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Cost and Time Effectiveness Analysis of a Telemedicine Service in Bangladesh

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Abstract. Telemedicine has great potential to overcome geographical barriers to providing access to equal health care services, particularly for people living in remote and rural areas in developing countries like Bangladesh. A number of telemedicine systems have been implemented in Bangladesh. However, no significant studies have been conducted to determine either their cost effectiveness or efficiency in reducing travel time required by patients. In addition, very few studies have analyzed the attitude and level of satisfaction of telemedicine service recipients in Bangladesh. The aim of this study was to analyze the cost and time effectiveness of a telemedicine service, implemented through locally developed PC based diagnostic equipment and software in Bangladesh, compared to conventional means of providing those services. The study revealed that the introduced telemedicine service reduced cost and travel time on average by 56% and 94% respectively compared to its counterpart conventional approach. The study also revealed that majority of users were highly satisfied with the newly introduced telemedicine service. Therefore, the introduced telemedicine service can be considered as a low cost and time efficient health service solution to improve health care facilities in the remote rural areas in Bangladesh.

Keywords. Telemedicine, health care, information and communication technology

Introduction

Telemedicine service is a value added service taking advantage of the developments in telecommunication and growing internet facilities. It can play a significant role in providing medical facilities in remote areas where modern health facilities are very limited. This service paradigm is especially critical for developing countries like Bangladesh where access to medical facilities and necessary equipment are limited in rural areas. Telemedicine can be a cheaper and easier way to disseminate medical facilities among large group of people in the remote areas by using limited resources [1].

The total population in Bangladesh is over 150 million. Among them, 77% people live in rural areas. A substantial improvement in health care sector in Bangladesh has reduced child mortality rate and maternal death, and increased immunization coverage and life expectancy of citizens [2]. However, due to having huge disparity in health care distribution between rural and urban areas, large portion of people living in rural

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areas are deprived from these modern health care facilities. They are required to travel long distance to access health care services which are costly and time consuming [3]. There are 663 Government hospitals in District head-quarters and Thana (sub-town) areas. Total number of beds available in both public and private hospitals and clinics are 51,648. Nevertheless, the ratio of hospital bed to citizen is around 1:2571 [4] with doctor to citizen ratio 1:43660 [5] in Bangladesh. However, most doctors in Bangladesh are located in urban areas due to a poor infrastructure in rural health care centers and villages.

Due to ill-equipment, insufficient numbers of doctors and health care professionals, and poor healthcare infrastructure, most rural people are required to travel long distance to access modern healthcare facilities mostly located in urban areas. To overcome this disparity in healthcare access, Telemedicine can play a critical role. It has great potential to improve both the quality and the access to health care service delivery with reduced costs even in the scarcity of resources [4]. Telemedicine could potentially reduce waiting times for patients and cost of health system's operations; it can improve interdepartmental and inter-hospital communication and collaboration; it can provide opportunity for sharing best practices among physicians within Bangladesh and international hospitals, and can enhance better resource allocation [6].

Leveraging the potentiality with Telemedicine services, recent years there has been an increasing concern about telemedicine services in Bangladesh. As a consequence, a number of Telemedicine initiatives have been taken in place [4]. However, none of them have been successful due to a number of reasons. For example, Mostafa et.al [7] in a study stated as 'Even though enthusiasm has been observed in deploying telemedicine in Bangladesh from different quarters, however, lack of sustainability and long-term deployments are major issues. Unfortunately, many pilot projects are not followed up to turn into stable and fully functional healthcare systems. The primary reason is that the projects started with a narrow scope and did not address a proper framework for telemedicine application in Bangladesh.' Another study by Nessa, et.al [4] indicated that technical issue was one of the major reasons for deployment of a telemedicine service in Bangladesh.

Previous research has also identified some other challenges in successful implementation of Telemedicine in Bangladesh including unavailability of initial huge startup costs, poor Information and Communication Technology (ICT) culture of healthcare professionals, poor power supply and people embedding political meanings into the system [7]. The weak state of information infrastructure at the hospital is another problem in the implementation of Telemedicine. The success of Telemedicine largely depends on effective communication in spite of differences in location, time, equipment, levels of expertise, and health care organizations involved in the exchange [8].

To introduce a new program, resource limitation is one of the major problems in developing countries. Although Telemedicine is started with high desire, it cannot reach its destination due to high costs, underdevelopment infrastructure, and lack of technical expertise [9]. The Interagency Working Group (IWG) ASIA Task Force on Telemedicine [10] discussed in a report that the implementation of Telemedicine is hampered by several challenges such as insufficient human and capital deficiencies.

The above review indicates that there are some studies investigating barriers and challenges in Telemedicine application, however, little or no significant systematic studies have been conducted from the beneficiary perspective in Bangladesh. The aim of this study was to evaluate the effectiveness, in terms of time and cost savings, of a

locally developed PC based diagnostic equipment and software based telemedicine services, which will be described in the next section, introduced in two districts (Faridpur and Madaripur) in Bangladesh. This study also attempted to analysis the service recipients' attitude towards this services.

1. Introduced Telemedicine System

To overcome the disparity in healthcare access, a locally developed PC based low cost diagnostic equipment and software telemedicine service has been introduced in various districts in Bangladesh. These services have been provided through local pharmacies as rural healthcare center considering the fact that most people see these places as a first place of contact for an initial medical advice if they have any health issues, especially rural people. Service feedbacks are collected by volunteers following the schedule. These services have become popular particularly to women, senior and disabled citizens, since they are unable to travel other places due to distance and cost. In addition, patients can receive health care services from a particular mobile telemedicine service point at a nearest place. The center provides one day free consultancy for poor, vulnerable, and disadvantaged people. A trained operator collects primary information of a patient such as name, age, weight, blood pressure, check diabetes, any previous report or prescription, etc. Through online Telemedicine application, patient can even consult with urban doctors through video conferencing. Remote doctor provides prescription, if necessary, of a patient to the local operator through the Internet. A remote doctor can access the physical condition of a patient using stethoscope over the Internet with the help of a local operator if necessary. This service also provides the ECG health monitoring facilities to the local patients. All patients' data are reserved in web server for further follow up services.

2. Methodology

The study was both qualitative and quantitative in nature. The study was conducted at Nagarkanda Upazilla in Faridpur District and Shibchar Upazilla in Madaripur District as a pilot project. Therefore, the citizens from those areas, who receiving Telemedicine service, were recruited as the study population. Informed consent was sought before conducting an interview. Data were collected through structured and semi-structured interviews shown details in Table 1.

Table 1. Data collection methods

Methods of data collection	Number of Respondents
Over phone interview with structure questionnaire	69
Interview with semi-structured questionnaire in person	66

Data entry was done concurrently with data collection. Data analyzed in SPSS software were reviewed, edited and cleaned by performing a series of frequency and data checks.

3. Findings of the Study

3.1. Demographics Details

About 56% service recipients were female and 44% male in this study. The findings of this study indicates (Table 2) that about 28% respondents accessed necessary health services from nearest general doctor's practices, whereas 22% respondents from district level medical college hospitals. On the other hand, about 20% service recipients opined they had necessary health services from private clinic or hospital, while 13% service recipients from district health center.

Table 2. Location of usual health services used

Location	Percentage (%)
Nearest doctor practice	28
Faridpur medical college hospital	22
Private clinic/ hospital	20
District health center	13
Government hospital/ medical center	6
Upazilla health center	6
Nearest dispensary/ rural doctor	5

3.2. Comparison of Time Consumption in Telemedicine and Conventional Health Service

Figure 1 shows the time spent by the participants in accessing health care services through Telemedicine and the conventional healthcare system. According to the figure, about 23% service recipients received health service in 30 minutes via Telemedicine service, whereas only 1% had access the similar service spending the same amount of time in conventional means of health service. Figure also shows that 48% respondents indicated that they had access health services by an hour whereas only 8% in conventional health service. In contrast, 27% Telemedicine service recipients and 65% conventional health service recipients were to spend about 5 hours in accessing health services. In Telemedicine service, only 2% service recipients were to spend more than 5 hours compared to 25% in conventional health services.

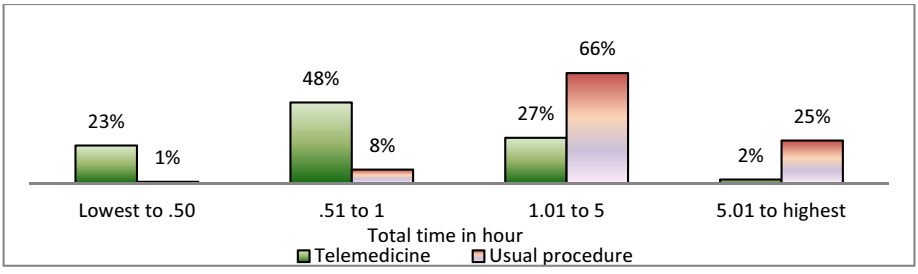

Figure 1. Time required by service recipients in Telemedicine and Conventional health service systems

3.2.1. Testing the Significance Level for the Time Requirement

Null Hypothesis

Ho: average time required by those who had access telemedicine service= average time required by those who did not have access telemedicine service.

Alternative (Research) Hypothesis

Ha: average time required by those who had access telemedicine service≠ average time required by those who did not have access telemedicine service.

Table 3. Test of significance for time requirement

	Test for equality of Variances		Test for equality of Mean		
	F-value	Significance Level	t-value	Degree of Freedom	Significance Level
Equal Variances assumed	.797	.373	-2.424	242	.016
Equal Variances not assumed			-2.629	177.746	.009

As per the Table 3, significance level (0.373) is greater than .05. Therefore, the variances are assumed to be equal. Thus, the null hypothesis can be rejected with the p-value for this t-test with 0.009. Therefore, this can support that average time required for those who received telemedicine service is not equal to the average time spent by those who did not access this service.

3.3. Cost Comparison between Telemedicine and Conventional Health Service

Figure 2 shows the total cost required in both approaches. According to the figure, 10% respondents receiving Telemedicine service cited that they were required to spend ≤ 50TK (US $1= 78TK) whereas this was the cost with 9% in conventional health service. In contrast, a much higher percentage of participants (87% compared to 19%) accessed health care service with the same cost (i.e., 150TK) via telemedicine service. About 4% and 28% respondents accessed health services via Telemedicine service and conventional health service respectively with the cost of 400TK. The figure clearly shows that about 43% informants were to spend 11,200TK to access required health services though the conventional health care system.

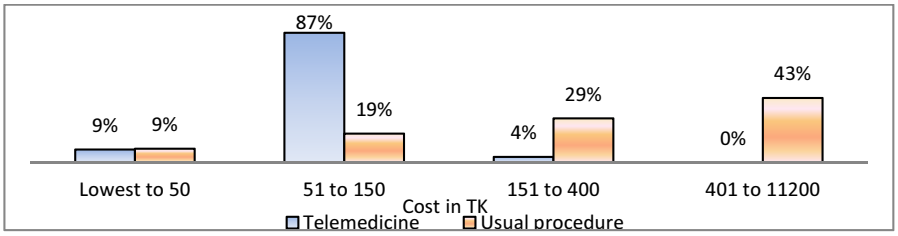

Figure 2: Total cost in both service processes

3.3.1. Testing the Significance Level for Cost

Null Hypothesis

Ho: average cost of those who received telemedicine service = average cost of those who did not receive telemedicine service**.**

Alternative (Research) Hypothesis

Ha: average cost of those who received telemedicine service ≠ average cost of those who did not received telemedicine service.

Table 4. Test of significance for cost

	Test for equality of Variances		Test for equality of Mean		
	F-value	Significance Level	t-value	Degree of Freedom	Significance Level
Equal Variances assumed	30.224	.000	-5.061	242	.000
Equal Variances not assumed			-4.546	108.093	.000

As per the Table 4, Significance Level (0.000) less than 0.05 indicates that the variances are not assumed to be equal; the null hypothesis can be rejected with the p-value for this t-test with 0.000. Therefore, it can be concluded that there is a significant evidence to support that average cost incurred to those who received telemedicine service is not equal to the average cost incurred to those who did not have access this service.

3.4. Comparative Analysis of Time and Cost

From the Table 5, it can be seen that the time spent by a patient to access healthcare services via introduced Telemedicine service was reduced by 56% (226 min to 99 min) compared to the tradition way of accessing the similar service. Similarly, average cost reduced by 94% (710TK to 45TK) in Telemedicine service. From the above discussion, it can be concluded that Telemedicine service appears a more cost effective and time efficient to the rural people in accessing their health care service requirements.

Table 5. Average time and cost in both service systems

Indicators	Required in manual system	Required in telemedicine	Saved (%)
Time (in minutes)	226	99	56
Cost (in TK.)	719	45	94

From the Table 5, it can be seen that the time spent by a patient to access healthcare services via introduced Telemedicine service was reduced by 56% (226 min to 99 min) compared to the tradition way of accessing the similar service. Similarly, average cost reduced by 94% (710TK to 45TK) in Telemedicine service. From the above discussion, it can be concluded that Telemedicine service appears a more cost effective and time efficient to the rural people in accessing their health care service requirements.

3.5. Advantages of Telemedicine Service

Study revealed that the introduced telemedicine service offers various advantages shown in Figure 3. In addition to a substantial reduction in time and cost, it provides other advantages including easy access to service (68%), less frequency of visit (67%), easy access to specialized doctor (65%), less harassment (59%), better service quality (54%), less travel (49%), and 24/7 service availability (46%).

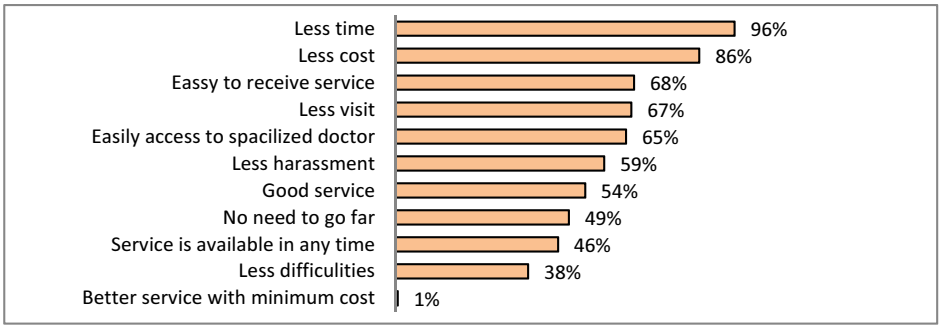

Figure 3. Advantages of Telemedicine service (multiple responses)

Table 6. Level of satisfaction of the respondents about Telemedicine service

Satisfaction Level	Percentage (%)
Satisfied	51
Moderately Satisfied	11
Very Satisfied	38

3.5.1. Level of Satisfaction

Table 6 shows the level of participant satisfaction in accessing health care services through proposed telemedicine system. About 51% informants opined that they were satisfied with Telemedicine service, whereas 11% were moderately satisfied. In contrast, 38% service recipients indicated that they were very satisfied with the introduced Telemedicine service.

Conclusion and Discussion

The findings of this study show that telemedicine service reduces significant amount of time and cost for the user to access the required health services. Majority of participants indicated that they had access their required health services within an hour. The significance test also supports the finding in that the telemedicine service consumes less time to provide health care access compared to the conventional procedure. In terms of cost, the study revealed that the telemedicine service reduces the health care cost of patient to a great extent. Users had to spend even less than 50TK on an average whereas they had to spend about 1000TK to access the same service in a conventional means of the service. In addition, the telemedicine service offers other

advantages resulting a higher satisfaction in the service recipients. Therefore, the Telemedicine service seems very cost and time effective health service method for the rural population of Bangladesh. It ensures easy accessibility to the health services for a large portion of citizens. This service decentralizes the modern health facilities offering rural population easy access to specialist doctors or hospitals from remotely. A Telemedicine system can, therefore, be considered as a potential and effective health service access means for the people especially living in remote and rural areas.

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