we have tried meticulously to understand the major requirements and needs of the portal from the focused end users. We have followed two methods to assess the requirements, one is an online survey and another is the interview of the focused users.

For conducting the survey, we developed a form where the users were asked about their biographical background, age and profession. We also wanted to know how frequently they meet with the doctors, how they utilize their leftover medicines and their speculation to do some welfare work with their leftover medicines [25]. The survey was distributed through the social media and emails. We sent 200 mails to request people to give their valuable opinions through this survey so that we could get accurate data as far as possible. This survey was distributed during the middle of March and three weeks were given to response to our survey. After the ending period, we have found the successful return of 110 survey responses that we consider for analyzing the needs finding.

From the result of the survey, we have seen that people who had participated in the survey have an age limit 25.158 in average. Among them the majority people are students others are service holder, businessman, housewife and doctor. We have also found that a large portion of people visit doctor upon requirement and a very small portion people go for regular checkup. Here 57.5% people said that they have leftover medicines at home while 42.6% people do not have. People who had participated in this survey said that maximum leftover medicines remain at home and after their expiry date people

throw them out while some people give the unused medicines to the poor or their relatives. (See Figure 1).

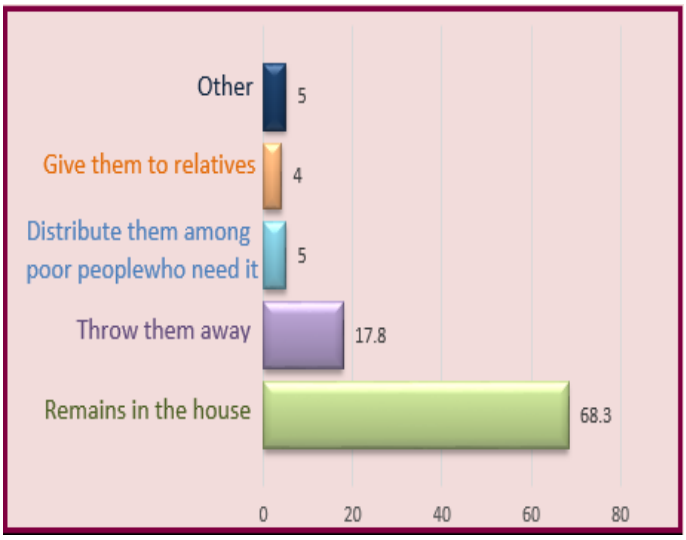

Fig. 1: The status of leftover medicines

Because of poverty, poor people cannot buy expensive medicines whereas many people waste a large amount of medicines. From the survey, we get to know that 91.1% people think of a trusted web portal where they can donate their unused medicine to help the poor people and it is the major cause of building our web portal. We also kept an open forum to know why people are not willing to receive medicines from a trusted web portal where people mentioned various reasons and one of the main reasons is the trust issue. People have doubt on medicine expiry date, therefore we thought of putting a restriction on medicine expiry date.

As ICT has not reached to all people, therefore for further checking we also conducted a semi-structured interview. A total of 5 males and 3 females whose age limit was 31.625 in average and income was below USD 2 per day were conducted. Among them two females were housemaid and the other one was a housewife of a rickshaw puller whereas 2 males were driver and others were rickshaw puller, caretaker, grocer respectably. Among these needy people, most of them lived under the poverty line and some of them had completed their primary education and rest were illiterate people. During interview we have asked them at first their biographical profile and then some questions like- how frequently they meet with the doctors, whether they are willing to buy medicines when the doctor prescribes them, whether they are capable of buying medicines, if there is any validated and trusted platform or organization having some tools to provide free medicines, whether they are willing to accept it or not. As a result, we found they are not willing to go to doctors frequently for the extra payment for the medicines. 3 of them are not very much willing to collect medicines from some organizations as they think that this might not be safe or trusted and the other 5 people are very much willing to collect medicines if there is any trusted organization who is controlling this web portal.

In summary, the outcome of need finding studies (survey and interview) highlights two issues-

(a) a web portal for medicine distribution would be very much helpful for low income people.
(b) people are willing to use a trusted web portal.

B. Conceptual Design

This section is focused on the conceptual design of our system which is the representation of the system composing the key concepts which can be used for knowing, understanding and simulating our system. The web based system will be the interface between the users (donors, doctors) and the trusted sources (government organizations/ NGOs) which will distribute medicines to the poor. The donors can donate their medicines through this web-portal and registered doctors can prescribe medicines for their patients who are unable to buy the costly medicines. The conceptual model for the system is depicted in Figure 2.

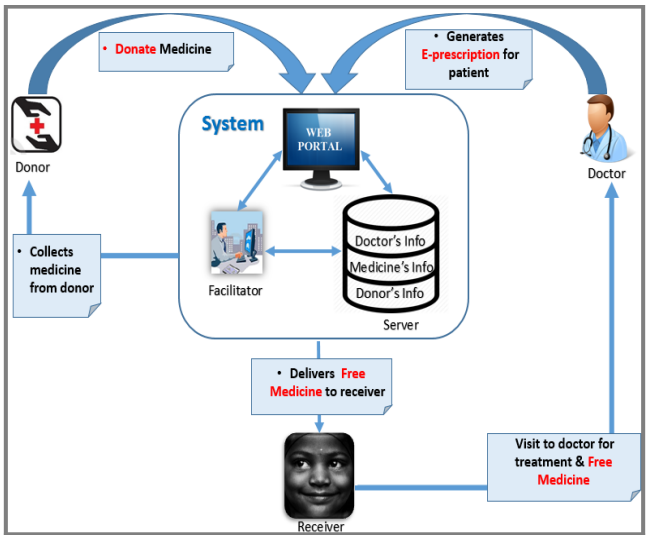

Fig. 2: Conceptual model diagram

The stakeholders of our system are donor who would donate medicine, doctors who would prescribe medicine, receiver (with income below US $2 per day) who would receive medicine for free of cost and the inter-connecting medium which can be any government welfare organization or any NGO that would be responsible for maintaining the system through checking the medicine list, donor's information, receiver's information, registered doctor's information, availability of medicine and also would be responsible for collecting medicines from donors and delivering prescribed medicine to the receivers and thus completes the circle of our system.

The medicine provider or donor as well as the doctor needs to create an account in our software system through which the system would be able to verify the account as well as all the information given by the donor or the doctor. For this process, registration name, address, sign up as (whether doctor or general), registration ID (for doctors only), email and password would be mandatory. During registration, the

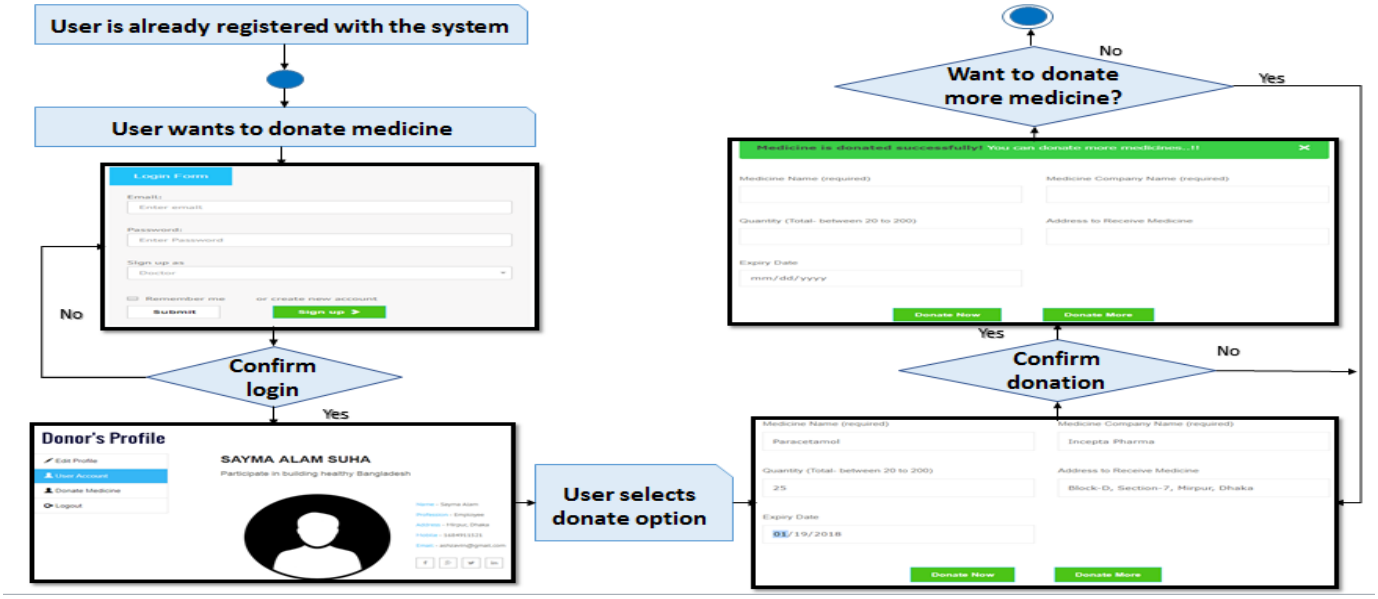

Fig. 3: Flow diagram of donation process

provided information is crosschecked to verify as this system is used for very delicate purpose and therefore, we handled the authentication system (specially for doctors) very cautiously. Doctor and donor both can access his/her account after this registration process and would be able to see the medicine list, from which the registered doctor can prescribe medicine and a PDF report would be generated and also the donor can donate medicine after providing necessary information.

On the other hand the receiver can receive medicines in two ways from the facilitators (responsible NGO's or government organizations) by visiting them in person. One way is to show a valid prescription from any registered doctors and national identity (NID) card to the concerned supplier for receiving medicines. Another way is- the patient needs to visit the doctor who are subscribed to the system and if the patient is unable to bear the cost of the medicine then the doctor may request for the medicine through the system and would generate an e-prescription so that the patient can visit to the facilitator with this prescription and with also his NID card for getting the medicine. Therefore, the receivers don't need to access the portal directly which solves their affordability and expertise issues regarding smart phones and internet use. Before delivering the medicine to the recipients, the concerned administrator would check for the availability of the prescribed medicines. Thus the system would fulfill the needs of the stakeholders of the system.

C. Developing the Portal

This section represents the portion how we develop the portal. We can divide the development phase in three parts.

1) Database and Server End: At first, we have designed an E-R (Entity Relationship) diagram of the database according to the requirements of our system and implemented the database in MYSQL server with enough security constraints to prevent unauthorized access. For security purpose in the system we used two separate databases (admin and user) so that no one can easily hack or destroy the existing top level information of admin panel. Admin panel ensures the requirements of the system that coming from the user database and keep the whole system updated.

2) User interface: In the system, secured access point is provided to personalize the information of the users where content of the web portal is unique based on the user criteria (donor/doctor/receiver). It has device and browser compatibility at the same time it is designed in a user friendly way so that it is easy to access for authenticated user. We have implemented notification system to notify the users through mail integration using PHP mailer (SMTP server) so that they can remain up-to-date about the web portal. For technical development of the system we used HTML, CSS, JavaScript, JQuery, PHP etc. that make the system more interactive for the users.

3) Security Aspects: Users need to register first to get the facilities of the web portal and their registration will be completed after verifying all the required information such as doctors will be verified against their registry number. We have used HTTP Basic authentication (using password_hash() function of PHP) which confirms the encrypted strong password for user that is verified with the existing email address through encrypted message. The session based login will be valid until the user will logged out or system will automatically logged out after a specific time when the session will be ended. Thus implementing these types of security aspects, we have tried to make the web-portal trustworthy and secured for the users.

For better understanding of the system's workflow, we have depicted the activities of a donor's donation process through an activity diagram shown in Figure 3. Suppose that, a donor wants to donate medicine, therefore user needs to login to

TABLE II: Summary results of the usability test

Participants	Task	TCT (Sec.)	Wrong Navigation (frequency)	Asking Help (frequency)	Input Error (frequency)	System Error	Task Completion Status
Doctor (n=4)	Prescribe medicine for patients with low income	123.6	2.25	1.5 (2 part. ask for 2 times, other 2 ask for 1 times)	1 (Medicine quantity exceeds the limit)	1 (internet failure)	Successfully completed (2 part. needs 2 trials, others need single trial)
Donor (n=4)	Fill up form for donating medicine with login	80.00	1.75	2.00 (2 part. ask for 2 times, 1 ask for 3 times, another 1 ask for 1 times)	1 (Expiry Date Missing)	0	Successfully completed (1 part. needs 2 trials, others need single trial)
Admin (NGO workers, n=4)	Medicine distribution to the low income people	15.5	1.25	1.75 (2 part. ask for 1 times, 1 ask for 2 times, another 1 ask for 3 times)	1(wrong password)	0	Successfully completed (all need single trial)
Total		73.03	1.75	1.75	3	1	

the system. After successful login, user enters into his profile, selects donate option and fills up the wish form. If the given information related to the medicine such as medicine name, company name and especially expiry date are valid, then user receives a notification that donation has been successful.

IV. Evaluation

The GiveMed portal was evaluated through a user study to evaluate the effectiveness (how accurately users can perform task using this portal), the efficiency (how much difficulty or effort is required to learn and perform the task in GiveMed portal), and satisfaction (how much users are satisfied to replicate the evaluation study). This section will briefly discuss the participants profile, the study procedure and the results of the evaluation.

A. Participant's Profile:

We have recruited a total of 16 participants from different types of stockholder to replicate the evaluation study; the participants team encompassed 4 doctors, 4 donors (1 banker, 1 engineer and 2 students), 4 NGO personnel and 4 low-income people (1 car driver, 1 housemaid, 1 shopkeeper and 1 home security guard). Among them 7 was male and 9 was female. Their average age was 35.121 years; except the low-income peoples all other participants had a good level (average 5.1 years) of experiences of using internet and smart phone.

B. Study Procedure:

We have performed a formative study where we have invited all the participants in the software engineering lab of the authors' institute. At the beginning, we provided a small brief about the purpose of the study, presented the GiveMed through PPT and live demonstration and then asked them to sign a concerned form. Doctor, donors and NGO personnel were asked to perform the tasks as listed in Table II and collect the data related to TCT (Time Completion Time) and frequency of wrong navigation, asking help, input error and system error. Finally, all types of participants are asked to complete a set of questionnaires. The questionnaires include 5 questions: 1) satisfaction level, 2) recommendation of the portal to others and 3) willingness to use the portal in future. The others are open questions: 4) Opinion about the tool's contribution in helping the poor people and 5) any other comments. The first three questions were closed questions and ask to rate into a scale of 1 (strongly disagree) to 5 (strongly agree).

TABLE III: Summary results of user experience (UX)

Participants	Average level of satisfaction	Recommend the portal to others (Avg score)	Future use (Avg score)
Donor (n=4)	4.5	4.00	4.75
Donor (n=4)	4.0	4.25	4.25
Admin (n=4)	4.25	3.75	4.00
Receiver (n=4)	4.00	4.00	4.70
Total (n=16)	4.19	3.75	4.38

C. Evaluation and Results:

The resultant outcome is shown in Table II and Table III. From Table II, we observed that all participants completed the task successfully within a short time (73.140 seconds) and most of the participants completed in single trials. No system error except internet failure occurred and input error frequency was comparatively less which all shows a good level of effectiveness. Required TCT, wrong navigation and asking help frequency were less; therefore they completed the task very smoothly and efficiently.

Table III showed that user satisfaction score gathered from all users (doctor, donor, admin, and receiver) was comparatively high. They were highly intended to recommend this portal to others and their willingness to use it in future was also overwhelming which represents a good level of satisfaction. From the open questions, we have found that all were agreed to say that the tool will introduce an innovative means of providing better health services for the poor or

low-income people in Bangladesh. They also highlight the following benefits:

- **Poverty diminution**: Two doctors, two donors and one NGO personnel opted that the system worked as a beneficial platform for the people live below the poverty line by providing them free medicines and it would remove the poor peoples sufferings from various diseases and make them more health concerned.
- **Reduce cost in taking health service**: Three receivers (low-income people) thought that the system would help them to overcome the problem of buying costly medicines.
- **Proper use of resources**: Three NGO personnel thought that this portal helps to make proper use of resources.
- **Privacy protection**: Three donors found that the system provides a secured and trustworthy framework for better enforcement of data privacy of the users and medicines information.

In a nutshell from the evaluation study, we found that the system is effective, efficient, useful as well as satisfiable to all users.

V. Conclusion

Modern era has begun. People both privileged or unprivileged, literate or illiterate are now conscious about their health. It is a matter of sorrow that being conscious poor people cannot pay much attention to their health care routine because of their low income. Government take great initiative by providing free treatment to poor people. But most of the cases, they get the treatment not the expensive medicines. Therefore, the great initiative become valueless to them. This paper provides a brief overview of the design and development of a web portal, which will be very effective and will bear great contribution to get the health services for these poor or low-income people in Bangladesh. The light weighted evaluation study also highlighted the portal as a useful, effective, efficient, and innovative mean of getting health service.

One of the main limitation of this research was the number of participants recruited in the evaluation study were comparitively low. Further research may therefore be carried out an extensive empirical study with large number of real-users for the improvements of the portal's usability and technical features. Future research may also be conducted to design and develop a mobile application of this portal and assess the performance comparing with this web portal.

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