Original Article

Preparedness of diabetic patients for receiving telemedical health care: A cross-sectional study

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Abstract

Introduction: This study evaluates feasibility of telemedicine to deliver diabetic care among different regions of the country. **Materials and Methods:** Medical interns affiliated with Rotaract Club of Medicrew (RCM) organized a Free Diabetes Screening Camp called "*Diab-at-ease"* at multiple sites across the country. Of all beneficiaries of the camp >18 years of age, patients previously diagnosed with diabetes and undiagnosed patients with a random blood sugar level of more than 200 mg/dL were interviewed regarding their knowledge, attitude, and practice regarding diabetes care and preparedness and vigilance to receiving care through telemedicine. Random blood sugar, height, weight, and waist circumference were also documented. **Results:** About 51.1% (*N* = 223) of female patients aged 57.57 ± 13.84 years (>18 years) with body mass index (BMI) =26.11 ± 4.63 were the beneficiaries of the health camps. About 75.3% (*n* = 168) of them were on oral hypoglycemic agents (OHAs), 15.7% (*n* = 35) were on insulin preparations, and 59.6% (*n* = 156) and 88.5% (*n* = 31) of which were highly compliant with treatment, respectively. About 35% (*n* = 78) and 43.9% (*n* = 98) of them were unaware of their frequency of hypoglycemic and hyperglycemic episodes, respectively. About 64.6% (*n* = 144) of the patients were equipped for receiving teleconsultation. Glucometer was only possessed by 51.6% (115) of which only 46.95% (*n* = 54) can operate it independently. Only 80 patients (35.9%) were aware of the correct value of blood glucose levels. **Conclusion:** While a majority of the population is compliant with treatment and aware about diabetes self-care, they lack adequate knowledge and resource equipment for the same leading to very limited utilization.

Keywords: Teleconsultation, tele-preparedness, telehealth, type 2 DM

Introduction

Diabetes is one of the leading non-communicable diseases that has become a global burden with prevalence rising steeply in developing countries such as India with an estimated crude prevalence of 7.5%.[1] Rapid socioeconomic development and an increase in sedentary lifestyle among individuals have led to the explosive increase in the prevalence of diabetes mellitus (DM) in India over the past decades. In a global context, the patients with DM have quadrupled in the past three decades with about one in every 11 adults having DM.[2] Diabetes is a major lifestyle disorder and requires monitoring and care, and therefore frequent follow-up visits. But with the advent of the coronavirus disease 2019 (COVID-19) pandemic, imposition of strict guidelines of quarantine, lockdown, travel, and social distancing has severely

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impacted the availability of healthcare facilities for non-COVID patients including patients with DM across the world.

To counter this, the healthcare sector underwent a digital revolution to provide delivery of healthcare services through the use of two-way electronic audiovisual technology named "Telemedicine." The World Health Organization (WHO) defines telemedicine as "The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities."[3] Telemedicine offers patients significant benefits such as lower cost and easier way to access quality care especially in testing times such as the recent pandemic. Evidence suggests a 135% increase (369.1 daily to 866.8 daily) and a 4345% increase (94.7 daily to 4209.3 daily) in virtual health visits between March 2, 2020, and April 14, 2020, for urgent and non-urgent care to an urban tertiary healthcare center in New York, respectively.[4]

Diabetes care also became a part of this digital revolution in medicine, with telemedicine finding its way into the homes of many patients with DM across the globe. Soon, the scientific community started evaluating the practical use and impact of telemedicine in diabetes care. A meta-analysis of 35 randomized controlled trials (RCTs) of telemedicine (video, phone, and email) from China [involving a pooled population (n = 3514)] showed a reduction in hemoglobin A1C (HbA1c) by −0.37% ($P < 0.001$) in the telemedicine group when compared to controls.[5] In a Cochrane review conducted by Flodgren *et al.*, 21 RCTs of patients with diabetes (n = 2768) were analyzed.[6] These patients had interactive telemedicine (remote monitoring or real-time video) delivered in addition to, or as an alternative to, or partly substituted for standard care vs. standard care alone.[6] This study showed that there was a reduction of HbA1c by e to, or$P < 0.001$) in patients on telemedicine when compared to controls.[6] In a review that included 46 studies where different modes of telemedicine were studied among patients of type 2 diabetes mellitus (T2DM, n = 24000) and type 1 diabetes mellitus (T1DM, n = 2052), it was noted that there was an overall mean reduction in HbA1c in the telemedicine intervention group in both T1DM (−0.12 to −0.86%) and T2DM (−0.01% to −1.13%) patients.[7] While telemedicine has a wide range of benefits, it also has some disadvantages such as compromising doctor–patient relationship, inability to perform thorough clinical examinations, and issues concerning the quality of health information. Along with concerns pertaining to feasibility of telemedicine, the medical community is still working to achieve an equilibrium between technology and in-person care.

Though telemedicine was initiated in India by the Indian Space Research Organization (ISRO) way back in 2001, it was only after the COVID-19 pandemic that the tipping point was reached.[8] India formally issued policy guidelines for practicing telemedicine in March 2020.[9] The intervening 2 decades witnessed enhanced Internet penetration and smartphone access which have set the stage for increased rollout of telemedicine services. In a resource-limited setting such as India, the feasibility of telemedicine deserves special attention due to the trifecta of abysmal urban–rural doctor ratio of 3.8:1,[10] high levels of multidimensional poverty index impacting social determinants of health,[11] and significant sections of the population lacking timely access to quality care.[12] This means that telemedicine can serve as an important bridge for the majority of the population to avail necessary healthcare services even as efforts are made to strengthen existing facilities.[13] With the world slowly progressing toward the incorporation of artificial intelligence in telehealth,[14] it is imperative to have adequate data available from highly populated countries such as India while making global health decisions. This study has been conducted to evaluate preparedness of the diabetic patients residing in different regions of the country to receive telemedical health care. Furthermore, the study also generates data regarding the knowledge, attitude, and practice of rural diabetic patients toward diabetes management.

Materials and Methods

Study design

This is a cross-sectional study.

Study population

Heterogeneous beneficiaries of Rotaract Club of Medicrew (RCM) organized a Free Diabetes Screening Camp called "*Diab-at-ease*" >18 years of age either previously diagnosed with documented diabetes or undiagnosed with a random blood sugar level of more than 200 mg/dL.

Inclusion criteria

1. Beneficiaries >18 years of age presenting to RCM's *Diab-at-ease* who consented to random blood sugar measurement by the skin prick method using a glucometer.
2. Beneficiaries previously diagnosed with documented diabetes or
3. Beneficiaries with random blood sugar of >200 mg/dL at the time of the health camp.

Exclusion criteria

1. Beneficiaries who denied consent to participate in the study after screening.
2. Beneficiaries with language differences with respect to the volunteers were excluded to avoid any communication bias.

Consent

A well-informed written consent explaining the study and ensuring the patients that their personal particulars shall be kept confidential was taken from the participants.

Study tools

A structured Google Form was used to record basic sociodemographic details of the beneficiaries. They were also administered a validated questionnaire which had been adapted from the freely available standardized diabetes history forms that are used in hospitals to assess an adult patient's diabetes behaviors.[15,16] The Google Form employed included questions in individual domains to assess the patients:

a. Social supports: Seven items about the primary care provider and individual social status of the patient.
b. Tele-preparedness of the diabetic patient: This was assessed by 22 items that covered the diabetic history (18 items: two items each dealt with blood glucose levels, blood pressures, body weight, height, and waist circumference of the patient, three items each dealt with oral hypoglycemic and injectable insulin as management modalities for the patient's diabetes, and one item each noted duration of DM and associated complications) and tele-preparedness of the patient (four items: one item assessing access to video conferencing applications and three items assessing the access to glucometers). Five items elicited yes/no responses, while three items were assessed using a 5-point Likert scale with higher scores indicative of better adherence to diabetes management practices and compliance with medications. The remaining items generated qualitative data.
c. Diabetes monitoring by the patient: This was assessed by five items that covered the patient's knowledge about diabetes (one item) and diabetes monitoring practices (four items). Two of these items were assessed using a 5-point Likert scale with higher scores indicative of greater care and monitoring by the patient.
d. Medical history: Eight items that comprised this domain included questions on addiction (five items) and prior illnesses (three items) requiring hospitalization or outpatient consultation.
e. Diabetes self-care behaviors: This included nine items that assessed the patient's attitude toward healthy lifestyle changes including exercise (six items) and weight changes (three items).

The entire Google Form was validated prior to being utilized for assessment. This was achieved by calculating the scale-level CVI= content validity index for the form based on its assessment by a panel of 10 content experts. Besides achieving extremely relevant ratings, the items had high content validity (0.81) as well which indicated that data obtained from the form adequately mapped the individual domains and were truly representative of them.[17]

Methodology

Medical interns affiliated with RCM organized a Free Diabetes Screening Camp called "*Diab-at-ease"* at multiple locations in the country over a period of 2 months. Of all beneficiaries of the camp >18 years of age, patients previously diagnosed with diabetes and undiagnosed patients with a random blood sugar level of more than 200 mg/dL were considered eligible for the study and were invited to participate in the same. Patients who consented to participate were interviewed regarding their preparedness, knowledge, attitude, practice, and vigilance toward telemedicine. Random blood sugar, height, weight, and waist circumference were also documented.

Outcome measures

The outcomes of the study have been analyzed to identify tele-preparedness, knowledge, attitude, and practice of the diabetic patients.

Statistical plan analysis

Qualitative data were collected through the survey and tabulated into Google Sheets. The frequency distribution of sociodemographic data was made. Depending on the frequencies and variables in the contingency tables drawn up, the Chi-square test and Fisher's exact test were used to identify any associations between demographic characteristics, knowledge, attitude, practice, and vigilance demonstrated by beneficiaries and their tele-preparedness.

Results

Of 223 patients aged 18–94 years, with a mean age of 57.57 ± 13.84 years, 51.1% of them were female. About 74.4% (166) of them were either unemployed or retired. About 70.4% of the study participants had someone to assist them with their routine diabetes care. The duration of the patient suffering from diabetes varied from less than 1 year to more than 40 years, with an average duration of 8.65 ± 8.40 years. Educational qualification of the patients is shown in Figure 1.

The body mass index (BMI) of the patients ranged from 17.43 to 51.52 kg/m^2, with an average of 26.11 ± 4.63 years. The duration of diabetes of the participants varied from newly detected in the past year to 40 years, with an average of 8.65 ± 8.40 years. About 46.6% (104) of the patients had a family history of DM. About 58.29% (130) of the patients had other comorbidities with hypertension being the most prevalent at 53.8%, and others are described in Table 1.

About 75.3% (168) of the patients used oral hypoglycemic agents (OHAs), 15.7% (35) used various insulin preparations, and 69.1% of the patients considered taking medications crucial for their health. Fifty-four of 168 members (32.14%) on OHA and 12 of 35 members (34.28%) on insulin knew the correct blood glucose values. Fifty-six (33.33%) and 11 (31.42%) members quoted lower values in OHA and insulin groups, respectively. On analyzing the self-assessment of compliance with a scale of 1–5, 133 of the 156 patients using OHAs (59.6%) [Table 2] and 31 of the 35 patients on insulin treatment rated themselves as highly compliant with their treatment. About 13% (29) of the participants reported physical limitations which interfered with their self-care for diabetes. Six members reported hearing problems, 20 and 16 members had trouble with the use of their feet and hands, respectively, and five members experienced vision loss which caused

interference. The frequency of hypoglycemic and hyperglycemic episodes as described by the patients is shown in Table 3.

Fifty-five (24.7%) of the patients considered it very important to monitor the blood glucose levels at least once a day, whereas 57 (25.6%) did not consider it important at all. Only 56 (26.9%) patients were confident that they could monitor their blood glucose values at least once a day [Table 4].

About 8.1% (18) have been hospitalized for DM or its complications, and 4.5% (10) have been to the emergency department for diabetes. About 10.8% of the patients drank alcohol on a regular basis. About 42.2% (94) of the patients considered it very important to be active and 49.8% of the patients reported engaging in exercise regularly. However, only 35.9% of the patients were sure that they could be active [Table 5]. Walking, jogging, and yoga were the most common forms of exercise patients resorted to.

On analysis of the tele-preparedness, 64.6% (144) of the patients were technically equipped and capable of independently operating video conferencing applications. Only 51.6% (115) of the patients had a glucometer, of which only 46.95% (54) of them knew how to operate the glucometer by themselves, whereas others required aid. Only 80 patients (35.9%) knew the correct value of blood glucose levels, whereas eight (2.7%) did not know the values at all, 65 (29.1%) of them quoted a lower than normal value, and 72 (32.3%) quoted a higher value. On comparing whether members who owned a glucometer knew the correct blood glucose levels, *P* value was found to be 0.034, which is statistically significant. While comparing the random blood sugar values of the 66 participants who did not have assistance with their diabetic care (mean = 154.58; SD = 65.78) with the 157 participants who had assistance (mean = 179.16; SD = 64.28), there was a significant statistical difference t (120) = -2.564 with a *P* value of 0.012. Anxiety and/or depression was reported in four of the members (6.06%) without support for their diabetic care and in five members (3.18%) for people with support.

Discussion

A critical aspect in the management of chronic diseases such as diabetes is centered around self-care and home-based family interventions.[18] As the majority of disease management activities occur in the family, a support person has been proven to help in better prognostic outcomes in diabetic patients.[19] Studies

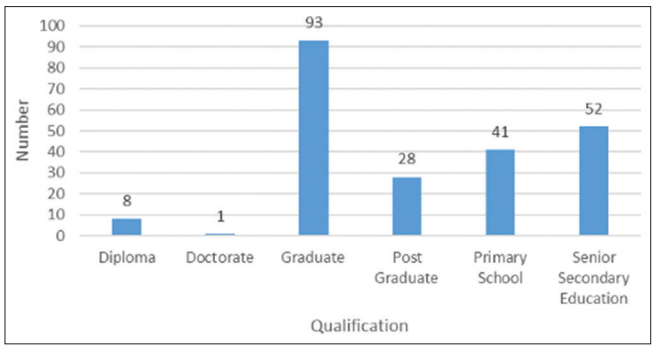

Figure 1: Educational qualification of the patient

Table 1: Comorbidities with percentage

Condition	Number	Percentage
Asthma	3	2.31
Obesity	27	20.77
High blood pressure	70	53.85
Eye of vision problems	39	30.00
Shortness of breath	10	7.69
Thyroid problems	26	20.00
Numbness/pain/tingling of hands/feet	31	23.85
Kidney/bladder problems	11	8.46
Depression/anxiety	9	6.92
Frequent nausea/vomiting/diarrhea/constipation	12	9.23
High cholesterol/triglycerides	33	25.38
Surgery in the last 5 years	29	22.31
Heart disease/chest pain	25	19.23

Table 2: OHA's self-assessment of compliance (scale of 1–5)

Score	Frequency	Percentage
1.0	2	1.28
2.0	2	1.28
3.0	8	5.12
4.0	11	7.05
5.0	133	85.25
Total	156	100.0

Table 3: Frequency of high and low blood sugar levels in patients

Response	Frequency of high blood sugars among patients		Frequency of low blood sugars among patients	
	Frequency	Percentage	Frequency	Percentage
A few times a month	8	3.6	6	2.7
Daily	4	1.8	1	0.4
Do not know	78	35.0	98	43.9
Once in a while	46	20.6	24	10.8
Rarely or never	74	33.2	93	41.7
Several times a week	13	5.8	1	0.4
Total	223	100.0	223	100.0

Table 4: Importance and practices of blood glucose monitoring

Score	Importance of blood glucose monitoring		How sure are you that you can monitor your blood glucose at least once per day	
	Frequency	Percentage (%)	Frequency	Percentage (%)
1.0	57	25.6	60	26.9
2.0	49	22.0	42	18.8
3.0	42	18.8	40	17.9
4.0	20	9.0	25	11.2
5.0	55	24.7	56	25.1

Table 5: Exercise and practices

Score	Importance of being active		Ability to be active	
	Frequency	Percentage	Frequency	Percentage
1.0	7	3.1	23	10.3
2.0	18	8.1	18	8.1
3.0	44	19.7	44	19.7
4.0	60	26.9	58	26.0
5.0	94	42.2	80	35.9

have reported an improvement in diabetes knowledge, diet, and exercise behaviors of patients and their family members, ultimately causing lifestyle modification changes for the entire family.[19-22] Studies that assessed psychological outcomes in diabetics present a positive correlation of incidence of depression and/or anxiety with the absence of a social support system.[23,24] Similarly, in our study, we found that patients with social support reported nearly half the incidence of anxiety or depression compared to people without a support system as a comorbidity, although we did not find any consistency in the positive relation of social support with blood sugar control which have been reported by authors previously.[25] It could be attributed to the variability of random blood sugar, and therefore, we suggest that future studies in this domain shall consider social support correlation with either fasting blood sugar or HbA1c to give more sustainable results.

More than half of our patients had hypertension as a comorbidity followed by vision problems and hyperlipidemias. The concurrence of which is in agreement with the non-communicable disease patterns of developing and developed countries.[26,27] In the context of India, the co-occurrence of hypertension with DM found by Shriraam *et al.* is similar to what we found in our patients.[28] This can be attributed to the pathogenic interlinks of common risk factors between DM and hypertension, disease to complication, relationship of DM to vision loss, and synergistic action of these illnesses.[26,29] The next common comorbid conditions reported in our patients were consistent with complaints of peripheral neuropathy and heart disease while being operated on at least once in the last 5 years. These findings are consistent with the pathogenetically interlinked constellation of non-communicable disease and highlight the necessity of taking a broad minimized number of evidence-based public health interventions and hospital management perspectives for multiple lifestyle-related diseases at once.[30,31]

Most of the beneficiaries of the health camp were elderly females, and therefore, grassroot level similar public health camps can be a novel tool for prevention by early screening for the vulnerable geriatric populations, being widely accepted and appreciated by the Indian population at present.[32] This is in contrast to the sociodemographic profile in community health camp beneficiaries observed by Bhondve *et al.* in the year 2019 where females only comprised one-third of the beneficiaries.[32] It comes as a promising finding that the trend of acceptance of these peripheral health camps is increasing especially in the female population in India, which could be attributed to increased awareness about public health and community health during the phase of the COVID-19 pandemic where they were among the worst hit populations. In terms of educational qualifications, a majority of our beneficiaries were graduate, senior secondary, and primary school qualified, either unemployed or retired. Therefore, it has been postulated that the community health camps can be utilized to provide health services to the low socioeconomic strata and achieve universal health care in India.[33]

All patients were on drug therapy and most of them considered it crucial for their health. OHAs were the common treatment agents followed by insulin, which is common practice by physicians as OHAs have better patient compliance and are very effective for clinical management of blood sugar. Self-assessed patient compliance with OHAs was reported to be high, and nearly the entire population taking insulin was highly compliant. This can be attributed to the "construct of reappraising fear" where an invasive therapy that can have serious side effects if not taken correctly is more effective and highly compliant due to the patient psychology of perceived fear.[34,35] Patient compliance is a direct indicator of patient's vigilance and willingness to their therapy.[36] A more compliant patient is expected to have better self-care, which is a vital aspect in diabetes management[36] but a majority of the patients were unaware of target blood sugar level, where the concerning percentage is the 33.33% in OHA and 31.42% in insulin who quoted less target value as it predisposes them to a possibly fatal hypoglycemia.

Our patients reported few health barriers to self-care consistent with peripheral neuropathies and diminution of vision, both of which can be explained on the basis of complications of diabetes itself, that is, diabetic neuropathy and retinopathy. Therefore, early screening of these complications is a must to prevent their disabling consequences, which make a patient dependent on others and less self-reliant putting him into risk of further complicating his illness and having a poorer prognosis.

Awareness about the frequency of hyperglycemia or hypoglycemia episodes was mostly unknown by the patients. It is consistent with many studies where T2DM patients are reported to be mostly unaware about their impaired blood glucose.[37-39] This has another implication as a special emphasis has been put by the clinicians to increase the awareness of the patients to perceive symptoms and signs of hypoglycemia and hyperglycemia as it might reduce the mortality in diabetic patients.[40] The majority did not even find it important for at least once-a-day measurement of their blood glucose. These factors are possibly due to lack of equipment such as glucometers, which is only possessed by 51.6% (n = 115) of population, of which only 46.95% (n = 54) know how to operate it coupled with the lack of awareness and knowledge about illness which is evident from the finding that only 35.9% (n = 80) of the patients knew the correct value of normal blood sugar range while majority quoting a high or low value. Of those who possessed a glucometer, they significantly know the correct blood sugar compared to those who do not

possess the equipment. This could be due to the increased vigilance in this group toward their sugar monitoring and is a reassuring finding to the physicians.

On the other side of balance, it is very crucial for T2DM patients to adapt lifestyle modification changes and be physically active. Although 42.2% (n = 94) of the patients believe it is very important to be physically active, only 35.9% (n = 80) of the patients are able to be physically active. Walking, jogging, and yoga were the most common activities patients were engaging in. This calls for a call to shift the focus to increase physical activity-related facilities such as collaborative exercise groups, activity forums, gyms, and parks in residential societies or neighborhoods along with awareness advertisements to enhance the participation of the elderly population for their overall health.[41]

The past experience with the COVID-19 pandemic brought telehealth as a key aspect to maintain access to health care in the context of new health-related risks and economic stressors. It has been especially recommended for the management of chronic illnesses such as DM, and systematic reviews and meta-analyses have reported a significant improvement in HbA1C levels in diabetic patients intervened by telehealth compared to usual care.[42,43] Now, it is important to look into if the Indian population is ready for the change. We found that 64.4% (n = 144) were technically equipped to operate video conferencing applications on their own and therefore can qualify to receive telehealth without any barrier. Future capacitation of patients in the field of technology, that is, tele-prepared patients, can help to reduce outpatient department (OPD) burden in hospitals with reduced exposure to hospital-related infections to the already high-risk group of diabetics.

However, our study did have some limitations. The offline camp was conducted at a limited number of urban locations, volunteers who registered patients by virtual camps were also from metropolitan cities, and therefore, our sample was concentrated at a few urban locations. More reliable indicators such as HbA1C could not be collected due to lack of laboratory support. Longitudinal studies with international multicentric collaborations to gather a humongous sample size to produce generalizable results are future recommendations.

Conclusion

While a majority of the population is aware about the importance of physical activity, diabetes self-care, monitoring, and compliance with treatment, they lack adequate knowledge and resource equipment for the same leading to very limited utilization. Capacitation of the elderly Indian population to operate applications to receive teleconsultation can prepare them to receive health care independently from the comfort of their home.

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Abbreviations

T2DM = type 2 diabetes mellitus; RCM = Rotaract Club of Medicrew; ISRO = Indian Space Research Organization; WHO = World Health Organization; OHA = oral hypoglycemic agent; OPD = outpatient department

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No extramural funding was received. All expenditures during the health camps were borne internally by The Rotaract Club of Medicrew.

Conflicts of interest

There are no conflicts of interest.

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