The Effect of Telemedicine on Self-Care Activities of Patients with Type 2 Diabetes Mellitus and Patient Satisfaction During the Coronavirus-19 (COVID-19) Pandemic: A Repeated Cross-Sectional Study

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ABSTRACT

Introduction Patients with diabetes require regular follow-ups to achieve optimal glycemic targets. The coronavirus-19 (COVID-19) pandemic resulted in interruptions in healthcare delivery placing greater importance on patient's self-management of their condition. Telemedicine bridged the gap between the physician and patient that was created by community quarantines.

Objective To determine if there is a difference in patient's self-care activities before and after using telemedicine using the Diabetes Self-Management Questionnaire (DSMQ).

Methodology A descriptive repeated cross-sectional study of patients with type 2 diabetes mellitus at the University of Santo Tomas Hospital who consulted via telemedicine using different available platforms were included. Self-care was measured using the DSMQ. Patient satisfaction with telemedicine was also assessed using a patient satisfaction survey.

Results An improvement in self-care practices was seen as significantly higher mean DSMQ scores after telemedicine consultations (6.79 ± 1.33 to 7.32 ± 1.21, p = 0.0015), with the highest scores on dietary control and physical activity. There was a statistically significant reduction in HbA1c on follow up (8.37 ± 2.31 to 7.31 ± 1.36; p<0.00001). Those with well-controlled diabetes (n = 14) at baseline remained to have good control while the proportion of those with poorly controlled diabetes (n = 34) showed improved glycemic control on follow up (p = 0.0045). Most patients were highly satisfied with telemedicine.

Conclusion The use of telemedicine by patients with diabetes showed numerical improvement in both self-care practices and glycemic control. These findings imply that telemedicine may be mainstreamed as part of diabetes care among Filipinos.

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INTRODUCTION

The coronavirus-19 (COVID-19) pandemic has been both an unexpected and unfortunate event that has affected everyone's lives. Healthcare resources, both manpower and financial, have been redirected towards the care of COVID-19 patients. As much as hospitals and physicians wanted to give the same attention to all patients, the care for patients with conditions that were non-COVID-19 and non-critical, such as chronic diseases like hypertension or diabetes was compromised.

Outpatient consultations comprise the bulk of patients in the practice of endocrinology. Majority of these are patients with diabetes who require regular followup consultations for medication dose readjustments. During this pandemic, patients were lost to follow-up placing them at risk for non-compliance with medications, poor glycemic control and diabetes-related complications. Hence, telemedicine was introduced.

Telemedicine involves an individual who wishes to obtain expert opinion regarding certain health-related concerns while they and the expert are separated in both space and time.[1,2] Numerous studies have been initiated that demonstrated the effect of telemedicine on diabetes care. Among patients with type 1 and type 2 diabetes mellitus, the efficiency of internet-based telemedicine on metabolic control has been investigated. Results showed that there were similar reductions in HbA1c and similar number of hypoglycemic episodes between those who consulted via telemedicine and those who were seen face-to-face.[3,4] Among patients with gestational diabetes mellitus, the use of telemedicine for control and management was not inferior to conventional face-to-face visits. There was no significant difference in maternal and neonatal outcomes in both groups.[5,6] The level of communication between patients and their healthcare providers was also increased in the telemedicine group.[6]

Self-management of diabetes in patients is a significant part of achieving goals and glycemic targets. Self-management is defined as the active participation of patients in their treatment.[7] The Diabetes Self-Management Questionnaire (DSMQ) is a 16-item questionnaire that was developed at the Research Institute of the Diabetes Academy Mergentheim by Andreas Schmitt in 2013 and was the first German instrument that focused on diabetes self-care. It is a global measure of diabetes self-management and covers several domains – diet, medication, blood glucose monitoring, physical activity, and contact with physician. It generally focuses on activities related to glycemic control.[8] Because of the pandemic, patients were unable to maintain regular face-to-face consultations with their physician, requiring them to take control in managing their diabetes for the meantime. In the Philippines, the need to contact their physicians for follow-up care inevitably led to the acceptance of telemedicine.

At present, there is also a paucity of studies on telemedicine in the Philippines, especially during this time of the pandemic. This study was undertaken to determine the effect of telemedicine on self-care activities of patients with diabetes mellitus, and whether this translated to better glycemic control. It was done to also determine overall patient satisfaction and experience with telemedicine.

METHODOLOGY

Study Design and Participants

A repeated cross-sectional study was conducted to determine the effect of telemedicine in the self-care practices of patients with type 2 diabetes mellitus. This study was conducted at the University of Santo Tomas Hospital (USTH). Participants must be diagnosed with type 2 diabetes mellitus seeking consult via telemedicine for the first time with USTH physicians using the available online platforms – Facebook, Viber, Medifi, SeriousMD, etc., were 21 years or older, with at least one follow up. Patients were excluded from the study if they had disabilities that hindered them from the use of telemedicine (eg, deaf, mute, blind, mental disabilities), lack of access to telemedicine for future follow-up and those who did not agree to participate in the study.

For each patient, the following information was obtained: 1) Pertinent laboratory results such as HbA1c, fasting blood sugar, lipid profile (if available

only), 2) Self-monitoring of blood glucose (capillary blood glucose testing at home), 3) Compliance with medications for diabetes, 4) Diet adherence, 5) Exercise routine. After the first visit, patients were asked to accomplish an online questionnaire that had three parts: 1) Questions on demographic and clinical profiles, 2) An online Filipino version of the DSMQ, 3) Patient satisfaction survey. Patients were asked to come back for follow up after 3 months with necessary laboratory examinations. They were also asked to answer the same surveys accomplished during baseline visit.

Study Instrument

The instrument used was the DSMQ developed at the Research Institute of the Diabetes Academy Mergentheim by Andreas Schmitt in 2013, and is now considered a global measure of diabetes self-management. A Filipino version of the DSMQ was developed and validated in 2016. It was a 16-item questionnaire that included the following domains: Regularity of medication intake, diabetes-related aspects of diet, regularity of self-monitoring of blood glucose (SMBG), regularity of physical activity and appointment adherence.

Ethical Considerations

All patients were asked to accomplish an electronic informed consent form that required an e-signature prior to study participation. The study was performed in accordance with the Declaration of Helsinki and the National Ethical Guidelines for Health and Health-Related Research of the Republic of the Philippines. The study protocol was approved by the University of Santo Tomas Hospital Research Ethics Committee.

Statistical Analysis

Stata MP version 16 software was used for data processing and analysis. Continuous variables were presented as mean/standard deviation (SD) or median/interquartile range (IQR) depending on data distribution. Paired t-test or Wilcoxon signed-rank test was used to compare continuous data before and during telemedicine consult. Comparison between problematic and non-problematic self-management was performed using independent t-test or Mann-Whitney U test for continuous data, and Fisher's exact test for categorical data. The P values ≤ 0.05 were considered statistically significant.

RESULTS

Demographic Characteristics

A total of 55 patients were included in the study. Majority of patients were between 41 to 60 years old. A slightly higher proportion of the population were females. Table 1 presents the baseline demographic and clinical characteristics of patients. Sixty-one percent of the patients were taking only oral medications for diabetes. Median duration of diabetes was 3 years, ranging from 0.5 to 40 years. On self-monitoring of blood glucose, median blood glucose levels was 129 mg/dl, ranging from 85–300 mg/dl. Forty-two percent of patients had poor glycemic control. Only three patients reported that they were non-compliant with their diabetes medications. Most patients consulted via Facebook messenger. The median consultation duration was 30 minutes, ranging from 10–60 minutes.

Outcomes of Interest

The changes in glycemic control before and after telemedicine are summarized in Table 2 and 3. Table 2 shows the change in mean HbA1c level before and after telemedicine consultations. The mean HbA1c level was significantly reduced compared to baseline values.

In terms of self-management behaviors, mean total DSMQ score significantly increased after telemedicine consultations. Table 3 shows the DSMQ mean scores before and after telemedicine consultation. The proportion of patients with problematic self-care significantly reduced during the consultation compared to baseline. Except for medication adherence, all subscales showed significant increase in the mean score. Medication adherence scores increased during follow-up, but did not reach statistical significance. Dietary control and physical activity subscales were found to have the highest statistically significant increase in scores.

Patients were divided into those with problematic and non-problematic self-care practices. When

Table 1. Demographic and clinical characteristics of diabetic patients (n = 55)

CHARACTERISTICS	n(%)
Age (in years), mean	52.31 ± 15.40
21-40 years old	15 (27)
41-60 years old	22 (40)
>60 years old	18 (33)
Sex	
Male	23 (43)
Female	32 (57)
Average monthly household income	
<10000 pesos	12 (22)
10000-50000 pesos	24 (44)
50000-100000 pesos	16 (30)
>100000 pesos	2 (4)
Diabetes medication	
Insulin only	4 (7)
Oral medication only	34 (61)
Insulin + oral medication	17 (31)
Diabetes duration (in years), median	3 [IQR: 2-6]
Average blood glucose level based on self-monitoring (in mg/dl), median	129 [IQR: 115-150]
At goal	33 (60)
Uncontrolled	22 (40)
Medication compliance	
Yes	52 (95)
No	3 (5)
Telemedicine platform used	
Text	1 (2)
Online: Facebook	38 (69)
Online: Viber	16 (29)
Duration of consult (in minutes), median	30 [IQR: 20-30]

IQR - Interquartile range

Table 2. Change in mean HbA1c level before and after telemedicine consult

	BEFORE	AFTER	P VALUE
HbA1c (in %)	8.37 ± 2.31	7.31 ± 1.36	<0.00001*

** Paired t-test was used*

correlated with their demographic and clinical profile, data showed that except for diabetes medication, no significant difference was noted between the two groups as seen in Table 4. A higher proportion of patients with problematic self-care were on oral medications alone.

Regarding patient satisfaction, median ranking of their telemedicine experience was 5/5 as seen

Table 3. DSMQ results before and after telemedicine consult

	BEFORE Mean ± SD	AFTER Mean ± SD	P VALUE
Total DMSQ score, mean	6.79 ± 1.33	7.32 ± 1.21	**0.0015**[a]
Problematic	14 (26)	6 (11)	**0.0114**[b]
Non-problematic	41 (74)	48 (89)	
Dietary control, mean	5.26 ± 1.95	5.93 ± 1.62	**0.0090**[a]
Glucose monitoring, mean	7.41 ± 2.21	7.94 ± 2.05	**0.0222**[a]
Medication adherence, mean	8.02 ± 2.22	8.46 ± 1.97	0.0560[a]
Physical activity, mean	6.09 ± 2.33	6.69 ± 2.05	**0.0200**[a]
Physician contact	7.94 ± 1.85	8.23 ± 1.84	**0.0467**[a]

[a] *Paired t-test was used;* [b] *McNemar test was used;*
DSMQ - Diabetes Self-Management Questionnaire

Table 4. Demographic and clinical characteristics of patients by self-management practice at baseline

CHARACTERISTICS	PROBLEMATIC (n=14) n(%)	NON-PROBLEMATIC (n=41) n(%)	P VALUE
Diabetes medication			
Insulin only	1 (7)	3 (8)	**0.047** [c]
Oral medication only	12 (86)	21 (53)	
Insulin + oral medication	1 (7)	16 (40)	
Diabetes duration (in years), median	2 [IQR: 2-6]	3 [IQR: 2.6-5]	0.1547 [c]
Average blood glucose level based on self-monitoring (in mg/dl), median (n=37)	120 [IQR: 115-150]	129.50 [IQR: 115-150]	0.9259 [a]
At goal	8 (57)	22 (58)	0.961 [b]
Uncontrolled	3 (37)	10 (34)	
Baseline HbA1c, mean	7.52 ± 1.94	8.78 ± 2.37	0.0794 [a]
Normal	5 (36)	8 (20)	0.201 [b]
Fairly controlled	2 (14)	4 (10)	
Poorly controlled	7 (50)	28 (70)	
Medication compliance			
Yes	13 (93)	38 (95)	1.000 [c]
No	1 (7)	2 (5)	

[a] *Independent t-test was used;* [b] *Fisher's exact test was used;* [c] *Mann-Whitney test was used*
IQR - Interquartile range

in Table 5. They responded that they were likely to recommend telemedicine to others and were most likely to continue using telemedicine even after the pandemic, when face-to-face consultations have resumed. Top reasons stated for recommending telemedicine to others were as follows: 1) Most convenient and easiest way to consult with a physician, 2) Travel time and traffic are avoided, 3) Satisfied with how telemedicine works, 4) No travel expenses, 5) Avoids exposure to people with possible infection.

DISCUSSION

Telemedicine has been incorporated in the management of type 1, type 2 and gestational

Table 5. Satisfaction rating during baseline and follow up among diabetic patients (n = 38)

	BASELINE (Visit 1) Median [IQR]	FOLLOW-UP Median [IQR]	P VALUE
Platform used	*5* [IQR: 4-5]	*5* [IQR: 4-5]	0.1770[a]
Duration of teleconsultation	*5* [IQR: 4-5]	*5* [IQR: 4-5]	0.2729[a]
Ease of setting an appointment	*5* [IQR: 5-5]	*5* [IQR: 5-5]	0.9613[a]
Quality of audio or video	*5* [IQR: 4-5]	*5* [IQR: 4-5]	1.000[a]
Method of sending prescription and laboratory request	*5* [IQR: 5-5]	*5* [IQR: 5-5]	0.5000[a]
Overall satisfaction towards telemedicine	*5* [IQR: 5-5]	*5* [IQR: 5-5]	0.3083[a]

[a]*Wilcoxon signed rank test was used*
IQR - Interquartile range

diabetes. In a study by Shea, et al.,[9] they devised home telemedicine units and distributed them in older, medically underserved patients with diabetes. This study demonstrated that when made accessible, technology-dependent interventions were well accepted by underserved patients who had low levels of educational attainment, income and computer familiarity. Our study participants were mostly in the low-to-middle class category and telemedicine platforms used were based on preference and convenience, which mimics a "real world" experience of telemedicine, as physicians utilize different platforms for their teleconsultations. Despite this difference, our study was consistent with their findings of a significant drop in HbA1c on follow-up.

A great part of caring for patients with diabetes is allowing them to be empowered enough to manage their disease. Based on several studies, good self-care or self-management has translated into better glycemic control, metabolic profiles and management of chronic diseases.[3,4,10-12] Our study showed that mean total DSMQ scores significantly increased on follow up, indicating an improvement in self-care practices after telemedicine consultations. All subscale scores, with the exception of medication adherence, showed a significant increase after teleconsultation. In a paper by Schmitt, et al.,[8] medication adherence, physical activity together with dietary control were found to be highly relevant in glycemic control. Thus we can infer that the noted significant reduction in HbA1c corresponds to an increase in DSMQ scores, reinforcing the importance of self-care practices in achieving glycemic targets.

Our results agree with a previous study by Esmatjes, et al.,[3] performed among patients with poorly controlled type 1 diabetes that employed an internet-based telemedicine system and website that allowed patients to input their blood glucose values, food intake, exercise and any insulin dose changes. Results showed that telemedicine was able to cause a significant reduction in HbA1c and could improve diabetes knowledge and self-care. Another clinically relevant finding of the studies was a significant reduction in patient and physician cost – time and monetary, with telemedicine.[12] This aspect was not explored in our study, and may be looked into in future researches.

Another important aspect of this study was obtaining patient satisfaction with telemedicine. Our study findings were similar to a study done by Xu, et al.,[4] wherein majority of the patients were satisfied with endocrinologic care received via telemedicine. Ninety percent (90%) of these patients claimed they would recommend telemedicine to others and that they preferred telemedicine over traveling long distances to see their physician. In our study, ninety-seven percent (97%) of the patients also claimed that they would use telemedicine again in the future, even after the pandemic due to its convenience and cost-effectiveness. The use of telemedicine has

improved communication between patients and their healthcare providers. This, in turn, may translate into better physician-patient relationships, which is also important in the management of chronic diseases such as diabetes. Another limitation of our study compared to previous studies done abroad was the unpredictability of internet connections in our country, which may have an impact on patient's acceptance of telemedicine.

With these findings, it can be surmised that the sudden shift from face-to-face consultations to telemedicine during this pandemic did not necessarily bring about worsening of glycemic control in this subset of patients. Although much work is needed to establish its place in healthcare delivery, results show that telemedicine holds promise as a means of caring for Filipino patients with diabetes.

Limitations of the study include a relatively small sample size and lack of patients who are using other platforms. The authors recommend employing a larger sample size and inclusion of other online telemedicine platforms available in future studies. Other metabolic or clinical endpoints may also be included such as blood pressure, lipid profile, body mass index, etc. Most importantly, although there was an improvement in self-care practices and glycemic control numerically, the fact was that other factors intrinsic and extrinsic to the patient may have contributed to this improvement. A comparator group doing face-to-face consultations may be included in further studies to establish the relationship between telemedicine and improvement in glycemic control/ self-care practices.

CONCLUSION

The use of telemedicine by patients with type 2 diabetes mellitus showed numerical improvements in self-care practices and subsequently, glycemic control. Patients were highly satisfied with telemedicine and were most likely to continue availing this service even after the pandemic. Hence, making telemedicine part of the mainstream in diabetes care may be a timely and viable option for patients moving forward.

Disclosure and Conflict of Interest

Dr. Elaine Cunanan and Dr. Sjoberg Kho are active consultants in the University of Santo Tomas Hospital. Dr. Dionise Bawal does not have any financial affiliations at the time of the study.

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Author's Contributions

1. Research project: A. Conception, B. Organization, C. Execution; 2. Statistical Analysis: A. Design, B. Execution C. Review and Critique; 3. Manuscript Preparation: A. Writing the manuscript, B. Review and Critique

DYB: 1A, 1B, 1C, 2A, 2B, 3A; ECC: 1A, 1B, 1C, 2A, 2B, 2C, 3B; SAK: 1A, 1B, 1C, 2A, 2B, 2C, 3B

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