

## **The Viability of Telemedicine for Type 1 Diabetes**

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### **Abstract**

#### **Introduction**

Our aim was to gauge the interest of potential stakeholders in a Telemedicine service that assists in managing Type 1 Diabetes(T1DM).

#### **Methods**

A cross-sectional questionnaire was conducted on a sample of 88 T1DM patients and 9 endocrinologists recruited in the Diabetes Clinic, UHG. Microsoft Excel was used to analyse results, tests included Pearson's chi-square. Level of significance:  $p < 0.05$ .

#### **Results**

Awareness of Telemedicine differed amongst stakeholders with only 21%(18) of patients aware compared to 100%(9) of doctors. Seventy-seven percent(68) of patients experienced barriers in accessing healthcare. Seventy-two percent(63) of patients and 67%(6) of doctors felt comfortable with video consultations. The patient’s home was determined as the most mutually preferred site of Telemedicine consultation with 83%(73) of patients and 89%(8) doctors in favour. Asked how beneficial Telemedicine would be for managing their condition, 58%(50) of patients stated Yes, 10%(9) stated No and 32%(28) were Unsure.

#### **Conclusions**

This study finds that a Telemedicine model would not only be feasible for this population but could lessen the barriers many patients experience. A sizable cohort of the population are unsure/would not find Telemedicine beneficial to managing their condition. We recommend Telemedicine as an optional service alongside annual face-to-face visits.

## Introduction

Type 1 Diabetes is an auto immune condition often diagnosed in childhood requiring continuous monitoring throughout a patient's life. While there is currently no national surveillance programme, or national population-based survey of diabetes in Ireland the population of people living with Type 1 Diabetes is approximately 14,000 – 16,000 (i.e. 10-15% of the population of people living with diabetes).

Despite the lack of concrete figures thus far, like the world over incidences of Diabetes have been increasing in Ireland<sup>1</sup>. The West of Ireland has long been recognised as a predominantly rural and low socioeconomic area of Ireland. The rural population (% of total population) in Ireland was reported at 36.83% in 2018, according to the World Bank collection of development indicators. Living with a chronic condition in rural areas presents a considerable challenge to patients' access to their healthcare providers.

Telemedicine allows health care professionals to evaluate, diagnose and treat patients in remote locations using two-way video, email, smart phones, wireless tools and other forms of telecommunications technology. Telemedicine in this way can be used in virtual consultations, patient education tools and mobile health messaging systems<sup>2</sup>. In conclusion, Bashshur et al<sup>3</sup> aptly summarises the potential of telemedicine in diabetic healthcare as giving patients "appropriate care at the appropriate time and place in the most appropriate manner".

Growing literature supports the use of a telemedical model in managing Type 1 Diabetes<sup>4,5</sup>. The chronic nature of Type 1 Diabetes requires management and monitoring throughout the patient's life. The routine check-ups involved can present a challenge to many patients from rural areas like the West of Ireland. Telemedicine could provide patients who live in rural and remote areas increased access to medical services. Telemedicine has long been postulated as a useful tool to assist patient self-management of long-term conditions and Hanlon et al<sup>6</sup> reported no negative effects of Telemedicine delivered self-management support. Moreover, the classic high-risk group of young adults living with Type 1 Diabetes could stand to benefit from the technological, less demanding nature of a Telemedicine service<sup>7</sup>.

The implementation of telemedicine in the management of this condition offers an accessible, flexible, and feasible alternative which could lead to better patient outcomes. Yaron M<sup>8</sup> showed telemedicine to be effective in a Type 1 Diabetes population by slightly reducing HbA1c, significantly reducing costs of care and increasing satisfaction. While the majority of studies<sup>9</sup> focus on the clinical outcomes from a telemedicine intervention, the appetite amongst the stakeholders is relatively unexamined. The degree of acceptability and usability of Telemedicine<sup>10</sup> is paramount to the success of a Telemedicine programme regardless of its effectiveness.

To our knowledge, this is the first study of Diabetes Telemedicine in Ireland. A study of Irish Telemedical services in 2007<sup>11</sup> found most telemedicine services to be in Dublin as opposed to the more acute, less densely populated West of Ireland. Additionally, that study mentioned no presence of a Tele-endocrinology service in Ireland at the time. The sustainability of a Telemedicine service will rely on increased public acceptance and less dependence on enthusiasts' flexibility<sup>12</sup>. We aimed to assess the feasibility and possible structure of a Telemedicine service in Ireland. Our primary research question was to ascertain the interest of diabetes care stakeholders in telemedicine as an additional way to manage the condition.

## Methods

This study was designed as a cross sectional clinical research project comprising of a survey distributed to T1DM patients and healthcare providers. The study took place in the University Hospital Galway(UHG) Diabetes centre between the months of June and July 2019.

STROBE guidelines for cross-sectional studies were followed. The study was ethically approved by the UHG Ethics board. Participants for the study were approached for consent and participation on days while a T1DM clinic was in place. Eligibility criteria for participants were T1DM patients over the age of 18.

The first key hypothesis asked do healthcare providers and people living with diabetes show interest in Telemedicine as an additional way to manage the condition. To test this, we developed a questionnaire (figure 1) influenced by existing validated surveys in the telemedical field. Existing survey questions in the literature were examined under the framework provide by Langbecker et al<sup>13</sup>. As per (Langbecker) guidelines, we constructed our Telemedicine questionnaire with the mindset of avoiding overly long surveys to improve data quality and avoiding an online survey as we felt this would show bias towards a population more likely to be in favour of telemedicine.

A sample size of 88 patients (approx. 10% of the Galway Type 1 Diabetes population) and 9 doctors in the Diabetes clinic were assessed. Participants were provided with an information leaflet explaining the project and defining Telemedicine before completing the survey. The main outcomes for the survey were awareness of Telemedicine, patients' barriers to healthcare, estimating commuting/waiting times, investigating stakeholders' technical and blood glucose management ability, preferences of telemedicine location, comparing Telemedicine and face to face consultations and whether Telemedicine would be beneficial to managing T1DM. Statistical analysis was carried out using IBM's SPSS 25 software and Microsoft Excel. Descriptive frequencies were carried out on all survey questions and tests included Pearson's chi-square and Likelihood Ratio, relevant frequencies were reported. Missing data was omitted from the calculations as it was usually an insignificant number (eg.1) or absent.

**Figure 1 (Telemedicine Patient Survey)**

**Telemedicine Patient Survey**

**For the following questions tick the box which most applies to you. Try to avoid neutral options where possible.**

1. Were you aware of Telemedicine before now? **Yes**  **No**

2. Do you experience any of the following barriers in accessing your healthcare clinic

**Commuting times**  **Availability for appointments**  **Personal Health issues**

**Means of transport**  **Other**

If you ticked Other please specify? \_\_\_\_\_

3. The commute to your healthcare clinic takes approximately-

**1-15mins**  **16-30mins**  **31mins-59mins**  **1hr-2hr**  **>2hr**

4. Are waiting times while in the hospital a problem for you during your check-ups? **Yes**  **No**

5. The average waiting time at the clinic for your check-ups lasts

**1-15mins**  **16-30mins**  **31mins-59mins**  **1hr-2hr**  **>2hr**

6. Would you be comfortable discussing your health with your doctor over the phone?

**Yes**  **No**  **Not sure**

7. Would you be comfortable discussing your health with your doctor over a Skype call?

**Yes**  **No**  **Not sure**

8. Do you feel your blood glucose levels are managed appropriately? **Yes**  **No**

9. Do you feel using Telemedicine would improve your management of your blood glucose?

**Yes**  **No**  **Not sure**

10. Do you think you have the technical skills to make a video call to your doctor?

**Yes**  **No**  **Not sure**

11. Would you be comfortable having a video consultation with your doctor at home?

**Yes**  **No**  **Not sure**

12. Would you be comfortable having a video consultation with your doctor at a purpose-built room for Telemedicine in your local town? **Yes**  **No**  **Not sure**

13. Would you be comfortable getting your insulin from a local drop off point delivered by drone to your nearest town? **Yes**  **No**  **Not sure**

14. Do you think Telemedicine would be beneficial in managing your condition? **Yes**  **No**  **Not sure**

15. Do you think a check-up with your doctor would be as satisfactory through Telemedicine as opposed to face-to-face? **Yes**  **No**

16. If you have any additional comments about Telemedicine and how you would you like to see it in practice please use the space provided below

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## Results

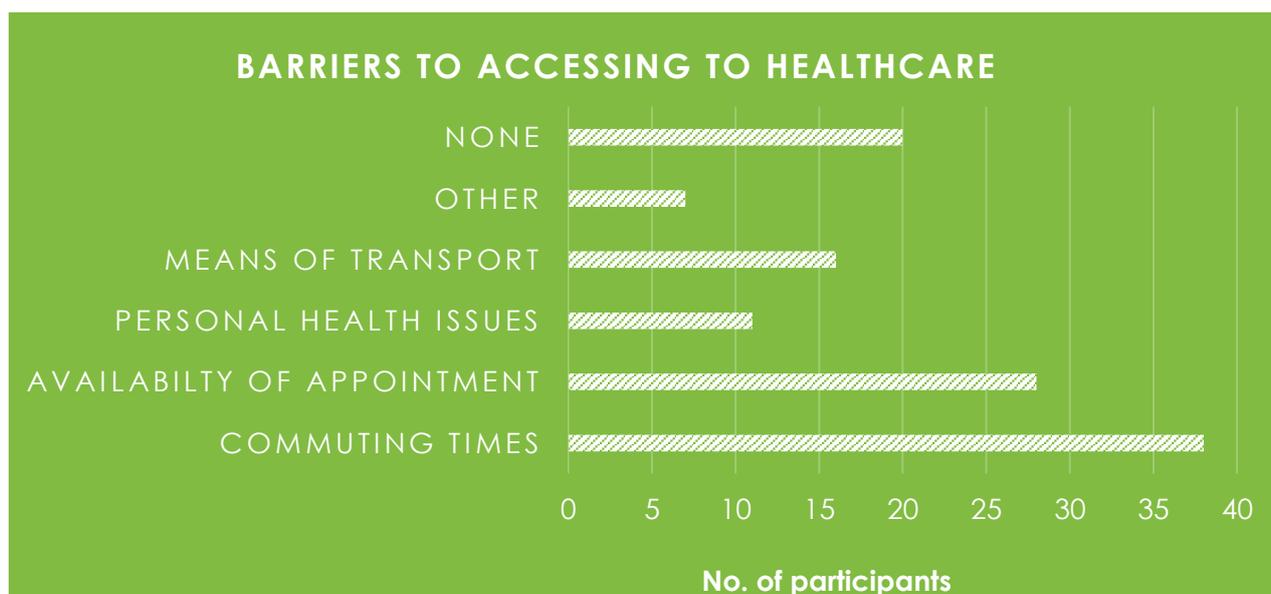
### *Demographic characteristics*

The mean age of T1DM patients at the UHG diabetes clinic is 42.9 years. Of these patients, 49.2% are male and 50.8% are female. The average duration of T1DM for these patients is 20 years. Of the 9 doctors making up the medical team, their grade and age were as follows: 1 x Consultant – age 50, 1 x Specialist Registrar – age 30, 2 x Registrars – average age 27, 5 x Senior House Officers – average age 24.

### *Awareness & Barriers*

Of the 88 patients who consented to participate their awareness of Telemedicine was low at 21%(18). While of the 9 doctors who took part, 89%(8) of them agreed that Telemedicine would reduce the burden placed on Irish hospitals. A statistically significant relationship ( $p= 0.034$ ) existed between how many barriers patients' experienced and whether they felt Telemedicine would be beneficial to their condition. The participants' average commuting and waiting times were 54 and 47 minutes respectively. Thirty-two percent(28) of patients waited more than an hour at the clinic while 34%(30) of patients had commutes longer than an hour to their clinic. The participants' average commuting and waiting times were 54 and 47 minutes respectively. Fifty-four percent(46) of participants had no problem with waiting times at their clinic

Seventy-seven percent(68) of patients experienced barriers in accessing their healthcare (figure 2); the most prominent being commuting times 32%(38) followed by availability for appointments 24%(28), means of transport 13%(16), personal health issues 9%(11) and other 5%(6). While 89%(8) of doctors agreed that Telemedicine would reduce the burden placed on Irish hospitals.



**Figure 2 (Barriers faced by patients while attending their Diabetic Clinic)**

### *Feasibility of Telemedicine*

80%(70) of patients and 67%(6) of doctors felt comfortable having a video consultation. The patient's home was determined as the most mutually preferred site of Telemedicine consultation with 83%(73) and 89%(9) of patients and providers respectively in favour of it. Contrarily regarding a purpose-built Telemedicine centre while 100%(9) of doctors were for it, only approximately half of patients would have been comfortable in that setting. Technical skills of both groups were high with 80%(70) of patients and 78%(7) of doctors. 24%(20) felt their blood glucose levels were currently not managed appropriately. 89%(9) of doctors stated they would like to see patient/doctor training implemented in a Telemedicine service.

	Patient	vs	Provider
Aware of TM	21%		100%
Comfortable with Phone Calls	80%		78%
Comfortable with Video Calls	72%		67%
Consultation at home	83%		89%
Consultation at Purpose-built centre	54%		100%
Would use drone medical delivery	38%		67%

**Table 1 (Comparing Patient versus Doctor preferences)**

### *Benefit of Telemedicine*

Patients were overall more likely to find Telemedicine beneficial, although a significant proportion were unsure with 10%(9) feeling Telemedicine wouldn't be beneficial in managing their condition while 57.5%(50) felt it would be beneficial and 32.2%(28) were unsure.

Doctors were more emphatic in their response to Telemedicine's benefit with 89%(8) thinking Telemedicine would be beneficial in managing their patient's condition however only 44%(4) thought that a check-up video consultation with their patients would be as satisfactory as a face to face check-up. The more barriers a patient experienced the more likely ( $p=0.034$ ) they were to find Telemedicine more beneficial.

### **Discussion**

Most of the Type 1 Diabetes population in the West of Ireland experience barriers in accessing their healthcare and would stand to benefit from a Telemedicine service. Technical acumen and comfort in bringing their healthcare to the home suggests this service would be feasible to implement. While patients and doctors differ in some areas regarding Telemedicine such as awareness and in its comparability to face to face consultation, they both agree in its ability to bypass the barriers in accessing healthcare and the majority would see its inclusion in Diabetes care as a beneficial one.

Telemedicine provides a novel way to increase patient interaction with their healthcare team, however a significant number of patients remain unfamiliar and unsure about adopting it. Lack of awareness of Telemedicine and preference to face to face consultations account for significant neutrality (32%) in patients' interest in the benefit of Telemedicine. These results place Telemedicine preferentially as an additional service in the treatment of Diabetes. An optional Telemedicine service alongside regular consultations or shared medical appointments<sup>15</sup> could be of acute interest in the management of young adults desiring freedom from the rigmarole of Diabetes management.

The application of Telemedicine extends beyond the virtual consultation. Increasingly patient and carer education is seen as an effective way to improve disease management; a recent study conducted in Irish primary schools<sup>16</sup> identified the lack of education in this setting as a key issue. The increased communication offered by a dedicated Telemedicine service in Ireland could assist primary schools, of which the majority lack even a single school nurse<sup>16</sup> to better care for younger Diabetes patients. This study's population of mixed city and rural dwellers in the West of Ireland can be extrapolated to a reasonable extent, certainly across Ireland but also other areas of Western Europe. Moreover, there is significant potential for a Telemedicine clinic with time to help manage other chronic conditions especially Type 2 Diabetes and in so the results of this study could be of wider use to the field of Telemedicine beyond Type 1 Diabetes.

Studies have demonstrated that the cost and time saved from a Telemedicine service<sup>5</sup> finance the initial costs taken to implement it. McFarlane et al's<sup>17</sup> pioneering study into the state of Telemedicine in Ireland back in 2006 painted a picture of Telemedicine being championed by enthusiasts with no large-scale services and little uptake amongst healthcare providers. While Telemedicine remains a novel concept within the Irish healthcare system, this study shows how evolving culture has changed patient and provider attitudes to Telemedicine and furthermore that the tools and landscape for a Telemedicine service have changed dramatically since 2006. With appropriate patient education and structures in the health service to accommodate a Telemedicine clinic we believe Telemedicine is not only a feasible but beneficial additional way for patients to access and interact with their healthcare.

This study chose to focus on the video-conferencing aspect of Telemedicine, however other approaches such as real-time patient monitoring, store-transmission methods and mobile health applications are other ways to implement Telemedicine. Sample size was limited by the Type 1 Diabetes patient population, expanding the questionnaire to Type 2 Diabetes patients (which has shown more compatibility to Telemedicine in some studies<sup>5</sup>) would significantly increase statistical power. A significant limitation of Telemedicine opposed to face to face consultations is the inability to check patient blood pressure, injection sites, feet, and overall wellness, as such Telemedicine is best seen as an adjunct to in-person consultations than as a replacement.

In conclusion, this study supports the use of Telemedicine as a means to help manage patients attending Type 1 Diabetes clinics, finding that sufficient interest is held by both patients and clinicians and that the inclusion of such a service could positively impact upon patient access to healthcare.

**Declaration of Conflicts of Interest:**

No competing financial interests exist.

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