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**Original Research Article**

# Outcomes and experience of telemedicine in the management of diabetes mellitus during COVID-19 pandemic

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## ABSTRACT

**Background:** Telemedicine has been promoted as an economical and effective way to enhance patient care, but the experience and its outcome in the diabetes management are not well understood. Thus, this study aims to assess the experiences and outcomes of diabetes management by tele-consultation.
**Methods:** A comparative study included 958 patients with T2DM attending the clinics for diabetes management. Of them 467 (48.75%) patients consulted the endocrinologists through telemedicine and 491 (51.25%) patients attended the clinics physically during the study period.
**Results:** The mean age was 58.5±4.3 years in telemedicine group and 55.8±5.1 years in the physically attending group. Male patients comprised about half [46.03% in telemedicine group; 51.32% in physically attending group)] of the study population and around half [55.46% in telemedicine, 44.54% in physically attending group] of them came from urban areas. The majority of patients were on MNT along with 2 or more OADs [42.18% versus 40.53%; p 0.90]. Among telemedicine users, 59.74% visited the clinic as regular follow up visits and the highest number of patients [49.67% (232)] used video calling, apps, WhatsApp. About 62.21% (291) of the telemedicine users did not face any difficulties in communication. Two-fifths of the participants (40.02%) required assistance for communication; 74.09% of the patients could understand the advices and instructions of the physicians and 76.45% found it cost effective and more than four-fifths of them admitted that telemedicine could save time. The majority of patients with T2DM (91.43%) were satisfied with telemedicine service.
**Conclusions:** For most patients with T2DM, telemedicine can be as good, or even better than, in-person care, especially for those who face geographical and time barriers to access during COVID-19 pandemic and may be afterword. population.

**Keywords:** Corona virus, COVID-19, Diabetes mellitus, Telemedicine, Virtual consultation

## INTRODUCTION

The world is in the midst of the 2nd wave of unprecedented coronavirus disease (COVID-19) pandemic, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which has caused a very high death tool worldwide.[1,2] Increased age and underlying health conditions, including diabetes, cardiovascular disease, obesity, and hypertension, significantly increase the risk of COVID-19 infection.[3] Several studies found the higher frequency and increased morbidity, mortality, longer hospital stay, prolonged post-COVID recovery times among patients diabetes when they get COVID-19.[4] Evidence shows poor glycemic control and wide glycemic variability are both negatively associated with and a consequence of COVID-19 infection, and the elderly

people with diabetes have the worst predictable consequences.[3,4]

Globally, as of 5:43pm CET, 24 February 2021, there have been 111,419,939 confirmed cases of COVID-19, including 2,470,772 deaths, reported to the World Health Organization (WHO). Till 23rd February 2021 Bangladesh declared 544,116 COVID-19 cases with 8,374 deaths.[5,6]

Many countries are under 'lockdown', night curfew or other forms of mobility restrictions of movements. This restrictions to movements may result in impairment of dietary management of diabetes - increased snacking, taking comfortable calorie dense foods; lack or absence of physical exercise and decreased availability of antihyperglycemic drugs including insulin. More importantly, such lockdown poses restrictions in routine visits to the physician. All these factors may lead to uncontrolled glycaemia, increases chances of hypoglycemia or worsening status of comorbid diseases (example- hypertension).

During this pandemic situation, virtual consultation/telemedicine may prove useful for the management of patients with chronic diseases, such as diabetes.[7]

With several challenges of maintaining the quality health care and continuous monitoring, telemedicine or telehealth may provide the effective opportunity to improve glycemic control, patient's wellbeing during the pandemic of the extensively contagious disease. Various technical aids has been increasingly integrated into diabetes education and care in modern times, such as, mobile based service, digital apps, computer-based or web-based education, and telemedicine or teleconsultation.[7] The National Health Service long-term plan set out to increase digitalization within NHS programs.[8,9] These attempts included roll-out of virtual or non-physical presence (non-face-to-face) clinics targeting the reduction exposure to infection spreading.9 This virtual or non–face-to-face consultations may be synchronous or asynchronous, meaning a direct or indirect line of communication with a health care provider, respectively.[10,11] Synchronous activities are usually performed by video or telephone consultations, whereas asynchronous activities may include monitoring of emails, short messages (SMS) or tracking system and responding to patients' questions/ queries through these platforms. The benefits of virtual or non-physical appointments are multifactorial and include the opportunity for better care and more connected patient care pathways, as well as cost savings and a reduced environmental impact.

Thus, the objectives of the study were to compare the outcome of diabetes management by virtual consultation in national lockdown period for other than corona (COVID-19) illnesses. This study may help the health care professionals to gain an insight into the virtual consultation/telemedicine process and role of facilitator with its overall benefit to the general population to manage diabetes. The health care professionals may apply this knowledge in improvising telemedicine consultation process.

## METHODS

A comparative cross-sectional study has been conducted among 958 adult patients with type 2 diabetes mellitus attending 2 private clinics for diabetes care clinics in Dhaka, Bangladesh during May to December 2020 for the diabetes care services by a non-probability sampling method, where sampling was not guided by the idea of random selection or statistical representation. Participants included those who: (1) had been diagnosed with T2DM, old or new; (2) aged between 18 and 75 years; (3) had regular access to the mobile phone, Internet. All the participating T2DM patients have been given the details of the study including its aims, procedures and ways of publishing data. Having signed the informed consent form signed, the patients were enrolled in the study. The information sheet, containing the study related information was given to them with contact details of the investigator for future communication. The patients who received diabetes care through telemedicine were cases and the patients who visited physically were taken as comparators. All participants were COVID negative and data were collected by face-to-face interview with the patients. Clinical information (weight, BMI, BP) was obtained by standard physical measurements. Diabetes relegated data such as duration of disease, HbA1C, comorbidities, medication use etc., were collected from the patient's records. T2DM patients with acute or severe conditions were excluded. Data were collected twice in a semi-structure case record form by the trained data collector from each participant, 1st time at the time of recruitment and 2nd time after 4 months of treatment period. All data have been entered, edited for discrepancies and analyzed by using Statistical Package for the Social Sciences (SPSS), version 24.

The study ethical approval from Bangladesh Medical Research Council (BMRC).

## RESULTS

A total of 958 patients with T2DM participated in the study. Among them 467 (48.75%) patients consulted the endocrinologists through telemedicine and 491 (51.25%) patients attended the clinics physically during the study period.

Table 1 shows the sociodemographic parameters of the T2DM patients. Mean age was 58.5±4.3 years telemedicine group and 55.8±5.1 years in the physically attending group. Less than half [46.03% (215)] in telemedicine group and more than half [51.32% (252)] in physically attending group were male. Again, more than half [55.46% (259)] of the telemedicne group patients and less half [44.54% (218)] of the physically attending group

patients came from urban areas. In both the groups home makers were the highest in the frequency followed by service-holders businessman.

**Table 1: Sociodemographic profile of the participants (n= 958).**

| Characteristics | Telemedicine [TM] group (n=467) | Physically attending [PA] group (n=491) | P |
|---|---|---|---|
| **Age (Mean)** | 58.5±4.3 | 55.8±5.1 | 0.02 |
| **Gender** | | | |
| Male | 215 (46.03) | 252 (51.32) | 0.06 |
| Female | 256 (53.97) | 247 (49.68) | 0.07 |
| **Area of residence** | | | |
| Urban | 259 (55.46) | 287 (58.45) | 0.01 |
| Rural | 218 (44.54) | 204 (41.55) | 0.04 |
| **Occupation** | | | |
| Service | 126 (26.98) | 145 (29.53) | 0.08 |
| Business | 109 (23.34) | 126 (25.66) | 0.09 |
| Home maker | 197 (42.18) | 178 (36.25) | 0.01 |
| Others | 35 (7.49) | 42 (8.55) | 0.08 |

**Table 2: Diabetes related information of the participants (n= 958).**

| Characteristics | Telemedicine group (n=467) | Physically attending group (n=491) | P |
|---|---|---|---|
| **Duration of DM** | 10.8±6.1 | 8.3±4.9 | 0.01 |
| **Current Modality of Treatment** | | | |
| ***MNT+ OAD (1)** | 11 (2.35) | 12 (2.44) | 0.02 |
| **MNT+ *OAD (≥ 2)** | 197 (42.18) | 199 (40.53) | 0.90 |
| **MNT+ OAD+ Insulin (Basal-bolus)** | 124 (26.55) | 149 (30.35) | 0.00 |
| **MNT+ OAD+ Insulin (Premixed)** | 125 (2677) | 141 (28.72) | 0.70 |

*MNT- medical nutrition therapy; *OAD- oral antihyperglycemic drug.

In table 2 diabetes related data were depicted. The telemedicine group has 10.8±6.1 and physically attending group has 8.3±4.9 years of mean duration of diabetes (p 0.01). The majority of T2DM patients were on MNT along with 2 or more than 2 OADs [42.18% versus 40.53%; p 0.90].

Figure 1 demonstrated the comorbidities and complications of diabetes among participants. More than two-thirds of the T2DM patients have DPNP (88.44% versus 84.93%) followed by HTN (74.95 versus 72.87) and dyslipidemia (65.38 versus 67.88).

**Table 3: Distribution of sample according telemedicine experiences (close ended quantitative questionnaire) (N=467).**

| Experience of patients with TM consultation | n (%) P |
|---|---|
| **Type of visit** | |
| **First time visit** | 148 (31.69) |
| **Regular follow up visit** | 279 (59.74) |
| **Urgent visit** | 40 (8.56) |
| **Medium used for telemedicine** | |
| **Text message, email** | 94 (20.13) |
| **Audio- telephone, mobile** | 141 (30.19) |
| **Video calling, video app, WhatsApp** | 232 (49.67) |
| **Faced difficulties to explain medical problem to the physician** | |
| **Yes** | 176 (37.69) |
| **No** | 291 (62.21) |
| **Assistance needed to use telecommunication** | |
| **Yes** | 229 (40.02) |
| **No** | 238 (59.98) |
| **Able to understand the medical advice of the physician** | |
| **Yes** | 346 (74.09) |
| **No** | 41 (8.78) |
| **To some extend** | 80 (17.13) |
| **Telemedicne saved expenses** | |
| **Yes** | 357 (76.45) |
| **No** | 110 (23.55) |
| **Telemedicne saved time** | |
| **Yes** | 389 (83.30) |
| **No** | 78 (16.70) |
| **Satisfaction with telemedicine (overall)** | |
| **Yes** | 427 (91.43) |
| **No** | 21 (4.49) |
| **I don't know** | 19 (4.07) |

Table 3 describes the experience of the T2DM patients with telemedicine during the COVID-19 pandemic. The majority of the patients (59.74%) visited the clinic for regular follow up and only 8.56% has to visit due to any of the urgent causes. The highest number patients [49.67% (232)] used video calling, apps, WhatsApp; then mobile or other audio devices [30.19% (141)] and text messages and email [20.31% (94)]. About 62.21% (291) of the telemedicine users did not face any difficulties in communication. Two-fifths of the participants (40.02%) required assistance for communication. About three-fourths (74.09%) of the patients could understand the advices and instructions of the physicians. More than three-fourths (76.45%) of them found it cost effective and more than four-fifths of them admitted that telemedicine could save time. The majority of patients with T2DM 91.43% (427) were satisfied with telemedicine service.

In table 4 the treatment outcomes are presented. The reduction of HbA1c was 0.9% in the telemedicine group and 0.4% in the physically attending group (p- 0.02). The weight change was significant (2.53 kg versus 0.73; p-0.01). The self-reported hypoglycemia events were less in telemedicine group (16 versus 23 events; p- 0.03).

**Table 4: Comparison of treatment outcomes of the telemedicine and physically attending groups (n= 958).**

| Group | HbA1C | | | | BMI | | | | H/O Hypo | |
|---|---|---|---|---|---|---|---|---|---|---|
| | V1 | V2 | Change of HbA1C (%) | p | V1 | V2 | Change of BMI ($Kg/M^2$) | p | No (%) | p |
| *TM Group | 9.3±1.7 | 8.4±2.1 | 0.9 | 0.02 | 29.75±4.5 | 27.23±2.2 | 2.53 | 0.01 | 16 (3.41) | 0.03 |
| *PA group | 9.5±1.3 | 9.1±1.9 | 0.4 | | 28.87±3.4 | 28.14±2.5 | 0.73 | | 23 (4.68) | |

*TM- telemedicine; PA- physically attending; V1- First Visit, V2- Second Visit; The chi-square statistic, p-value and statement of significance appear in the right columns of the table.

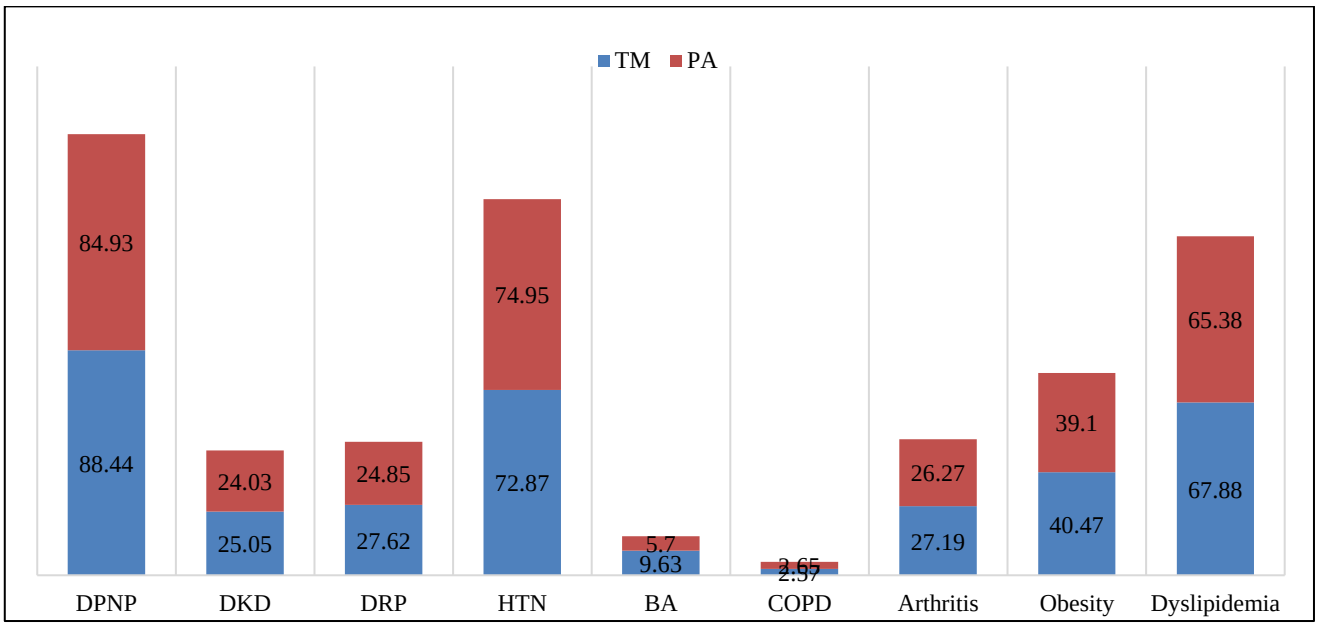


**Figure 1: Frequency of complications and comorbidities among the participants (n= 958).**

## DISCUSSION

This comparative cross sectional has been conducted in perspective of COVID-19 pandemic and probably this is the pioneer study to look for outcomes of diabetes care in this country during COVID-19 pandemic. A total of 958 adults with T2DM participated in the study. Of them 467 (48.75%) patients consulted the endocrinologists through telemedicine and 491 (51.25%) patients attended the clinics physically during the study period. The mean age was 58.5±4.3 years among those using telemedicine [TM] consultation and 55.8±5.1 years among the physically attending [PA] T2DM patients. Less than half [46.03% (215)] in telemedicine group patients and more than half [51.32% (252)] of the physically attending group patients were male. More than half [55.46% (259)] of the telemedicine group patients and less half [44.54% (218)] of the physically attending group patients came from urban areas. In both the groups home makers were the highest in the frequency followed by service holders, businessman. Tele-consultation has been evolved as a rapidly expanding option of clinical care in the wake of the recent COVID-19 pandemic. Telehealth refers to the broad use of health-related digital services, including monitoring wearables or patient education videos.[12]

A good number of consultants, both in government and non-government clinical cares, adopted with the experience variable effectiveness. In an Indian study Ghosh et al described the similar patterns of demography and the feasibility of telemedicine in the COVID-19 scenario and Mathur14 on role of telemedicine in health care delivery there.[13]

The telemedicine group has 10.8±6.1 and physically attending group ha 8.3±4.9 years of mean duration of

diabetes (p 0.01). The majority of T2DM patients were on MNT along with 2 or more than 2 OADs [42.18% versus 40.53%; p 0.90]. The reduction of HbA1c was 0.9% in the telemedicine group and 0.4% in the physically attending group with (p- 0.02). The weight change was significant (2.53 kg versus 0.73; p- 0.01). The reported hypoglycemia events were less in telemedicine group (16 versus 23 events; p- 0.03). All the patients with diabetes should undergo therapeutic lifestyle changes, take appropriate medications to achieve optimal glycemic control and maintain it. Even then, the overall glycemic control is very satisfactory here. Selim et al found only 18.88% of adult Bangladeshi adult patients with diabetes had HbA1C >7%.[15] Considering these perspectives, the reduction of during the pandemic could be taken as fair. Intriguingly, the attainment of glycemic control was significantly higher among the patients who consulted through telemedicine (p 0.90). In one of Bangladeshi studies it was found that 73.5% of patients with T2DM received with single OAD along with MNT and 26.5% received multiple OADs and 11% of total patients received insulin.[16]

More than two-thirds of the T2DM patients have DPNP (88.44% versus 84.93%) followed by HTN (74.95 versus 72.87) and dyslipidemia (65.38 versus 67.88). In a systematic review Mahiuddin17 described almost similar findings. It found more than 60% visual disturbances and 56% to have HTN and in total, 75% patients with T2DM attending the tertiary care hospitals in Dhaka had chronic complications of diabetes. The self-reported hypoglycemia events were less in telemedicine group [3.41% versus 4.68; p- 0.03). This lower than other study findings of the same population.[18]

The more than half of the patients (59.74%) of the study visited the clinic as regular follow up and only 8.56% has to visit due to any of the urgent causes. Chaturvedi et al found 76.35% of the T2DM patients adopted telemedicine[19] as the first consultation in an Indian City.

This study reported the highest number patients [49.67% (232)] to use video calling, apps, WhatsApp; then mobile or other audio devices [30.19% (141)] and text messages and email [20.31% (94)]. Similar findings have published by Chaturvedi et al.[21] They found 73.95% of the telemedicne users took audio- telephone, mobile devices for their communication with the endocrinologist. This can be categorized as the standard classification of telemedicine.[19]

The study tried to find out the experience of the T2DM patients with tele-consultations in particular, facing any hardships of difficulties. It has been found that 62.21% (291) of the telemedicine users did not face any difficulties to communicate with the consultant. Two-fifths of the participants (40.02%) required assistance for communication. About three-fourths (74.09%) of the patients could understand the advices and instructions of the physicians and follow these to apply for therapeutic interventions. There were easier ways to have decisions from experts of multiple disciples. These findings are also supported by an exploratory study conducted by Bhatia et al on Adoption of Telemedicine in India. They that a collective, comprehensive, positive, sincere and dedicated approach, on the part of multidisciplinary healthcare role players, is the prime most essentiality for enhancing telemedicine.

More than three-fourths (76.45%) of the participants found it cost effective and more than four-fifths of them admitted that telemedicine could save time. Chaturvedi et al13 described in the recent study that more than three-fourths of the patients with diabetes has taken telemedicine as less expensive. Imlach et al described the convenience of telehealth consultations, in terms of saving time and money, and reducing stress, travel, employment disruption and exposure to infection (with COVID-19 and other pathogens).[21] Conversely, some found care more difficult to access, particularly if contacting practices by telephone and at the start of lockdown when many practices deactivated their patient online portals and patients were required to phone rather than book appointments online.[21]

The overall satisfaction with telemedicine was very high in the study. Nine-tenths (91.43%) stated that they were satisfied with it and only 4.49% were not satisfied. One of recent Indian studies reported majority of their participants (83.53%) participants were satisfied with telemedicine consultation process.[18]

The use of telemedicine in delivering various aspects of health care related information in the prevention of disease (both chronic- noncommunicable and contagious), in the monitoring of medical conditions (blood glucose, blood pressure etc.) as well as regular medical care for diabetes management has been proposed as an innovative solution to improve the patient care.[22-24] This is very pertinent to improve diabetes care in both developing and developed worlds, as it can help to established communication between care providers and care receivers and maintain flow of accurate and reliable data. [23-26] It can empower the attitude and behaviors of the patients towards a therapeutic lifestyle changes and ultimate achieving optimum glycemic control and maintaining it. [26-28]

***Clinical implications***

There is a need of continual improvement of healthcare technologies to ensure better and sustained clinical support through the year and for all categories of patients. This is very crucial during this COVID-19 pandemic periods. Telemedicne or telehealth may be opted for the alternative means healthcare during this time. Even there is light to be hopeful that if suitable communication methods are applied and the patients are trained, telemedicine may the better way of diabetes monitoring, diabetes management. This may be applicable in may more clinical conditions. But when lifestyle managements are warranted, as in diabetes, telemedicine can provide a better alternative for many areas of the world.

***Strengths and limitations***

The study has some limitations. First, although diverse population were recruited, these participants were only limited to some urban and rural areas of Bangladesh. Participants from different geographical and socioeconomic groups should different intellectual state and technical soundness. Future studies should include patients from both urban and rural locations and also include participants with high technology literacy, as this could potentially influence the uptake and acceptability of telemedicine. Finally, results of this study may not draw a definitive conclusion regarding differences in provider practices, patient knowledge as well as attitudes from different clinic sites other than those examined in this study.

## CONCLUSION

The results of the study indicate that telemedicine may confer better diabetes management during COVID-19 pandemic. This cost effective and time saving as well. As most of the patients with T2DM are satisfied with the method, this may be considered for future diabetes management tool in home management of the disease.

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