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Original Article

Perception of virtual clinics among Saudi adults with type 1 diabetes during the COVID-19 pandemic



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ABSTRACT

Background and aims: We aimed to assess patient perception toward the rapid implementation of virtual phone clinics among Saudi adult patients with type 1 diabetes mellitus (T1DM) during the coronavirus disease (COVID-19) pandemic.

Methods: This cross-sectional, web-based study included Saudi adult patients with T1DM who attended at least one virtual phone visit with the diabetes clinic at King Abdulaziz Medical City, Jeddah, Saudi Arabia, between August 1 and December 31, 2020. Patients anonymously answered a Google form-created Arabic questionnaire. Information about patient characteristics, outcome, and perception of the virtual phone visit were obtained. Data were presented using descriptive statistics, chi-square, one-way ANOVA, independent *t*-, and Welch's *t*-tests.

Results: The questionnaire was sent to 281 patients, of whom 201 completed it. 59.2% patients were satisfied with their overall virtual phone clinic experience, and 75.6% preferred to continue attending the virtual phone clinics in the future. The average perception value of patients toward virtual phone clinics was 67.76 ± 19.9 , suggesting good perception among the majority. Negative or neutral views of current health, asking to be physically seen, and missing a virtual appointment were associated with significantly lower average patient perception value ($p < 0.001$).

Conclusions: Most Saudi patients with T1DM have adapted to virtual phone consultations, exhibiting good satisfaction and perception, and high preference to continue using this system in the future. The utilization of the service to assist patients with diabetes is highly encouraged, especially during the COVID-19 pandemic. Strategies need to be developed to further enhance the patient experience.

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1. Introduction

In late 2019, a new coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was discovered as the source of an outbreak of acute respiratory illness in Wuhan city, China. The World Health Organization announced a public health emergency and described the virus and its associated disease, coronavirus disease 2019 (COVID-19), as a pandemic in March 2020 [1]. In Saudi Arabia, the government applied precautionary actions to decrease and limit the spread of the virus by suspending schools, closing

offices, and enforcing lockdown which lasted for approximately three months (March 25th, 2020 to June 21st, 2020) [2]. Additionally, promotion of social distancing practices and other preventative measures were continued and re-emphasized after the lockdown ended [3].

Type 1 diabetes mellitus (T1DM) is characterized by an autoimmune reaction against insulin-producing pancreatic cells leading to deficient insulin production [4]. During the COVID-19 pandemic, it was shown that patients with T1DM were at increased risk of in-hospital mortality due to COVID-19 compared to patients without diabetes [5]. Moreover, the COVID-19 mortality risk was shown to be independently associated with poor glycemic control and elevated body mass index (BMI) in those with T1DM among other risk factors [6].

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Telemedicine is the technology utilized to enhance patient outcomes by improving accessibility to healthcare and medical knowledge [7]. Before the pandemic, a Cochrane systematic review on 21 studies that compared telemedicine to typical healthcare in patients with diabetes revealed that telemedicine could be associated with better health outcomes in terms of glycated hemoglobin (HbA1c) reduction, decreased low-density lipoprotein, and improved blood pressure reduction [8]. At King Abdulaziz Medical City, Jeddah, Saudi Arabia, virtual phone clinics were implemented for the first time to serve as the primary means of delivery of regular outpatient care during the COVID-19 pandemic. Patients with diabetes successfully communicated with their healthcare provider without the need to come to the clinic, which helped reduced risk of contracting the virus [9]. We aimed to assess patients' perception toward the rapid implementation of the virtual phone diabetes clinics among patients with T1DM during the worldwide spread of COVID-19 infection.

The objectives of this study were to evaluate the patients' perception of virtual phone clinics for the routine follow-up of diabetes mellitus in adult patients with T1DM during the COVID-19 pandemic, and to investigate possible associations between specific patients' characteristics and perception.

2. Subjects, materials, and methods

2.1. Study setting and context

At King Abdulaziz Medical City, we have a specialized diabetes clinic which provides individualized multidisciplinary care for patients with diabetes. The clinic is run by certified endocrinologists, fellows in diabetes and endocrinology, clinical nutritionists, and diabetes educators. Appointments are usually booked every 3–6 months according to the level of required diabetes control. During the COVID-19 pandemic, all upcoming follow-up appointments were scheduled to be carried out virtually by implementing a virtual phone clinic. An SMS message was sent to the patient's registered phone number twice; at the time of booking, and two days prior to the appointment date. The message included the date and time of the appointment, in addition to a request not to attend physically, as the physician would call the patient through the hospital's call center.

During the virtual phone visit, a detailed discussion between the physician and the patient was carried out that involved inquiries about any change in current health status, including presence of hypoglycemic and hyperglycemic episodes, and macrovascular and microvascular complications. Additionally, a review of insulin regimen and doses, blood glucose charts (logbook of self-monitoring blood glucose and/or flash/continuous glucose monitoring data), physical activity, sleep, and eating patterns of the patients was performed. Finally, patient counseling and adjustments to insulin doses were performed as necessary to optimize diabetes control and avoid hypoglycemia, and referral to a dietician and diabetic educator was done if indicated.

If the patient did not answer, the physician would try to contact the patient three times in total, at 15-min intervals between each attempt. If there was still no answer, the patient was booked to the next available appointment along with the required laboratory tests. Even though the vast majority of follow-up visits were conducted virtually, in-person appointments were carried out at the patient's or physician's request. Moreover, patients still needed to present themselves to the hospital to do the routine laboratory tests and receive medication.

2.2. Study design

This cross-sectional, web-based study included ≥ 18 -year-old Saudi patients ($n = 201$) with T1DM who successfully attended at least one virtual phone follow-up visit with the diabetes clinic at King Abdulaziz Medical City, Jeddah, Saudi Arabia, between August 1 and December 31, 2020.

2.3. Data collection

A web questionnaire was created in Arabic using Google Forms and sent to patients via WhatsApp to their registered phone number in the system. Data collection was done between January 23 and February 10, 2021. The questionnaire was developed to evaluate patients' perception of the usage of virtual phone clinics for the routine care of diabetes mellitus in adult patients with T1DM during the COVID-19 pandemic. It was designed by the research team and was face validated by three consultants who are expert in the fields of T1DM and research. The questionnaire was pretested on 10 adult subjects, and subsequent refinements and minor wording modifications were done to ensure clarity of the statements based on their feedback. The reliability of the questionnaire was then assessed in a pilot study of 31 participants, who were included in the final analysis, yielding a Cronbach's alpha of 0.920.

The questionnaire included three sections. The first section included demographic characteristics, such as age, gender, marital status, educational level, total monthly income, occupation, type of treatment for T1DM, place of residence, presence of diabetes complications and comorbidities, having been diagnosed with COVID-19, presence of COVID-19 related symptoms and/or hospitalization, perceived current health status, and perceived impact of COVID-19 infection on patients with diabetes. The second section assessed the outcomes of the virtual phone visit. Participants were asked if they had missed an appointment and, if so, to specify the reason. Additionally, participants were asked if they had requested to be physically seen in the clinic, or if they had been asked to be physically assessed by the physician. The third section included ten statements designed to assess patients' perception of virtual phone clinic during the COVID-19 pandemic. Participants rated their agreement or disagreement with the statements based on a 5-point Likert scale, ranging from strongly disagree (one point) to strongly agree (5 points). The statements explored several aspects of the usage of the virtual phone clinic, which included its impact on decreasing the risk of contracting COVID-19 infection, ability to routinely follow-up with the physician, accessibility to healthcare, cost savings, decreased absenteeism from work or household duties, ability of the physician to develop a good understanding of the medical condition, and level of satisfaction with the provided health service. Moreover, participants were asked to rate their agreement or disagreement with finding their overall experience with the virtual clinic beneficial and preference to continue with the virtual phone clinics for the routine care of diabetes in the future. Anthropometric measurements and HbA1c level were acquired from the electronic medical report system in our hospital.

2.4. Ethical standards

Approval was provided by the Institutional Review Board of the KAIMRC, National Guard-Health Affairs, Riyadh, Saudi Arabia, with reference number IRBC/0098/21, dated December 28, 2020. Informed consent was obtained before proceeding with the questionnaire, following the Declaration of Helsinki guidelines. Each participant was assigned a serial number that was used during data collection and analysis to ensure privacy.

2.5. Statistical analyses

Data collected were processed utilizing IBM SPSS ver 23 (IBM Corp., Armonk, N.Y., USA), and visually presented using GraphPad Prism ver 8 (GraphPad Software, Inc., San Diego, CA, USA). Simple descriptive statistics were utilized to present categorical and nominal variables in the form of counts and percentages. Continuous variables, on the other hand, are presented through mean and standard deviations. A reliability analysis with a model of alpha (Cronbach) was utilized to study the properties of the measurement scales and the items that compose the scales and the average inter-item correlation, a domain (perception toward virtual phone clinic) was calculated by simple additive method, and converted to a hundred-point scale. Furthermore, comparison of the study variables to demographics as well as other indicators, and establishment of a relationship between categorical variables were determined using chi-square test. For 2 group means and >2 groups, an independent *t*-test and one-way ANOVA, with least significant difference as a post hoc test, was utilized. These were accomplished assuming that normal distribution exists. Otherwise, Welch's *t*-test for 2 group means was used as an alternative test. A standard *p*-value < 0.05 was set to eliminate the null hypothesis.

3. Results

3.1. Demographic characteristics

We identified 285 adult patients with T1DM who had attended at least one virtual phone visit with the diabetes clinic between August 1 and December 31, 2020. Of these, 201 patients completed the questionnaire, and were included in our study (70.5% response rate). On the other hand, 78 patients (27.4%) did not respond, and six patients (2.1%) refused to participate.

The demographic characteristics of our participants are summarized in Table 1. Results showed that the patients had an average age of 28.15 ± 9.0 years ($n = 201$; range, 18–58), with majority being between 18 and 30 years old (70.6%, $n = 142$), female (60.0%, $n = 120$), single (61.2%, $n = 123$), residing at Jeddah (62.2%, $n = 125$), and attained a bachelor level of education (54.7%, $n = 110$). The participants were largely comprised of students (38.3%, $n = 77$), followed by employees (34.8%, $n = 70$), and non-employees (26.9%, $n = 54$). With regards to monthly income, more than one third of the participants (37.8%, $n = 76$) had a monthly income of ≤ 5000 Saudi Riyals, and a slightly smaller percentage (30.3%, $n = 61$) had a monthly income between 5001 and 10,000 Saudi Riyals.

Three quarters of participants were on multiple daily insulin injections as treatment for their condition (74.6%, $n = 150$), with only one quarter utilizing an insulin pump (25.4%, $n = 51$). In terms of the glycemic control, the participants had a mean HbA1c level of $8.42 \pm 1.8\%$, in which nearly half had values between 7 and 9% (47.3%, $n = 95$), followed by $\geq 9\%$ HbA1c level (28.9%, $n = 58$), and $\leq 7\%$ HbA1c level (23.9%, $n = 48$). Based on BMI, nearly 40% had normal weight (38.0%, $n = 76$), while around one third were overweight (31.5%, $n = 63$), and one quarter were obese (24.5%, $n = 49$).

3.2. Health and COVID-19-related characteristics

The majority of participants had no diabetes-related complications (85.6%, $n = 172$), as well as no other comorbidities beside diabetes (55.2%, $n = 111$). Many of our participants strongly agreed or agreed to being satisfied with their current health (69.6%, $n = 140$), while few participants were neutral (15.9%, $n = 32$), and a minority strongly disagreed or disagreed (3%, $n = 6$) with this statement. Similarly, most patients agreed or strongly agreed to

being aware that they were more vulnerable to possibly experiencing severe complications if they contracted COVID-19 (73.6%, $n = 148$), followed by neutral (19.9%, $n = 40$), and strongly disagreeing or disagreeing (6.5%, $n = 13$) with this statement. Twenty-eight patients reported having been diagnosed with COVID-19. Out these, more than half experienced at least two symptoms (60.7%, $n = 17$), but most were not hospitalized (85.7%, $n = 24$).

3.3. Outcomes of the virtual phone visit

Assessment of the outcomes of the virtual phone visit are illustrated in Table 2. Most participants did not ask their physician to be physically seen in the clinic (84.1%, $n = 169$). Also, the majority reported that their physicians did not request to physically see them as well (82.1%, $n = 165$). Moreover, approximately three quarters of participants did not miss their virtual appointments (73.1%, $n = 147$). For the small fraction who missed their appointments, around two thirds reported having missed the call (63.0%, $n = 34$), and approximately one quarter said they did not receive a call (24.1%, $n = 13$).

3.4. Patient perception toward the virtual phone clinic

Table 3 summarizes the patients' responses to statements designed to assess perception toward the virtual phone diabetes clinic. Results revealed that around two thirds agreed or strongly agreed that: (a) virtual phone clinics have improved their diabetes control (63.2%, $n = 127$; mean = 3.59 ± 1.0 , min = 1, max = 5), they had the ability to routinely conduct their follow-up visit with their physician (61.7%, $n = 124$; mean = 4.05 ± 1.0 , min = 1, max = 5), and had access to healthcare (66.2%, $n = 133$; mean = 3.70 ± 1.1 , min = 1, max = 5); (b) they feel as satisfied with the health service presented by the virtual phone clinic compared to traditional clinics (68.7%, $n = 138$; mean = 3.76 ± 1.0 , min = 1, max = 5); and (c) the physicians were able to obtain a good understanding of their condition via phone (63.2%, $n = 136$; mean = 3.69 ± 1.0 , min = 1, max = 5). Roughly 80% of the subjects agreed or strongly agreed that the virtual phone clinics have also decreased their: (a) possibility of contracting COVID-19 because physical presence was not necessary (79.1%, $n = 159$; mean = 4.05 ± 1.0 , min = 1, max = 5); and (b) absence from work or household duties (80.6%, $n = 162$; mean = 4.09 ± 1.0 , min = 1, max = 5). On the other hand, almost half agreed or strongly agreed that virtual phone clinics helped them save money (44.7%, $n = 90$; mean = 3.22 ± 1.1 , min = 1, max = 5). Overall, more than half of the patients agreed or strongly agreed to be satisfied with the overall virtual phone clinic experience for the follow-up of T1DM (59.2%, $n = 72$; mean = 3.54 ± 1.2 , min = 1, max = 5) (see Fig. 1), and three quarters of agreed or strongly agreed that they would prefer to continue attending their respective routine follow-up appointments through the virtual phone clinic in the future, in comparison with the traditional clinic (75.6%, $n = 152$; mean = 3.90 ± 0.9 , min = 1, max = 5) (see Fig. 2).

Using reliability statistics, the Cronbach's alpha value generated from the analysis of patient perceptions was found to be 0.920 (N of items = 10). The average patients' perception value toward the virtual phone clinic was measured as $67.76 \pm 19.9\%$ (min = 2.50, max = 100.00) after converting to a hundred-point scale, suggesting that the majority of participants had good perception value toward the virtual phone clinic.

3.5. Patients' perception vs demographic characteristics

The association of patients' perception toward the virtual phone clinic for the routine follow-up of T1DM against the demographic characteristics with subcategories was further assessed. Findings

Table 1
Demographic characteristics of patients with T1DM who attended the virtual phone diabetes clinic (N = 201).

Demographic characteristics	Count	%
Total	201	100.0
Age		
18–30	142	70.6
31–40	39	19.4
41–50	12	6.0
51–60	8	4.0
Gender		
Male	80	39.8
Female	121	60.2
Marital status		
Single	123	61.2
Married	74	36.8
Divorced	3	1.5
Widowed	1	.5
BMI Categories		
Underweight	12	6.0
Normal weight	76	37.8
Overweight	64	30.8
Obese	49	24.4
HbA1c Categories (%)		
7 or below	48	23.9
Between 7 and 9	95	47.3
9 and above	58	28.9
Type of treatment for T1DM		
Multiple daily insulin injections	150	74.6
Insulin pump	51	25.4
Place of residence		
Jeddah	125	62.2
Bahra	20	10.0
Makkah	24	11.9
Others	32	15.9
Level of education		
Illiterate or no education	2	1.0
Primary school	3	1.5
Intermediate school	7	3.5
High school	54	26.9
Diploma	18	9.0
Bachelor	110	54.7
Master	7	3.5
Occupation		
Employed	70	34.8
Not employed	54	26.9
Student	77	38.3
Monthly income (SAR)		
≤5000	76	37.8
5001–10,000	61	30.3
10,001–15,000	36	17.9
More than 15,000	28	13.9

T1DM, type 1 diabetes mellitus; BMI, body mass index; SAR, Saudi Riyal.

Table 2
Assessment of outcomes of the virtual phone visit among patients with T1DM attending the virtual phone diabetes clinic.

	Count	%
Total	201	100.0
During your virtual phone visit, did you ask your physician to be physically seen?		
Yes	32	15.9
No	169	84.1
During your virtual phone visit, did your physician ask you to be physically seen in the clinic?		
Yes	36	17.9
No	165	82.1
Have you missed any virtual phone appointments?		
Yes	54	26.9
No	147	73.1
If you missed an appointment, what was the reason?		
Total	54	100.0
Missed the call	34	63.0
Did not receive a call	13	24.1
I do not feel comfortable with virtual appointments	3	5.6
I could not answer the call because I was busy	2	3.7
The number that is registered in the system was not mine	2	3.7

T1DM, type 1 diabetes mellitus.

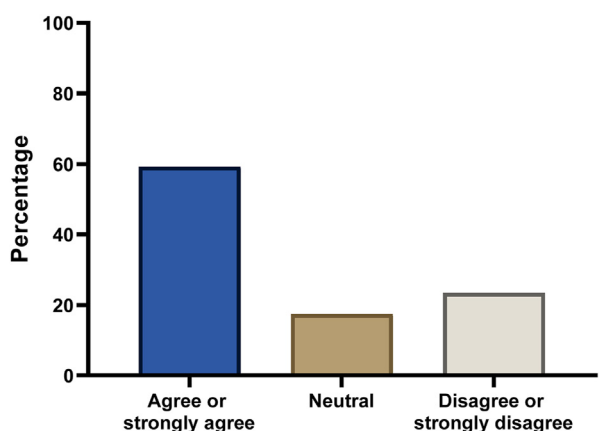
showed no significant differences ($p > 0.05$) among the mean perception values with respect to demographic characteristics, namely age, gender, marital status, educational level, monthly income, place of residence, occupation, HbA1c, BMI, and type of treatment for T1DM.

3.6. Patients' perception vs health and COVID-19 characteristics

One-way ANOVA analysis revealed that significant differences were only found in the perception values of the patients relative to the 'satisfaction to current health status' factor ($p = <0.001$). Specifically, we found that significantly higher mean perception values

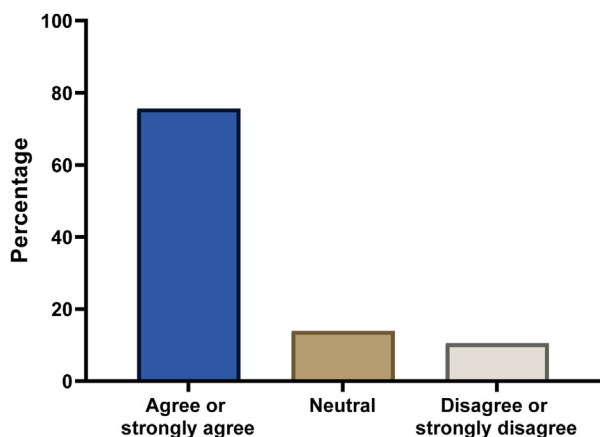
Table 3
Assessment of patients' perception toward the virtual phone diabetes clinic among adults with type 1 diabetes (N = 201).

Statement	Agree or strongly agree	Neutral	Disagree or strongly disagree
The virtual phone clinics decrease my risk of contracting COVID-19 infection because it does not require my physical presence.	79.1%	11.4%	9.5%
The virtual phone clinics improve my ability to routinely follow-up diabetes mellitus with the physician.	61.7%	21.9%	16.4%
The virtual phone clinics improve my accessibility to health care.	66.2%	16.4%	17.4%
The virtual phone clinics can help me save money.	44.7%	26.4%	28.9%
The virtual phone clinics can decrease my nonattendance at work or household duties.	80.6%	8.0%	11.5%
Compared to the traditional clinics, I feel as satisfied with the health service, talking to the physician over the phone.	68.7%	15.9%	15.4%
The physician can get a good understanding of my medical problem over the phone.	67.7%	15.9%	16.4%
The virtual phone clinics can improve my diabetes control.	63.2%	20.4%	16.4%
Overall, I am satisfied with my experience with the virtual phone clinics for the routine follow-up of diabetes mellitus.	59.2%	17.4%	23.4%
In the future, I would prefer to continue attending my routine diabetes follow-up appointments in the virtual phone clinics than in the traditional clinics.	75.6%	13.9%	10.5%



Overall, I am satisfied with my experience with the virtual phone clinics for the routine follow up of diabetes mellitus.

Fig. 1. Overall satisfaction of patients with T1DM who attended the virtual phone diabetes clinic (N = 201). T1DM, type 1 diabetes mellitus.



In the future, I would prefer to continue attending my routine diabetes follow up appointments in the virtual phone clinics than in the traditional clinics.

Fig. 2. Preference for future virtual diabetes care among patients with T1DM who attended the virtual phone diabetes clinic (N = 201). T1DM, type 1 diabetes mellitus.

($p < 0.001$) were reported by participants who agreed or strongly agreed to be satisfied with their current health status (71.80 ± 18.1 , $N = 140$), compared to those who disagreed or strongly disagreed (60.31 ± 20.4 , $N = 32$), or were neutral (57.93 ± 22.0 , $N = 29$). It can

also be noted that the perception of patients was close to exhibiting significant differences relative to the 'previous diagnosis with COVID-19' factor ($p = 0.052$), as higher mean perception value was found in those who were previously diagnosed with COVID-19 (74.73 ± 17.6), compared to those who were not (66.88 ± 20.0). Nevertheless, this factor and all other health and COVID-19-related characteristics exhibited no significant differences ($p > 0.05$) based on one-way ANOVA analysis.

3.7. Patients' perception vs virtual phone visit outcomes

By employing independent *t*-test and Welch's *t*-test, an analysis of patients' perception against virtual phone outcomes was performed. Findings showed that significantly higher perception value toward the virtual phone clinic was observed for those who did not ask their physician to be physically seen during the virtual appointment (mean = 70.21 ± 18.4 , $N = 169$), compared to those who asked (mean = 56.17 ± 23.1 , $N = 32$) according to the independent *t*-test ($p = 0.002$). Also, significantly higher perception value toward the virtual phone clinic was seen for those who did not miss any virtual phone appointments (mean = 69.98 ± 19.1 , $N = 147$), compared those who missed appointments (mean = 62.50 ± 20.9 , $n = 54$), according to the independent *t*-test ($p = 0.017$).

4. Discussion

This study provides new insights into the perception of patients with T1DM toward virtual phone clinics, a new approach for providing patient care that has been introduced in Saudi Arabia during the COVID-19 pandemic. Our target population included patients who had their virtual phone visit after the COVID-19 lockdown ended, i.e., between August 1 and December 31, 2020; this period was chosen so that it would closely represent the current situation. Almost 70% of participants in the present study agreed or strongly agreed to being satisfied with their present state. The open-access web-based global survey of Scott et al. also reported that 85% of T1DM patients feel good-to-excellent with their pre-existing health status [10]. The majority of patients in the current study also agreed or strongly agreed to being aware that they are more vulnerable to possibly experiencing severe complications when contracting COVID-19 (73.7%), and approximately 80% agreed or strongly agreed that virtual phone clinics decreased their possibility of contracting COVID-19, as it did not involve their physical presence. Such awareness was probably influenced by the media [11], a known platform which has already reported diabetes as a risk factor for COVID-19 [11–14]. Different studies reported the association between poor glucose control and COVID-19

complicated risks, especially risk of death [6,13,15–17].

With regards to patient perception toward the virtual phone clinic in the present study, around two thirds of patients agreed or strongly agreed that virtual phone clinics have improved their diabetes control, ability to routinely conduct their follow-up with their physician, and improved their access to healthcare, as well as feeling satisfied with the phone call-assisted healthcare service compared to traditional clinics. Telemedicine has been reported to allow patients with diabetes to easily communicate with a healthcare provider in the comfort of their home [9,18], and patients were able to receive their healthcare needs [18]. The online survey study of Fung et al. in British Columbia involved pediatric T1DM patients who responded that they partly improved their healthcare service access through telehealth visits during the pandemic [19]. Moreover, the current study reported that physicians were able to obtain a good understanding of their condition via phone (63.2%), despite the application of virtual phone clinics as a new experience or technology for them. Similarly, as shown by Fung et al., the families of pediatric patients reported a high score for feeling comfortable with interacting with the clinician virtually [19].

Overall, 59.2% of the patients agreed or strongly agreed with experiencing satisfaction with their virtual phone clinic experience. Additionally, our participants obtained an average perception value of $67.76 \pm 19.9\%$, suggesting that the majority had a good perception toward the virtual phone clinic for the routine care of T1DM. This is in agreement with another cross-sectional web-based study done in our institution during lockdown in Saudi Arabia, wherein the majority of insulin pump-treated T1DM patients rated the virtual phone visit they had as beneficial [18]. Moreover, Fung et al. also noted higher overall satisfaction of their studied pediatric T1DM patients, having an overall positive assessment of virtual visits of families [19]. The global survey-based study of Scott et al. reported a large proportion (86%) of patients who utilized telephone and videocall-assisted healthcare as having positive perception to remote appointments [10]. Several studies have also noted positive perception among patients as well as physicians toward telemedicine for the care of T1DM during the COVID-19 pandemic [9,11,15,20,21].

Three quarters of participants in the present study responded that they would prefer to continue attending their respective routine follow-up appointments through virtual phone clinics in the future, in comparison with traditional clinics (75.6%). This is consistent with the response of T1DM patients in another study wherein approximately three quarters (72%) desired to continue telephone-assisted healthcare in the future [19]. In addition, the same proportion of T1DM patients in the global survey-based study of Scott et al. considered having remote appointments after the pandemic [10]. Another study emphasized that telemedicine utilization would allow reaching out to more patients with diabetes in comparison with conventional face-to-face consultation [22]. Additionally, telemedicine will more likely exhibit a vital function in healthcare delivery, more notably for diabetes after the COVID-19 pandemic [22]. The preference to telemedicine has already been reported in many studies prior to the COVID-19 pandemic. The result of randomized-controlled trials by Su et al. involving 9258 patients with diabetes (T1DM and T2DM) showed favor for telemedicine compared to conventional care (Hedges' $g = -0.48$, $p < 0.001$) [23], noting the beneficial effect to be more pronounced for patients with T2DM compared to those with T1DM. Despite the high proportion of patients who may prefer to use telemedicine in the future, there are still patients who do not. Powell et al. reported a decline in access to virtual clinics for patients with diabetes who used an insulin pump, with high utilization in the first two months and then gradual reduction after six months [24]. This is a typical

pattern for web-based healthcare, as patients can easily discontinue using the system [24,25], with changes in interest and engagement over time [24]. It is, therefore, suggested that further research on the evaluation of effective and sustainable telemedicine for patients and healthcare professionals is performed after the pandemic [15,19].

The results of the present study revealed no significant differences ($p > 0.05$) among the mean perception values of patients toward the virtual phone clinic, with respect to demographic factors such as age and level of education. A similar result was observed by Scott et al., in which no significant differences were found among the perception of patients between age groups and educational demographic factors [10]. This implies that telemedicine can potentially be useful for most of the population, and is not just limited to pediatric patients [10]. Conversely, missing a virtual appointment and asking the physician to be physically seen were reported to be linked to lower mean patient perception value toward the virtual service in the present study. Similarly, those with negative or neutral views of their current health had lower mean perception values compared to those who had positive views. Therefore, future strategies need to be developed to further enhance patient experience. Firstly, we suggest checking the accuracy of the registered phone number in the system and placing additional appointment reminders and calling attempts. Secondly, healthcare physicians should promote patient self-assessment, such as periodic self-checking of blood pressure, weight, feet, and blood glucose levels. Thirdly, performing a formal physical examination at least once annually and laboratory testing at appropriate intervals is encouraged [26]. Fourthly, enhancing telemedicine by incorporating web-based applications utilizing insulin pumps is also suggested to be helpful [22]. Lastly, the implementation of a medication delivery system is especially beneficial for patients with transportation issues; however, in-person visits should remain an option for patients who require urgent care, and for those with limited ability to adapt to technology, or who opt for in-person consultations [26,27].

5. Limitations

Unfortunately, the online survey was only completed by those with internet access, suggesting a possible social bias in the data collection. Considering such a limitation, it is a good approach to secure adequate resources for such patients as part of new strategy in telemedicine care. Moreover, it should be noted that data on patient perception toward virtual phone clinics were not obtained for those who had their visits between January 1 and May 31, 2021. During this period, a nationwide vaccination program against COVID-19 in addition to easing of COVID-19 restrictions was implemented by the government, and this could have altered patients' views toward virtual phone clinics with increasing hope of controlling the spread of COVID-19 [28,29].

6. Conclusion

While telemedicine is already utilized, the COVID-19 pandemic has stimulated increased use of this medium for healthcare provision. This study demonstrated that a large proportion of Saudi patients with T1DM attending the diabetes clinic at King Abdulaziz Medical City have adapted to the virtual phone clinic consultation during the pandemic, exhibiting good satisfaction and perception, and high preference to continue using the system in the future. Hence, the utilization of virtual phone clinics to assist patients with diabetes is highly encouraged, especially during this pandemic, and strategies need to be developed to further enhance the patient experience with the service. With the emerging use of

telemedicine, programs to assist patients with limited resources and access to the internet could allow researchers to see the bigger picture of telemedicine, without potential social bias. Future research that aims to evaluate the efficacy and sustainability of the virtual service is needed after the pandemic.

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Submission declaration

The authors declare that this research has not been published before, nor is it being considered for publication in any other journal and, if accepted, will not be published in the same form in any language without the written consent of the Editor-in-Chief.

Declaration of competing interest

The authors declare no conflicts of interest.

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