Using telemedicine to support care for type 2 diabetes mellitus: A qualitative analysis of patient’s perspective

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Using telemedicine to support care for type 2 diabetes mellitus: A qualitative analysis of patient's perspective

Short running title: Patient's perspective of telemedicine

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Abstract

Objective: Telemedicine has been promoted as an economical and effective way to enhance patient care but the acceptability among patients is poorly understood. This study aimed to explore the experiences and perspective of type 2 diabetes mellitus patients who use telemedicine to manage their condition.

Design: We conducted an in-depth interviews and focus group with participants who used telemedicine. Questions included participants' perception of program use, satisfaction as well as engagement with program. All interviews and focus groups were audio-recorded and transcribed verbatim. The data were analyzed using a thematic approach.

Participants and setting: All type 2 diabetes patients who had participated in a randomized controlled study examining the use of telemedicine for the management of diabetes.

Results: Twelve focus groups and two in-depth interview with a total of 48 adults were conducted and four themes emerged from the analysis. (1) The younger generation was more receptive to telemedicine. (2) Using telemedicine was a convenient solution to care for their disease. (3) Sharing of personal health status with family members kept patients accountable for their health. (4) Some participants expressed concerned about their privacy infringement, presence of malware and costs.

Conclusion: Despite the potential positive benefits of using telemedicine for diabetes care, several barriers could inhibit the sustained and effective use of this technology. As such, collaboration between educators, health care providers,

telecommunication service providers and patients is required to stimulate telemedicine adoption and use.

Strengths and limitations of this study

- This study focused on the acceptability and perception towards using technology for the management of type 2 diabetes
- We captured the views, experiences, as well as barriers and facilitators to using telemedicine of patients rather than healthcare providers, as these tend to be frequently overlooked
- The study was conducted in an urban setting in Malaysia and its applicability and transferability to other population remains unknown.

Introduction

Diabetes is a major health concern worldwide, and according to a recent report by the International Diabetes Federation, the global prevalence of diabetes has increased from 415 million in 2015 to 425 million in 2017[1]. The prevalence varies considerably between different regions, but the epicenter of the diabetes crisis is currently located in the Western Pacific and South-East Asia region, with 159 million and 82 million individuals with diabetes respectively. In many individuals with diabetes, self-monitoring of blood glucose (SMBG) is considered a key component of treatment, and widely recommended by clinical practice guidelines irrespective of treatment strategy [2-4]. SMBG is often used as an early warning sign for detecting hypoglycemia, for improving the recognition of severe hyperglycemia, to encourage physical activities as well as improve diet control. These data are also often used by the treating physician to facilitate an individualized treatment regimen.

Despite these potential benefits, there is controversy on the efficacy of SMBG especially in non-insulin dependent type 2 diabetes due to its cost, uncertainty on frequency of testing as well as impact on patients' general health and well-being. Studies of enhanced SMBG which involved engagement of patients and/or clinicians to interpret the SMBG values found that larger HbA1c reduction compared to only regular SMBG which did not involve any active participation from any parties[3 5-7].
The application of telemedicine in diabetes management has been suggested as an innovative solution to improve diabetes care[8-10]. Increasingly, telemedicine is being viewed as a promising technology in assisting patients to manage their diabetes[9 11 12]. The use of telemedicine is promising in diabetes management, as it produces

accurate and reliable data, empowers patients, improves glycemic control and influences their attitude and behaviors, potentially leading to a better quality of life[11-13]. Additionally, telemedicine has the potential to reduce the barrier to adherence of self-management through real-time data transfer between patient and provider, the review glucose measurement trends, and a reduction opportunity costs. Some potential telemedicine applications and technologies that have been examined to date include mobile phones, texting, emails, e-health portals, videoconferencing as well as devices[14].

However, implementation of a telemedicine service in conventional care is a complex process. Studies have shown that while telemedicine can expand the boundaries of care to a larger population, there is heavy resistance to change, especially among patients[15 16]. Nevertheless, one of the major limitation of existing literature is the lack of studies which has examined the perspective of patients from a low-middle income country. Therefore, the goal of this study was to explore patients' views and experiences of telemedicine for diabetes management in Malaysia.

Materials and Methods

Study design

This qualitative study used a purposive sampling to select participants who had been part of a larger multicenter randomized controlled study, Intervention for Diabetes with Education, Advancement and Support (IDEAS) reported elsewhere (Box 1)[17]. Participants were approached for the qualitative study when they agreed to participate in the study, but participation for the in-depth interview was optional. The clinics in the study were drawn from a nationally representative list of clinics in Klang Valley, Malaysia.

Participants and Procedure

Participants for this qualitative study were patients who received care in one of the eleven clinics which provided diabetes care. Selection criteria for participants included: (1) diagnosed with type 2 diabetes, (2) received a web-enabled gluco-meter, (3) provided written informed consent and (4) agreed to be contacted by phone or in person for any clarification after the interview. All potentially eligible participants were contacted by telephone and invited to participate in the study. All focus groups interviews were conducted at the health clinic during the follow-up to accommodate participants schedule as much as possible. If participants were not able to attend a focus group session, an individual in-depth interview at their own home was conducted instead.

A set of open-ended questions was employed as the interview guide to capture the experiences of patients in using telemedicine. Interviews were conducted in either in the Malay or English language, led by the first author (JYL). Interviews continued until the researcher, in discussion with the wider research team considered data saturation or no new themes or codes could be identified

Ethics

The Monash University Research Ethics Committee (CF14/1977 – 2014001016 & CF15/1073 - 2015000502) and the National Medical Research Register (NMRR-14-177-19466 & NMRR-14-1368-22943) approved this study. This study was registered with ClinicalTrials.gov under the registration NCT0246680.

Patient and public involvement

The study was designed to understand the patients' views, perception and experience of using telemedicine for type 2 diabetes management. However, patients were not included in the design of the study, interview questions or conduct of study. Patients who participated in this qualitative study did so anonymously, and thus we could not disseminate the results to study participants.

Data Analysis

All sessions were audio recorded and fully transcribed verbatim. These transcripts were read several times to familiarize with the data. The data were subsequently analyzed using thematic analysis, allowing the researchers who worked in teams to identify, analyze and report the patterns or themes within a set of data[18]. All themes were derived inductively from the data where codes and theme development were directed by the content of the transcribed data. All coding was checked and iteratively refined using paired analysis of transcripts by two researchers (JYL and SWHL).

Results

A total of 48 participants were interviewed in the 12 focus group (average 3-4 participants per group) and 2 interview sessions. The participants were mostly females (56.3%), with a mean age of 51.9 years, and a mean duration of diabetes of 5.6 years (Table 1). Four core themes emerged from our interviews: (1) Age is a key factor (2) Its time saving, (3) My family and my life and (4) User experience and data security.

Theme 1 – Age is a key factor

Overall, we noted that there were two distinct groups of participants with regards to their preference on how to record their blood glucose reading. In general, older participants (those aged 50 years and above) preferred to record their glucose readings manually, using pen and paper. They found that using a telemonitoring device required a lot of technical know-how and that it was a challenging and complex process. As explained by the participants:

> I manually record. I do not understand telephone especially opening. To me manual is easier. [Patient 4, 59/F].
>
> But I am an old person I like it to be written. I'm old I need to write down. Anyway as long as someone shows me how to do it I can do it. Of course it's easier because you bring your hand phone everywhere you go. [Patient 5, 57/F]

However, participants were generally enthusiastic as they saw the potential benefits of telemedicine. They expressed the desire and need to have more training and assistance, especially when they had not used the device for some time, since they would have forgotten how it functions and to use.

> For me it's not difficult just need to teach that's all. See the learning condition first maybe need two or three times. I'm over fifty [years old] so first time will be a problem ……need to teach a few times before I understand. First time might be difficult to understand. [Patient 7, 56/M]

These participants felt that the use of telemedicine was more suitable for the younger diabetes patients who were more technology savvy. As one explained it, "Maybe for the young ones la. Technology for youngsters is more suitable since they like to sit at home and like the thing called Internet." Some participants also expressed their preference to meet their health care providers in person and reported that travelling to the clinic was not an onerous task.

> I don't mind coming to the clinic and have a chat with the doctor. We discuss and sometimes we can ask questions and doctors can show it physically. For me to use the Internet is difficult to learn my children are not here. [Patient 6, 60/M, Malay].

Conversely, younger participants were more inclined to learn and use new technologies if sufficient training and guidance were given. Additionally, they were optimistic about using telemedicine to manage their conditions, as they knew the various benefits that technology would provide, including data tracking ability and convenience.

> Digitals way. Everyday you can see it in your digital way in the software so no need to record like manual. Sometime even you record manual the paper wherever missing. Digital you have a backup. [Patient 8, 35/F]

> I like this because you can transfer directly to your phone. It's useful to me as an indication. I prefer that I can use it to check my medicine effect my glucose. I think that this is the best tools because you can monitor by the Internet everywhere you go. [Patient 9, 44/M]

> It's even more convenient since we do not have the time to come and sometimes some people do not have transport. [Patient 10, 44/F]

Theme 2 – Its time saving

Participants expressed that the use of a mobile phone which is connected to a glucometer is a convenient alternative for the management of diabetes. Participants viewed that it is a more convenient option in the event of time constraints and a lack of transportation to the clinic. Participants also revealed how having a telemonitoring device encouraged them to monitor their glucose levels regularly compared to the quarterly check-ups at the clinic. As expressed by one participant “It’s good to use especially over the Internet. It’s so much easier we do not have to come to the clinic and can stay at home (Patient 12, 60/M)”.

Theme 3 – My family and my life

Our analysis showed that there was some conflicting perspective when it comes to data sharing. Several participants expressed that they were willing to share their monitoring results with family members, as they felt that the family member would keep them accountable to their diabetes management, which was a significant motivation for them to meet their daily goals.

> The use of this what you call it [web-telemonitor]……… my health is good especially when family members want to monitor your sugar control can monitor as well. [Patient 11, 54/F]

> It’s a good part because of this you can do it at home. If at the clinic you get pricked nobody knows but when you do it at home you children will be informed as well. [Patient 5, 57/F]

Conversely, some participants expressed concerned that the sharing of medical information with their family members might infringe on their personal space and potentially cause conflicts between members of the family.

> That thing is okay but what I am afraid of is sometimes conflicts because it feels like you are being monitored by others. But it is beneficial at least there is somebody remind you. [Patient 1, 45/M]

Theme 4 – User experience and data security

Participants in this study emphasized the importance of having a user-friendly technology. Most participants in this study reported minor technical difficulties related to internet connectivity and availability during the study, which limited their ability to utilize the telemonitoring device effectively. Additionally, participants expressed concern they had about the presence of malware in telemonitoring devices that could compromise their personal information.

> Problem with the Internet. Occasionally we can receive the reading occasionally are unable too. Very inconvenient. [Patient 11, 54/F].

> I think depend on the situation where you live in a village very difficult now also because certain villages you don't have (Internet) line so you still need have the manual. [Patient 8, 35/F]

As explained by one participant, having a robust system which is user-friendly, and has good support is essential to ensure that the implementation of telemedicine is successful “Okay (lah) but what happens when there is a virus? It is a problem for one week my handphone hang. After one week it hang that is a problem” (Patient 13, 54/F).

Another aspect which participants were worried of was the costs involved compared to conventional care and that telemonitoring would only be suitable for affluent patients.

> All this (telemedicine) is for people who are wealthy. Of course this is a good system. [Patient 14, 63/M]

Some participants also found that meeting health care providers personally was a faster method to solve their queries as they felt that health care practitioners would be able to explain their clinical measures in a more concise manner. As explained by one participant “Face-to face (consultation) is more important (as) its better. (With) face-to face (consultation), information is clearer, more satisfying and friendly (Patient 2, 67F).”

Discussion

In our study, we present the conditions for the success of a telemonitoring health device for managing type 2 diabetes, from patients' perspective. We identified a set of distinctive but interrelated condition which is central to the success of such programs. Firstly, participants' demographics played a crucial factor in ensuring the acceptability of telemedicine. We noted that younger participants between ages of 29-50 years old preferred using a web-based glucometer compared to older participants who preferred recording their results manually. Such outcome is not surprising as young individuals who grew up in this digital era are usually more technologically savvy compared to their older counterparts[19 20]. Participants cited various reasons for being unable to use a web-based glucometer, among them were the lack of Internet connection especially in the rural areas. Indeed, concerns about the stability of Internet connection was the biggest barrier in using telemedicine in diabetes care in this study. The need for a simple, user friendly technology was also consistently highlighted, to encourage acceptability among participants to use a remote telemonitoring system[8 21 22].

As telemedicine technology is improving continuously, participants expressed enthusiasm on the potential added value of telemedicine. Most participants were willing to incorporate technology as part of their diabetes management, but expressed the need to have sufficient training and on-going support, especially when they encountered issues such as equipment limitations. Our study also identified the potential benefits which fueled participants' enthusiasm towards telemedicine. These include receiving alerts, being able to respond to SMBG readings with advice from a health care professional; as well as reducing opportunity cost incurred when using telemedicine[23]. Our study also offers an additional perspective and insight into the importance of patient-provider relationship. Our results support previous research which indicated that personal interaction with a health care practitioner was an important aspect to support type 2 diabetes patients, especially when it involves SMBG[24]. This view was also expressed by most participants in the present study, and also that a lack of emotional support especially when communicating through remote telemonitoring resulted in participants dropping out of the study[9].

Our study also noted that not all participant perceive enhanced SMBG as a positive tool to help achieve good glycemic control. Some participants in this study expressed reservation on the feedback and monitoring feature, which they felt intruded into their personal space. They also expressed some tension between achieving good glycemic control and quality of life, especially with the involvement of health care providers and family members whom they felt were acting as a "police". As a results, some of these patients opted not to take part in the study, for fear that this could further amplify the tension and strain the relationship, an outcome which they definitely did not want. By exploring the insights of patients, we illustrate how family values and technology literacy could influence participants' opinion on telemonitoring. Our study was also culturally specific to an Asian context and thus, we could gain an in-depth understanding and broader views of participants' behaviors when managing diabetes.

There were some limitations to our study. Firstly, although we had included a diverse sample of participants and reached thematic saturation in our interviews, these participants are only limited to one geographical location in Malaysia. Participants were from suburban districts in Selangor where connectivity and technology literacy were moderate. Future studies should include patients from both urban as well as rural location and those with high technology literacy, as this could potentially influence the uptake and acceptability of telemedicine. While published literature suggest that the trends are likely generalizable to other regions in Malaysia, the context may differ among other countries and settings. The views expressed here are solely from a patients' point and does not represent the views of health care providers or policy makers. Finally, our sample size was not large enough to draw definitive conclusion regarding differences in provider practices, patient knowledge as well as attitudes from different clinic sites.

Implications for practice

The continual improvements in technology will facilitate the use of telemedicine in future. The largest implication will be its ability to reduce logistical barriers as well as saves time. However, it is important to also consider the economic standing of patients living in rural areas, who may have limited internet connectivity. As such, health care professionals and policy makers need to consider these aspects prior to introducing any telemedicine technology for their patients to ensure that patients' expectations are met.

Another theme that emerged from this interview was the need to invest in capacity building especially in human resources. Specifically, the creation of training programs for both public as well as health workers are particularly important, especially among the non-IT savvy groups. In addition, there is also a need to simultaneously create a policy for the integration of telemedicine into the health service system and aligning it to correspond with local and national health strategies.

Conclusion

In conclusion, findings from this study indicate that the implementation of telemonitoring requires strategic planning with inputs from various stakeholders including, educators, health care providers, telco service providers and patients. These need to take into consideration the patient's personal and contextual factors, which could have a positive or negative effect. As such, health care providers need to discuss patients' perspective to ensure the optimal use of telemedicine to improve patients' clinical parameters and quality of life.

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Author Disclosure Statement

The authors report no conflict of interests.

Author Contributions

All authors named contributed substantially to the document. JYL conducted and transcribed the interview, interpreted the results and wrote the draft manuscript. SWHL obtained the funding, designed the study and provided support in editing the manuscript. CKYC, SSC, CJN, TP, KKCL, CPW, NHN and CSST contributed to the study design and critical review of the manuscript. All authors approved the final version.

Data sharing statement

All data generated or analysed during this study are included in this published article. They can be made available from the corresponding author on reasonable request.

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Table 1: Baseline demographics of participants who participated in the focus group

Patients (n= 48)	Men (n = 21)	Women (n = 27)
Age (years)	54.19	50.15
Range	29-62	31-69
Duration of diabetes (years)	4.06	6.88
Range	0.83-24	0.5-15
No of oral hypoglycemic agents used, n (%)		
1-2	18 (85)	27 (100)
≥3	1 (4)	0 (0)
No of antihypertension drugs used, n (%)		
1-2	9 (42)	11 (40)
≥3	3 (14)	7 (25)
Insulin use, n (%)		
Yes	4 (19)	2 (7)
No	17 (81)	25 (93)

Data are expressed as mean, unless otherwise stated.

Box 1: IDEAS study

The Intervention for Diabetes with Education, Advancement and Support (IDEAS) study is a cluster randomized controlled study to evaluate the use of telemedicine to improve diabetes care. Participants in the telemedicine group were instructed to measure their blood glucose at least twice weekly (one fasting and one non-fasting) or more frequent as recommended by physician. These blood glucose readings will be transmitted via a Bluetooth technology to the participants' mobile phone to a remote secure server. Participants and their physicians were able to access the records on the server. Advice on lifestyle modification, any potential changes in medication, who and how to contact their healthcare providers were also given monthly during the study. A researcher also checked participants' results weekly and initiate intervention if needed (e.g. medication changes, counselling) with the consent of the attending physician.

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Abstract

Objective: Telemedicine has been promoted as an economical and effective way to enhance patient care but its acceptability among patients in low and middle income countries are still poorly understood. This study aimed to explore the experiences and perspective of people with type 2 diabetes mellitus patients who use telemedicine to manage their condition.

Design: We conducted in-depth and focus group interviews with participants who used telemedicine. Questions included participants' perception of program use, satisfaction as well as engagement with program. All interviews and focus groups were audio-recorded and transcribed verbatim. The data were analyzed using a thematic approach.

Participants and setting: All people with type 2 diabetes who participated in a randomized controlled study examining the use of telemedicine for the management of diabetes.

Results: Twelve focus groups and two in-depth interviews with 48 adults were conducted and four themes emerged from the analysis. (1) Generational difference (2) Independence and convenience, (3) Sharing health data and privacy; and (4) Concerns and challenges. The main barriers to using telemedicine were related to the user friendliness of the devices as well as internet connectivity. Cost was also another significant concern raised by participants. However, participants generally were positive about the benefits of telemedicine, including reduction in clinic visits, ability to provide real time data and disease monitoring.

Conclusion: Despite the potential positive benefits of using telemedicine for diabetes care, several barriers could inhibit the sustained and effective use of this technology.

As such, collaboration between educators, health care providers, telecommunication service providers and patients is required to stimulate telemedicine adoption and use.

Strengths and limitations of this study

- Article followed the Standards for reporting qualitative Research (SRQR) recommendations on reporting
- Focus group discussion allowed the exchange of opinions about telemedicine, leading to richer information
- View and experiences of using telemedicine from patients were captured rather than that of healthcare providers
- The study was conducted in an urban setting in Malaysia and its applicability and transferability to other population remains unknown.

Introduction

Diabetes is a major health concern worldwide, and according to a recent report by the International Diabetes Federation, the global prevalence of diabetes will increase from 415 million in 2015 to 642 million in 2040.[1] The prevalence varies considerably between different regions, but the epicenter of the diabetes crisis is currently located in the Western Pacific and South-East Asia region, with 159 million and 82 million individuals with diabetes respectively.[2] In many individuals with diabetes, self-monitoring of blood glucose (SMBG) is considered a key component of treatment, and widely recommended by clinical practice guidelines irrespective of treatment strategy.[3-5] SMBG is often used as an early warning sign for detecting hypoglycaemia, for improving the recognition of severe hyperglycaemia, to encourage physical activities as well as improve diet control. These data are also often used by the treating physician to facilitate an individualized treatment regimen.

Despite these potential benefits, there is controversy on the efficacy of SMBG especially in non-insulin dependent type 2 diabetes due to its cost, uncertainty on frequency of testing as well as impact on patients' general health and well-being.[6-8] Studies have shown that the use of enhanced SMBG (where there are high levels of engagement between patients and clinicians to interpret the SMBG values) resulted in larger HbA1c reduction compared to regular SMBG.[4 9-11]

The application of telemedicine, or technology to deliver various aspects of health information, prevention, monitoring and medical care in diabetes management has been suggested as an innovative solution to improve diabetes care.[12-14] Increasingly,

telemedicine is being viewed as a promising technology in assisting patients to manage their diabetes,[13 15 16] as it produces accurate and reliable data[17], empowers patients[12], improves glycaemic control and influences their attitude and behaviours[16 18], potentially leading to a better quality of life.[19] Additionally, telemedicine has the potential to reduce the barrier to adherence of self-management through real-time data transfer between patient and provider, the review of blood glucose measurement trends, and a reduction in opportunity costs. These telemedicine services can be categorized to either synchronous (real-time), asynchronous (whereby data is stored and forwarded subsequently) and continuous (remote monitoring). In diabetes care, all forms of telemedicine services have been examined and include using mobile phones, texting, emails, e-health portals, videoconferencing as well as devices.[20]

However, implementation of a telemedicine service in conventional care is a complex process. Studies have shown that while telemedicine can expand the boundaries of care to a larger population and offer person-centred care,[21] there are examples of patient resistance to change.[22 23] Nevertheless, one of the major limitation of existing literature is the lack of studies which has examined the perspective of patients from a low and middle income country, where telemedicine is now increasingly being used. Therefore, the goal of this study was to explore patients' views and experiences of telemedicine for diabetes management in Malaysia.

Materials and Methods

Study design

The present qualitative study was part of a larger multi-centre cluster randomized controlled study, IDEAS conducted between April 2015 to June 2017 which aimed to examine the impact of a telemedicine program for people with type 2 diabetes (Box 1).[24] This nested study design allowed the investigators to explore the facilitators and barriers to using telemedicine, as well as participants' view if telemedicine was implemented in routine practice.

Participants

Participants were recruited from eleven primary care clinics located within the Klang Valley, which is part of the Ministry of Health Malaysia's primary care clinic network. These clinics serves the districts of Klang and Petaling, which provides care for approximately 2.56 million individuals and can be considered to be nationally representative of primary care clinics in Malaysia.

On completion of the IDEAS trial, participants from the trial were invited to participate in the current qualitative study. All potentially eligible participants were contacted by telephone and invited to participate in the qualitative study. Participants were briefed regarding the purpose, procedure and nature of the study and allowed to clarify their doubts. A separate information sheet and written informed consent were obtained prior to participation. All focus groups interviews were conducted at the respective health clinic, when participants visited the clinics for their follow-up sessions with their physicians to accommodate participants' schedule. In the event that a participant was not able to attend a focus group session, an individual in-depth interview was conducted at their own home. Study participants were incentivized with a RM50 (approximately USD$12) voucher for their participation.

Interview schedule

A semi-structured interview was used in all the focus groups, which was based on an interview guide. Table 1 outlines the topic areas and key questions which were used during the discussions. The topic guide aimed to capture the experiences of patients in using telemedicine and was developed based on relevant literature.[8 10 23]

The interviews were conducted either in the Malay or English language, which was facilitated by the first author (JYL). The interviews usually lasted between 35 - 44 minutes in an undisturbed room in the clinic. All interview sessions were digitally recorded, transcribed verbatim immediately after the interview and checked for accuracy by SWHL. Interviews were conducted to explore for emerging themes with simultaneous analysis of data until data saturation was achieved, when no new themes or codes were identified.

Data analysis

The NVivo software version 11 (QSR International Pty Ltd) was used to organized and code the data for thematic analysis.[25] All transcripts were read several times to familiarize with the data. Transcripts were translated from Malay language to English by an independent research assistant. The translated English transcripts were double checked by one of the authors (JYL) and any discrepancies were resolved via discussion with another of the authors (SWHL). The data were subsequently coded, based upon keywords or phrases that appeared to convey an opinion or perception regarding telemedicine. These initial codes were further examined and refined, with codes combined to be main themes if they had similar contexts or split into subthemes. The final codes were summarized, cross checked and iteratively refined using paired analysis of transcripts by two researchers (JYL and SWHL). In the event that there was a divergent interpretation, the transcripts were reviewed again and discussed until consensus was achieved.

Ethics

The study was approved by the Monash University Research Ethics Committee (CF14/1977 – 2014001016 & CF15/1073 - 2015000502) and the National Medical Research Register (NMRR-14-177-19466 & NMRR-14-1368-22943). All participants provided written informed consent for participation in the research. This study was registered with ClinicalTrials.gov under the registration NCT0246680.

Patient and public involvement

The current study was designed to understand the patients' views, perception and experience of using telemedicine for type 2 diabetes management. Patients were not involved in the initial design of the study, development of interview questions or conduct of study. All participants who participated in this qualitative study were not provided with the results but were informed that the results will be published in a peer-review journal.

Results

Demographics of participants

A total of 48 participants were interviewed in the 12 focus group (average 3-4 participants per group) and 2 interview sessions. The participants were mostly females (56.3%), with a mean age of 51.9 years, and a mean duration of diabetes of 5.6 years (Table 2). Four core themes emerged from the focus groups and the two in-depth interviews: (1) Generational difference (2) Independence and convenience, (3) Sharing health data and privacy; and (4) Concerns and challenges

Theme 1 – Generational differences

We noted that there were generational differences with regards to their preference on how to record their blood glucose reading. In general, older participants (those aged 50 years and above) preferred to record their glucose readings manually, using pen and paper. They found that using a telemonitoring device required a lot of technical know-how and this was a challenging and complex process. As explained by the participants:

> I (prefer to) manually record (my blood glucose readings). I do not understand (how to operate the mobile) telephone especially opening (the software). To me manual (recording) is easier. [Patient 4, 59/F].

> But I am an old person (and so) I like it (blood glucose results) to be written. I'm old (and) I need to write (the results) down. Anyway as long as someone

> shows me how to do it I can do it. Of course (using telemedicine) is easier because you bring your hand phone everywhere you go. [Patient 5, 57/F]

These participants felt that the use of telemedicine was more suitable for younger people with diabetes who were more technology savvy. As explained by one participant, “Maybe for the young ones (lah). Technology (is) for youngsters (and) is more suitable since they like to sit at home and like the thing called Internet. [Patient 41, 67/M]” Some participants also expressed their preference to meet their health care providers in person and reported that travelling to the clinic was not an onerous task.

> I don't mind coming to the clinic and have a chat with the doctor. We (can) discuss (my medical condition) and sometimes we can ask questions and doctors can show (my problem to me) physically. For me to use the Internet is difficult to learn (as) my children are not here. [Patient 6, 60/M].

Conversely, younger participants were more inclined to learn and use new technologies if sufficient training and guidance were given. Additionally, they were optimistic about using telemedicine to manage their conditions, as they knew the various benefits that technology would provide, including data tracking ability and convenience.

Theme 2 – Independence and convenience

Participants expressed that the use of a mobile phone which is connected to a glucometer is a convenient alternative for the management of diabetes. Participants viewed that it is a more convenient option in the event of time constraints and a lack of transportation to the clinic. Participants also revealed that having a telemonitoring device encouraged them to monitor their glucose levels regularly compared to the quarterly check-ups at the clinic. As expressed by one participant “It’s good to use especially over the Internet. It’s so much easier we do not have to come to the clinic and can stay at home [Patient 12, 60/M]”.

> Digitals way (is the preferred choice). Everyday you can see (your blood glucose results) in the software so (there is) no need to record like manual. Sometime even you record manual the paper will go wherever (or) missing. (Using) digital you have a backup. [Patient 8, 35/F]

> I like this because you can transfer (your blood glucose results) directly to your phone. It’s useful to me as an indication. I prefer (using technology so) that I can use it to check how my medicine affects my glucose. I think that this is the best tools because you can monitor by the Internet everywhere you go. [Patient 9, 44/M]

> It’s even more convenient since we do not have the time to come (to the clinic) and sometimes some people do not have transport. [Patient 10, 44/F]

Most participants were generally enthusiastic as they saw the potential benefits of telemedicine. Participants described how the use of a web-based glucometer was useful as it could provide them with reminders and alerts as well as the ability to connect with their healthcare providers without going to the clinic. Nevertheless, they expressed the desire and need to have more training and assistance, especially when they had not used the device for some time, since they would have forgotten how it functions and to use.

> For me it’s not difficult … just need to teach (me) that’s all. See the learning condition first (and perhaps I need more training), maybe need two or three times. I’m over fifty (years old) so (the) first time will be a problem ……need to teach a few times before I understand. First time might be difficult to understand. [Patient 7, 56/M]

Theme 3 – Sharing health data and privacy

Our analysis showed that there was some conflicting perspective with data sharing. Several participants expressed that they were willing to share their monitoring results with family members, as they felt that the family member would make them accountable for their diabetes management, which was a significant motivation for them to meet their daily goals.

> The use of this what you call it (web-telemonitor)……… my health is good especially when family members want to monitor your sugar control can monitor as well. [Patient 11, 54/F]

> The good part (of telemedicine is) you can do it at home. If (you check your blood glucose levels) at the clinic you get pricked (but) nobody knows (the results)… but when you do it at home you children will be informed as well. [Patient 5, 57/F]

Conversely, some participants expressed concern that the sharing of medical information with their family members might infringe on their personal space and could potentially cause conflicts between family members.

> That thing is okay but what I am afraid of is (that the use of telemonitoring may) sometimes (cause) conflicts because it feels like you are being monitored by others. But it is beneficial, at least there is somebody remind you. [Patient 1, 45/M]

Participants expressed concern they had about the presence of malware in telemonitoring devices that could compromise their personal information.

> (What happens when we have a) problem with the Internet (connection). Occasionally we (may) receive the reading, but occasionally (we will be) unable to (do so). (This can be) very inconvenient. [Patient 11, 54/F].

Some participants felt that meeting or contacting their health care providers was a simpler and faster way to solve their queries as the health care practitioners would be able to explain their clinical measures in a more concise manner. As explained by one participant “Face-to face (consultation) is more important (as) its better. (With) face-to face (consultation), information is clearer and more satisfying to me. [Patient 2, 67F].”

Theme 4 – Concerns and challenges

Participants in this study emphasized the importance of having a user-friendly technology. Most participants in this study reported minor technical difficulties especially with internet connectivity and availability especially in rural areas, which limited their ability to utilize the telemonitoring device effectively. Participants also expressed concerns regarding the stability of Internet connection at their homes.

> I think depend on the situation.. whether you live in a village where it will be very difficult….. because (in) certain villages you don't have (Internet) line so you still need have (to record the blood glucose results) manually. [Patient 8, 35/F]

Participants suggested the need to have a robust system which is user-friendly, has good technical support which they felt was essential to ensure that the implementation of telemedicine was successful.

> “Okay (lah) but what happens when there is a virus? It is a problem for one week my handphone “hang”. After one week it hang (again)….that is a problem” [Patient 13, 54/F].

Another aspect which participants were worried of was the costs involved compared to conventional care and that telemonitoring would only be suitable for affluent patients.

> All this (telemedicine) is for people who are wealthy. Of course this is a good system. [Patient 14, 63/M]

Discussion

In our study, we present the conditions for the success of a telemonitoring health device for managing type 2 diabetes, from patients' perspective. We identified a set of distinctive but interrelated condition which are central to the success of such programs. Firstly, participants' demographics played a crucial factor in ensuring the acceptability of telemedicine. We noted that younger participants between the ages of 29 to 50 years old preferred using a web-based glucometer compared to older participants who preferred recording their results manually. Such outcome is not surprising as young individuals who grew up in this digital era were usually more technologically savvy compared to their older counterparts.[26 27] Participants cited various reasons for being unable to use a web-based glucometer, including the lack of Internet connection especially in the rural areas. Indeed, concerns about the stability of Internet connection was the biggest barrier in using telemedicine in diabetes care in this study. The need for a simple, user friendly technology was also consistently highlighted, to encourage acceptability among participants to use a remote telemonitoring system.

As telemedicine technology is improving continuously, participants expressed enthusiasm on the potential added value of telemedicine. Most participants were willing to incorporate technology as part of their diabetes management, but expressed the need to have sufficient training and on-going support, especially when they encountered issues such as equipment limitations. Our study also identified the potential benefits which fueled participants' enthusiasm towards telemedicine. These include receiving alerts, being able to respond to SMBG readings with advice from a health care professional; as well as reducing opportunity cost incurred when using telemedicine.[28] Our study also offers an additional perspective and insight into the importance of patient-provider relationship. Our results support previous research which indicated that personal interaction with a health care practitioner was an important aspect to support type 2 diabetes patients, especially when it involves SMBG.[29] This view was also expressed by most participants in the present study, and also that a lack of emotional support especially when communicating through remote telemonitoring resulted in participants dropping out of the study.[13]

Our study also noted that not all participant perceive enhanced SMBG as a positive tool to help achieve good glycaemic control. Some participants in this study expressed reservation on the feedback and monitoring feature, which they felt intruded into their personal space. They also expressed some tension between achieving good glycaemic control and quality of life, especially with the involvement of health care providers and family members whom they felt were acting as a "police". As a results, some of these patients opted not to take part in the randomized controlled trial, for fear that this could further amplify the tension and strain the relationship, an outcome which they definitely did not want. Findings of this study identified several issues which are salient in the literature. For example, our study like many others noted that patients were acceptable to telemedicine due to its ability to reduce travel time, increase self-awareness and access to care. However, our study also found several additional barriers that have never been reported in literature, such as the tensions between operational practicality versus patient's privacy and health security.

Our study offers several strength. By exploring the insights of patients, we illustrate how family values and technology literacy could influence participants' opinion on telemonitoring. Our study was also culturally specific to an Asian context and thus, we could gain an in-depth understanding and broader views of participants' behaviors when managing diabetes. There were some limitations to our study. Firstly, although we had included a diverse sample of participants and reached thematic saturation in our focus groups and in-depth interviews, these participants were only limited to one geographical location in Malaysia. Participants in this current study were recruited from suburban districts in Selangor where connectivity and technology literacy were moderate. Future studies should include patients from both urban as well as rural location and those with high technology literacy, as this could potentially influence the uptake and acceptability of telemedicine. While published literature suggest that these trends are likely to be transferable to other regions in Malaysia, the context may differ in other countries and settings. The views expressed here are solely from a patients' point and does not represent the views of health care providers or policy makers. Finally, our results cannot draw definitive conclusion regarding differences in provider practices, patient knowledge as well as attitudes from different clinic sites other than those examined in this study.

Implications for practice

The continual improvements in technology will facilitate the use of telemedicine in future. The largest implication will be its ability to reduce logistical barriers and time saving potential. However, it is important that any telemedicine programs consider the economic standing of patients, especially those living in rural areas, who may have limited internet connectivity. As such, health care professionals and policy makers need to take into consideration these aspects prior to introducing any telemedicine technology for their patients to ensure that patients' expectations are met. Another theme that emerged from this interview was the need to invest in capacity building especially in human resources. Specifically, the creation of training programs for both public as well as health workers are particularly important, especially among the non-IT savvy groups.

Conclusion

In conclusion, findings from this study indicate that the implementation of telemonitoring requires strategic planning with inputs from various stakeholders including, educators, health care providers, telco service providers and patients. These need to take into consideration the patient's personal and contextual factors, which could have a positive or negative effect. As such, health care providers need to discuss patients' perspective to ensure the optimal use of telemedicine to improve patients' clinical parameters and quality of life.

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Author Disclosure Statement

The authors report no conflict of interests.

Author Contributions

All authors named contributed substantially to the document. JYL conducted and transcribed the interview, interpreted the results and wrote the draft manuscript. SWHL obtained the funding, designed the study and provided support in editing the manuscript. CKYC, SSC, , TP, KKCL, NHN and CSST contributed to the study design and critical review of the manuscript. All authors approved the final version.

Data sharing statement

All data generated or analysed during this study are included in this published article. They can be made available from the corresponding author on reasonable request.

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Table 1: The interview guide topic areas and key questions

Topic area	Key questions used in interviews
Diabetes	• How would you describe your experience so far with diabetes? • How have you been coping with diabetes so far? Describe some of the ways you have been coping • Who and how much support do you have to cope with your conditions now • What are some of the most important treatment needs for a patient with diabetes
Telemedicine	• Describe and tell us your experience with using the web-enabled glucometer so far. • How do you think the system was able to affect your diabetes management? • How do you think other will accept this system? • What would you think are some areas where the system was good and where are the areas we can improve? • What do you think about using this system for the long term?

	- What would be some of your concerns (if any) if this was to be used? - How was your interaction with your healthcare professional with the device?

Table 2: Baseline demographics of participants who participated in the focus group

Patients (n= 48)	Men (n = 21)	Women (n = 27)
Age (years)	54.19	50.15
Range	29-62	31-69
Duration of diabetes (years)	4.06	6.88
Range	0.83-24	0.5-15
No of oral hypoglycaemic agents used, n (%)		
1-2	18 (85)	27 (100)
≥3	1 (4)	0 (0)
No of antihypertension drugs used, n (%)		
1-2	9 (42)	11 (40)
≥3	3 (14)	7 (25)
Insulin use, n (%)		
Yes	4 (19)	2 (7)
No	17 (81)	25 (93)

Data are expressed as mean, unless otherwise stated.

Box 1: IDEAS study

The Intervention for Diabetes with Education, Advancement and Support (IDEAS) study is a cluster randomized controlled study to evaluate the use of telemedicine to improve diabetes care. Participants in the telemedicine group were instructed to measure their blood glucose at least twice weekly (one fasting and one non-fasting) or more frequent as recommended by physician. These blood glucose readings will be transmitted via a Bluetooth technology to the participants' mobile phone to a remote secure server. Participants and their physicians were able to access the records on the server. Advice on lifestyle modification, any potential changes in medication, who and how to contact their healthcare providers were also given monthly during the study. A researcher also checked participants' results weekly and initiate intervention if needed (e.g. medication changes, counselling) with the consent of the attending physician.

Standards for Reporting Qualitative Research (SRQR)*

http://www.equator-network.org/reporting-guidelines/srqr/

Page/line no(s).

Title and abstract

Title - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	1
Abstract - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	3

Introduction

Problem formulation - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	6-7
Purpose or research question - Purpose of the study and specific objectives or questions	7

Methods

Qualitative approach and research paradigm - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale**	9
Researcher characteristics and reflexivity - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	9
Context - Setting/site and salient contextual factors; rationale**	8
Sampling strategy - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**	8
Ethical issues pertaining to human subjects - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	10
Data collection methods - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**	8-9

Data collection instruments and technologies - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	9 & Table 1
Units of study - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	11
Data processing - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	9
Data analysis - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale**	9-10
Techniques to enhance trustworthiness - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale**	10

Results/findings

Synthesis and interpretation - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	11-17
Links to empirical data - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	11-17

Discussion

Integration with prior work, implications, transferability, and contribution(s) to the field - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	18-20
Limitations - Trustworthiness and limitations of findings	21

Other

Conflicts of interest - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	22
Funding - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	23

*The authors created the SRQR by searching the literature to identify guidelines, reporting standards, and critical appraisal criteria for qualitative research; reviewing the reference lists of retrieved sources; and contacting experts to gain feedback. The SRQR aims to improve the transparency of all aspects of qualitative research by providing clear standards for reporting qualitative research.

**The rationale should briefly discuss the justification for choosing that theory, approach, method, or technique rather than other options available, the assumptions and limitations implicit in those choices, and how those choices influence study conclusions and transferability. As appropriate, the rationale for several items might be discussed together.

Reference:

O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. **Standards for reporting qualitative research: a synthesis of recommendations.** *Academic Medicine*, Vol. 89, No. 9 / Sept 2014
DOI: 10.1097/ACM.0000000000000388

Manuscript: Using telemedicine to support care for people with type 2 diabetes mellitus: A qualitative analysis of patient's perspective

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Developed from:

Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

No. Item	**Guide questions/description**	**Reported on Page #**
Domain 1: Research team and reflexivity		
	Personal Characteristics	
1. Inter viewer/facilitator	Which author/s conducted the inter view or focus group?	9
2. Credentials	What were the researcher's credentials? E.g. PhD, MD	1
3. Occupation	What was their occupation at the time of the study?	1
4. Gender	Was the researcher male or female?	1
5. Experience and training	What experience or training did the researcher have?	9
	Relationship with participants	
6. Relationship established	Was a relationship established prior to study commencement?	10 .
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	8
8. Interviewer characteristics	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	9

Domain 2: study design		
Theoretical framework		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	9-10
Participant selection		
10. Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	8
11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	8-9
12. Sample size	How many participants were in the study?	8
13. Non-participation	How many people refused to participate or dropped out? Reasons?	8
Setting		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	11
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	11
16. Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	11
Data collection		
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Table 1
18. Repeat interviews	Were repeat inter views carried out? If yes, how many?	No
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	9-10
20. Field notes	Were field notes made during and/or after the inter view or focus group?	No
21. Duration	What was the duration of the inter views or focus group?	9

22. Data saturation	Was data saturation discussed?	9
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No
Domain 3: analysis and findings		
Data analysis		
24. Number of data coders	How many data coders coded the data?	10
25. Description of the coding tree	Did authors provide a description of the coding tree?	10
26. Derivation of themes	Were themes identified in advance or derived from the data?	No
27. Software	What software, if applicable, was used to manage the data?	9
28. Participant checking	Did participants provide feedback on the findings?	10
Reporting		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Yes. 11-17
30. Data and findings consistent	Was there consistency between the data presented and the findings?	18-20
31. Clarity of major themes	Were major themes clearly presented in the findings?	Yes. they were. 11-20
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Discussion of major and minor themes 18-20

BMJ Open

Using telemedicine to support care for people with type 2 diabetes mellitus: A qualitative analysis of patient's perspective

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Using telemedicine to support care for people with type 2 diabetes mellitus: A qualitative analysis of patient's perspective

Short running title: Patient's perspective of telemedicine

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Abstract

Objective: Telemedicine has been promoted as an economical and effective way to enhance patient care but its acceptability among patients in low and middle income countries is poorly understood. This study aims to explore the experiences and perspectives of people with type 2 diabetes mellitus who used telemedicine to manage their condition.

Design: We conducted in-depth and focus group interviews with participants who used telemedicine. Questions included participants' perception on program use, satisfaction as well as engagement with the telemedicine program. All interviews and focus groups were audio-recorded and transcribed verbatim. Data were analyzed using a thematic approach.

Participants and setting: People with type 2 diabetes (n=48) who participated in a randomized controlled study which examined the using telemedicine for diabetes management.

Results: Twelve focus groups and two in-depth interviews were conducted. Four themes emerged from the analysis: (1) Generational difference (2) Independence and convenience, (3) Sharing of health data and privacy; and (4) Concerns and challenges. The main barriers to using telemedicine were related to the user friendliness of the devices as well as internet connectivity. Cost was also another significant concern raised by participants. However, participants were generally positive about the benefits of telemedicine, including its ability to provide real time data and disease monitoring and the reduction in clinic visits.

Conclusion: Despite the potential positive benefits of using telemedicine for diabetes care, several barriers could inhibit the sustained and effective use of this technology.

As such, collaboration between educators, health care providers, telecommunication service providers and patients is required to stimulate telemedicine adoption and use.

Strengths and limitations of this study

- Article followed the Standards for reporting qualitative Research (SRQR) recommendations on reporting
- Focus group discussion allowed the exchange of opinions about telemedicine, leading to richer information
- View and experiences of using telemedicine from patients only were captured rather than that of healthcare providers
- The study was conducted in an urban setting in Malaysia and its applicability and transferability to other population remain unknown.

Introduction

Diabetes is a major health concern worldwide, and according to a recent report by the International Diabetes Federation, the global prevalence of diabetes will increase from 415 million in 2015 to 642 million in 2040.[1] The prevalence varies considerably between different regions, but the epicenter of the diabetes crisis is currently located in the Western Pacific and South-East Asia region, with 159 million and 82 million individuals with diabetes respectively.[2] In many individuals with diabetes, self-monitoring of blood glucose (SMBG) is considered as a key component of treatment, and widely recommended by clinical practice guidelines, irrespective of treatment strategy. [3-7] SMBG is often used as an early warning sign for detecting hypoglycaemia, for improving the recognition of severe hyperglycaemia, to encourage physical activities as well as improve diet control. These data are also often used by the treating physicians to facilitate an individualized treatment regimen.

Despite these potential benefits, there is controversy on the efficacy of SMBG, especially in non-insulin dependent type 2 diabetes, due to its cost, uncertainty on frequency of testing as well as impact on patients' general health and well-being.[8-10] Studies have shown that the use of enhanced SMBG (where there are high levels of engagement between patients and clinicians to interpret the SMBG values) resulted in larger reduction in HbA1c compared to regular SMBG.[4 11-13]

The application of telemedicine, or technology to deliver various aspects of health information, prevention, monitoring and medical care in diabetes management has been suggested as an innovative solution to improve diabetes care.[14-16] Increasingly,

telemedicine is being viewed as a promising technology in assisting patients to manage their diabetes,[15 17 18] as it produces accurate and reliable data[19], empowers patients[14], improves glycaemic control and influences their attitude and behaviours[18 20], potentially leading to a better quality of life.[21] Additionally, telemedicine has the potential to reduce the barrier to adherence of self-management through real-time data transfer between patient and provider, the review of blood glucose measurement trends, and a reduction in opportunity costs. These telemedicine services can be categorized to either synchronous (real-time), asynchronous (whereby data is stored and forwarded subsequently) and continuous (remote monitoring). In diabetes care, various forms of telemedicine services have been examined and include using mobile phones, texting, emails, e-health portals, videoconferencing as well as remote monitoring devices.

However, implementation of a telemedicine service in conventional care is a complex process. Studies have shown that while telemedicine can expand the boundaries of care to a larger population and offers person-centred care,[22] there are examples of patients' resistance to change.[23 24] Nevertheless, one of the major limitations of existing literature is the lack of studies which have examined the perspective of patients from a low and middle income country, where telemedicine is now increasingly being used. Earlier work on this topic have mostly focused on the views of physicians and fewer studies have at looked the patient's perspective.[25 26] In most of these studies, there was limited understanding on the drivers and barriers that were faced by patients using telemedicine; and have mostly focused on the telemedicine technology as well as utilization rates of telemedicine.[24 27] Furthermore, very little is known as to how empirically supported interventions can be transferred or implemented in resource-constraint countries, i.e., in most developing countries. Understanding the behaviors among various levels of stakeholders is an important component of successful implementation research.[28]

As patients' experience with telemedicine may be one of the reasons that will determine the success or failure of any intervention, we conducted a qualitative study to explore patients' views and experiences of telemedicine for diabetes management in Malaysia. The study focused on the end users' perspective in context which were necessary to ensure the successful delivery and implementation of a telemedicine program for diabetes.

Materials and Methods

Study design

The present qualitative study was part of a larger multi-centre cluster randomized controlled study, (IDEAS) conducted between April 2015 to June 2017, which aimed to examine the impact of a telemedicine program for people with type 2 diabetes (Box 1).[29] This nested study design allowed the investigators to explore the facilitators and barriers to using telemedicine, as well as participants' view if telemedicine was implemented in routine practice.

Participants

Participants were recruited from eleven primary care clinics located within the Klang Valley, which is part of the Malaysian Ministry of Health's primary care clinic network. These clinics serve the districts of Klang and Petaling, which provides care for approximately 2.56 million individuals and can be considered to be nationally representative of primary care clinics in Malaysia.

In line with the qualitative nature of our study, we adopted a non-probability sampling approach, in which sampling was not guided by the idea of random selection or statistical representativeness. Nevertheless, we aimed to cover as broad a spectrum of participants who had experience using telemedicine, as possible. As such, we invited participants who had completed the IDEAS study to participate in the current qualitative study. Briefly, participants included those who: 1) had been diagnosed with type 2 diabetes for at least 6 months; 2) aged between 18-75 years; 3) had regular access to the internet; 4) had HbA1c levels of between 7.5% and 11.0; and 5) were randomized into the intervention arm of the IDEAS study[29]. Participants were excluded if they had no experience in using any telemedicine devices or had dropped out of the IDEAS study. All potentially eligible participants were contacted by telephone and invited to participate in the qualitative study. Participants were briefed regarding the purpose, procedure and nature of the study and allowed to clarify their doubts. Separate information sheet and written informed consent were obtained prior to participation. To accommodate participants' schedules, all focus group interviews were conducted at the respective health clinics, when participants visited the clinics for their follow-up sessions with their physicians. In the event that a participant was not able to attend a focus group session, an individual in-depth interview was conducted at their own home. Study participants were incentivized with a RM50 (approximately USD$12) voucher for their participation.

Interview schedule

A semi-structured interview was used in all the focus groups, which was based on an interview guide. Table 1 outlines the topic areas and key questions which were used during the discussions. The topic guide aimed to capture the experiences of patients in using telemedicine and was developed based on relevant literature.[10 12 23]

The interviews which was facilitated by the first author (JYL) were conducted either in Malay or English language. The interviews usually lasted between 35 and 44 minutes in a private room in the clinic. All interview sessions were digitally recorded, transcribed verbatim immediately after each interview and checked for accuracy by SWHL. Interviews were conducted to explore for emerging themes with simultaneous analysis of data until data saturation was achieved, when no new themes or codes were identified.

Data analysis

The NVivo software version 11 (QSR International Pty Ltd) was used to organized and code the data for thematic analysis, using both an inductive and deductive approach.[30] All transcripts were read several times to familiarize with the data. Transcripts were translated from Malay language to English by an independent research assistant. The translated English transcripts were double checked by one of the authors (JYL) and any discrepancies were resolved via discussion with another of the authors (SWHL). Firstly, transcripts were coded into an initial set of themes based on keywords or phrases that appeared to convey an opinion or perception regarding telemedicine guided by themes identified previously from previous literature[10 12 23]. These initial codes were further examined and refined, with codes combined to be main themes if they had similar contexts or split into subthemes via an inductive process. The final codes were summarized, cross checked and iteratively refined using paired analysis of transcripts by two researchers (JYL and SWHL). In the event that there was a divergent interpretation, the transcripts were reviewed again and discussed until consensus was achieved.

Ethics

The study was approved by the Monash University Research Ethics Committee (CF14/1977 – 2014001016 & CF15/1073 - 2015000502) and the National Medical

Research Register (NMRR-14-177-19466 & NMRR-14-1368-22943). All participants provided written informed consent for participation in the research. This study was registered with ClinicalTrials.gov under the registration NCT0246680.

Patient and public involvement

The current study was designed to understand the patients' views, perception and experience of using telemedicine for type 2 diabetes management. Patients were not involved in the initial design of the study, development of interview questions or conduct of study. All participants who participated in this qualitative study were not provided with the results but were informed that the results will be published in a peer-reviewed journal.

Results

Demographics of participants

A total of 48 participants were interviewed in the 12 focus groups (average of 3-4 participants per group) and 2 interview sessions. The participants were mostly females (56.3%), with a mean age of 51.9 years, and a mean duration of diabetes of 5.6 years (Table 2). Four core themes emerged from the focus groups and the two in-depth interviews: (1) Generational difference (2) Independence and convenience, (3) Sharing of health data and privacy; and (4) Concerns and challenges

Theme 1 – Generational differences

Our data suggest that there were generational differences with regards to participants' preference on how to record their blood glucose reading. In general, older participants (those aged 50 years and above) preferred to record their glucose readings manually, using pen and paper. They felt that the telemonitoring device required a lot of technical knowledge and was a challenging and complex process for them. As narrated by the participants:

> "I (prefer to) manually record (my blood glucose readings). I do not understand (how to operate the mobile) telephone especially opening (the software). To me manual (recording) is easier." [Patient 4, 59/F]

> "But I am an old lady. I like it (blood glucose results) to be written (down). I'm old (and) I need to write (the results) down. Anyway, as long as someone

> shows me how to do it, I can do it. Of course (using telemedicine) is easier because you bring your hand phone everywhere you go.” [Patient 5, 57/F]

These participants felt that the use of telemedicine was more suitable for younger individuals with diabetes who were more technology savvy. As explained by one participant, “Maybe for the young ones . Technology (is) for youngsters (and) is more suitable since they like to sit at home and like the thing called Internet.” [Patient 41, 67/M]

Some participants also expressed their preference to meet their health care providers in person and reported that travelling to the clinic was not an onerous task.

> “I don't mind coming to the clinic and have a chat with the doctor. We (can) discuss (my medical condition) and sometimes we can ask questions and doctors can show (my problem to me) physically. For me to use the Internet is difficult to learn (as) my children are not here.” [Patient 6, 60/M]

Conversely, younger participants were more inclined to learn and use new technologies if sufficient training and guidance were given. Additionally, they were optimistic about using telemedicine to manage their conditions, as they knew the various benefits that technology would provide, including data tracking ability and convenience.

Theme 2 – Independence and convenience

Participants expressed that the use of a mobile phone which was connected to a glucometer was a convenient alternative for the management of diabetes. Participants viewed it was a more convenient option in the event of time constraint or when they had issues commuting to the clinic for their appointment. Participants also mentioned that having a telemonitoring device encouraged them to monitor their glucose levels regularly compared to the quarterly check-ups at the clinic. As expressed by participants

> "It's good to use especially over the Internet. It's so much easier we do not have to come to the clinic and can stay at home" [Patient 12, 60/M].

> "Digitals way (is the preferred choice). Everyday you can see (your blood glucose results) in the software so (there is) no need to record like manual. Sometimes even you record manual the paper will go wherever (or) missing. (Using) digital you have a backup." [Patient 8, 35/F]

> "I like this because you can transfer (your blood glucose results) directly to your phone. It's useful to me as an indication. I prefer (using technology so) that I can use it to check how my medicine affects my glucose. I think that this is the best tools because you can monitor by the Internet everywhere you go." [Patient 9, 44/M]

> "It's even more convenient since we do not have the time to come (to the clinic) and sometimes some people do not have transport." [Patient 10, 44/F]

Most participants were generally enthusiastic as they saw the potential benefits of telemedicine. Participants described how the use of a web-based glucometer was useful as it could provide them with reminders and alerts as well as the ability to connect with their healthcare providers without going to the clinic. Nevertheless, they expressed the desire and need to have more training and assistance, especially when they had not used the device for some time, since they would have forgotten the functions on the device.

> "For me it's not difficult … just need to teach (me) that's all. See the learning condition first (and perhaps I need more training), maybe need two or three times. I'm over fifty (years old) so (the) first time will be a problem ……need to teach a few times before I understand. First time might be difficult to understand" [Patient 7, 56/M].

Theme 3 – Sharing health data and privacy

Our analysis showed that there were conflicting perspectives with data sharing. Several participants expressed that they were willing to share their monitoring results with family members, as they felt that the family member would make them accountable for their diabetes management, which was a significant motivation for them to meet their daily goals.

> “The use of this what you call it (web-telemonitor)……… (I feel) my health is better since my family members (also) monitors (my) sugar levels as well” [Patient 11, 54/F].

> “The good part (of telemedicine is) you can do it at home. If (you check your blood glucose levels) at the clinic you get pricked (but) nobody knows (the results)… but when you do it at home you children will be informed as well” [Patient 5, 57/F].

Conversely, some participants expressed concern on the sharing of medical information with their family members, which they felt their personal space was infringed and could potentially lead to conflicts between family members.

> “That thing (Telemonitoring device) is okay (to use) but what I am afraid of is (that the use of telemonitoring may) sometimes (cause) conflicts because it feels like you are being monitored by others. But it is beneficial, at least there is somebody remind you” [Patient 1, 45/M].

Participants also expressed concern about the presence of malware in telemonitoring devices that could compromise their personal information.

> “(What happens when we have a) problem with the Internet (connection). Occasionally we (may) receive the reading, but occasionally (we will be) unable to (do so). (This can be) very inconvenient” [Patient 11, 54/F].

Some participants felt that meeting or contacting their health care providers was a simpler and faster way to solve their queries as the health care practitioner would be able to explain their clinical measures in a more concise manner. As explained by one participant “Face-to face (consultation) is more important (as) its better. (With) face-to face (consultation), information is clearer and more satisfying to me.” [Patient 2, 67F].

Theme 4 – Concerns and challenges

Participants in this study emphasized the importance of having a user-friendly technology. Most participants in this study reported minor technical difficulties especially with Internet connectivity and availability in rural areas, which limited their ability to utilize the telemonitoring device effectively. Participants also expressed concerns regarding the stability of Internet connection at their homes.

> “I think depending on the situation.. whether you live in a village where (I feel) it will be very difficult….. because (in) certain villages you don't have (Internet) line so you (will) still need have (to record the blood glucose results) manually” [Patient 8, 35/F].

Participants suggested the need to have a robust system which is user-friendly, with good technical support which they felt were essential to ensure the successful implementation of telemedicine.

> “Okay but what happens when there is a virus? It is a problem for one week my handphone “hang”. After one week it hangs (again)….that is a problem” [Patient 13, 54/F].

Another aspect which participants were worried of was the costs involved compared to conventional care and that telemonitoring would only be suitable for affluent patients.

> “All this (telemedicine) is for people who are wealthy. Of course this is a good system.” [Patient 14, 63/M]

Discussion

In our study, we present the conditions for the success of a telemonitoring health device for managing type 2 diabetes, from patients' perspective. We identified a set of distinctive but interrelated conditions which were and will be central to the success of such programs in the context of a developing country. Firstly, participants' demographics played a crucial factor in ensuring the acceptability of telemedicine. We noted that younger participants between the ages of 29 and 50 years old preferred using a web-based glucometer compared to older participants who preferred recording their results manually. Such outcome is not surprising as young individuals who grew up in this digital era were usually more technologically savvy compared to their older counterparts. Participants cited various reasons for being unable to use a web-based glucometer, including the lack of Internet connectivity especially in the rural areas. Indeed, concerns about the stability of Internet connections were the biggest barrier in using telemedicine in diabetes care in this study. The need for a simple, user friendly technology was also consistently highlighted, to encourage acceptability among participants to use a remote telemonitoring system.

As telemedicine technology is improving continuously, participants expressed enthusiasm on the potential added value of telemedicine. Most participants were willing to incorporate technology as part of their diabetes management, but expressed the need to have sufficient training and on-going support, especially when they encountered issues such as equipment limitations. Our study also identified the potential benefits which fueled participants' enthusiasm towards telemedicine. These include receiving alerts, being able to respond to SMBG readings with advice from a health care professional; as well as reducing opportunity cost incurred when using telemedicine. Our study also offers an additional perspective and insight into the importance of patient-provider relationship. Our results support previous research which indicated that personal interaction with a health care practitioner was an important aspect to support type 2 diabetes patients, especially when it involves SMBG.[14 31] This view was also expressed by most participants in the present study, and also that a lack of emotional support especially when communicating through remote telemonitoring resulted in participants dropping out of the study.

Our study also noted that not all participant perceived enhanced SMBG as a positive tool to help achieve good glycaemic control. Some participants in this study expressed reservation on the feedback and monitoring feature, which they felt intruded into their personal space. They also expressed some tension between achieving good glycaemic control and quality of life, especially with the involvement of health care providers and family members, who they felt were acting as the "police". As a result, some of these patients opted not to take part in the randomized controlled trial, for fear that this could further amplify the tension and strain in the relationship, an outcome which they definitely did not want. Findings of this study identified several issues which are salient in the literature. For example, our study like many others noted that patients were acceptable to telemedicine due to its ability to reduce travel time[32-34], increase self-awareness[35 36] and access to care[37 38]. However, our study also found several additional barriers that have never been reported in literature, such as the tensions between operational practicality versus patient's privacy and health security.

Our study offers several strength. By exploring the insights of patients, we illustrate how family values and technology literacy could influence participants' opinion on telemonitoring. Our study was also culturally specific to an Asian context and thus, we could gain an in-depth understanding and broader views of participants' behaviors when managing diabetes. There were some limitations to our study. Firstly, although we had included a diverse sample of participants and reached thematic saturation in our focus groups and in-depth interviews, these participants were only limited to one geographical location in Malaysia. Participants in this current study were recruited from suburban districts in Selangor where connectivity and technology literacy were moderate. Future studies should include patients from both urban as well as rural locations and those with high technology literacy, as this could potentially influence the uptake and acceptability of telemedicine. While published literature suggests that these trends are likely to be transferable to other regions in Malaysia, the context may differ in other countries and settings. The views expressed here are solely from the patients' point and does not represent the views of health care providers or policy makers. Finally, our results cannot draw definitive conclusion regarding differences in provider practices, patient knowledge as well as attitudes from different clinic sites other than those examined in this study.

Implications for practice

The continual improvements in technology will facilitate the use of telemedicine in the future. The largest implication will be its ability to reduce logistical barriers and the potential to save time. However, it is important that any telemedicine programs consider the economic standing and access to technology of patients, especially those living in rural areas, who may have limited internet connectivity. As such, health care professionals and policy makers need to take into consideration these aspects prior to introducing any telemedicine technology for their patients to ensure that patients' expectations are met. Another theme that emerged from this interview was the need to invest in capacity building, especially in human resource. Specifically, the creation of training programs, for both the general public as well as health care workers, are particularly important, especially among the non-IT savvy groups.

Conclusion

In conclusion, findings from this study indicate that the implementation of telemonitoring in diabetes management requires strategic planning with inputs from various stakeholders including, educators, health care providers, telco service providers and patients. The patient's personal and contextual factors, which could have a positive or negative effect on the uptake of the service should be taken into consideration. As such, health care providers need to discuss and consider patients' perspective to ensure the optimal use of telemedicine to improve patients' clinical parameters and quality of life.

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Author Disclosure Statement

The authors report no conflict of interest.

Author Contributions

All authors named contributed substantially to the document. JYL conducted and transcribed the interview, interpreted the results and wrote the draft manuscript. SWHL obtained the funding, designed the study and provided support in editing the manuscript. CKYC, SSC, TP, KKCL, NHN and CSST contributed to the study design and critical review of the manuscript. All authors approved the final version.

Data sharing statement

All data generated or analysed during this study are included in this published article. They can be made available from the corresponding author on reasonable request.

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Table 1: The interview guide topic areas and key questions

Topic area	**Key questions used in interviews**
Diabetes	• How would you describe your experience so far with diabetes? • How have you been coping with diabetes so far? Describe some of the ways you have been coping • Who and how much support do you have to cope with your conditions now • What are some of the most important treatment needs for a patient with diabetes
Telemedicine	• Describe and tell us your experience with using the web-enabled glucometer so far. • How do you think the system was able to affect your diabetes management? • How do you think other will accept this system? • What would you think are some areas where the system was good and where are the areas we can improve? • What do you think about using this system for the long term?

	What would be some of your concerns (if any) if this was to be used? How was your interaction with your healthcare professional with the device?

Table 2: Baseline demographics of participants who participated in the focus group

Patients (n= 48)	Men (n = 21)	Women (n = 27)
Age (years)	54.19	50.15
Range	29-62	31-69
Duration of diabetes (years)	4.06	6.88
Range	0.83-24	0.5-15
No. of oral hypoglycaemic agents used, n (%)		
1-2	18 (85)	27 (100)
≥3	1 (4)	0 (0)
No. of antihypertension drugs used, n (%)		
1-2	9 (42)	11 (40)
≥3	3 (14)	7 (25)
Insulin use, n (%)		
Yes	4 (19)	2 (7)
No	17 (81)	25 (93)

Data are expressed as mean, unless otherwise stated.

Box 1: IDEAS study

The Intervention for Diabetes with Education, Advancement and Support (IDEAS) study is a cluster randomized controlled study to evaluate the use of telemedicine to improve diabetes care. Participants in the telemedicine group were instructed to measure their blood glucose at least twice weekly (one fasting and one non-fasting) or more frequent as recommended by physician. These blood glucose readings will be transmitted via a Bluetooth technology to the participants' mobile phone to a remote secure server. Participants and their physicians were able to access the records on the server. Advice on lifestyle modification, any potential changes in medication, who and how to contact their healthcare providers were also given monthly during the study. A researcher also checked participants' results weekly and initiate intervention if needed (e.g. medication changes, counselling) with the consent of the attending physician.

Manuscript: Using telemedicine to support care for people with type 2 diabetes mellitus: A qualitative analysis of patient's perspective

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Developed from:

Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

No. Item	Guide questions/description	Reported on Page #
Domain 1: Research team and reflexivity		
Personal Characteristics		
1. Inter viewer/facilitator	Which author/s conducted the inter view or focus group?	9&10
2. Credentials	What were the researcher's credentials? E.g. PhD, MD	1
3. Occupation	What was their occupation at the time of the study?	1
4. Gender	Was the researcher male or female?	1
5. Experience and training	What experience or training did the researcher have?	9 & 10
Relationship with participants		
6. Relationship	Was a relationship established prior to study	10

established	commencement?	.
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	8
8. Interviewer characteristics	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	9

Domain 2: study design		
Theoretical framework		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	9-10
Participant selection		
10. Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	8
11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	8-9
12. Sample size	How many participants were in the study?	8
13. Non-participation	How many people refused to participate or dropped out? Reasons?	8
Setting		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	9
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	9
16. Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	9-10
Data collection		

17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Table 1
18. Repeat interviews	Were repeat inter views carried out? If yes, how many?	No
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	9-10
20. Field notes	Were field notes made during and/or after the inter view or focus group?	No
21. Duration	What was the duration of the inter views or focus group?	10
22. Data saturation	Was data saturation discussed?	10
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No
Domain 3: analysis and findings		
Data analysis		
24. Number of data coders	How many data coders coded the data?	11
25. Description of the coding tree	Did authors provide a description of the coding tree?	11
26. Derivation of themes	Were themes identified in advance or derived from the data?	No
27. Software	What software, if applicable, was used to manage the data?	11
28. Participant checking	Did participants provide feedback on the findings?	12
Reporting		

29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Yes. 13-19
30. Data and findings consistent	Was there consistency between the data presented and the findings?	20-23
31. Clarity of major themes	Were major themes clearly presented in the findings?	Yes. they were. 13-23
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Discussion of major and minor themes 20-22

Standards for Reporting Qualitative Research (SRQR)*

http://www.equator-network.org/reporting-guidelines/srqr/

Title and abstract

	Page/line no(s).
Title - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	1
Abstract - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	3-4

Introduction

Problem formulation - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	6-7
Purpose or research question - Purpose of the study and specific objectives or questions	8

Methods

Qualitative approach and research paradigm - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale**	10
Researcher characteristics and reflexivity - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	10
Context - Setting/site and salient contextual factors; rationale**	9
Sampling strategy - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**	9
Ethical issues pertaining to human subjects - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	11
Data collection methods - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**	9-10

Data collection instruments and technologies - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	10-11 & Table 1
Units of study - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	12
Data processing - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	10
Data analysis - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale**	11
Techniques to enhance trustworthiness - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale**	11

Results/findings

Synthesis and interpretation - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	13-19
Links to empirical data - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	13-19

Discussion

Integration with prior work, implications, transferability, and contribution(s) to the field - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	20-22
Limitations - Trustworthiness and limitations of findings	22

Other

Conflicts of interest - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	25
Funding - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	25

*The authors created the SRQR by searching the literature to identify guidelines, reporting standards, and critical appraisal criteria for qualitative research; reviewing the reference lists of retrieved sources; and contacting experts to gain feedback. The SRQR aims to improve the transparency of all aspects of qualitative research by providing clear standards for reporting qualitative research.

**The rationale should briefly discuss the justification for choosing that theory, approach, method, or technique rather than other options available, the assumptions and limitations implicit in those choices, and how those choices influence study conclusions and transferability. As appropriate, the rationale for several items might be discussed together.

Reference:

O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. **Standards for reporting qualitative research: a synthesis of recommendations.** *Academic Medicine*, Vol. 89, No. 9 / Sept 2014
DOI: 10.1097/ACM.0000000000000388

BMJ Open

Using telemedicine to support care for people with type 2 diabetes mellitus: A qualitative analysis of patient's perspective

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Using telemedicine to support care for people with type 2 diabetes mellitus: A qualitative analysis of patient's perspective

Short running title: Patient's perspective of telemedicine

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Abstract

Objective: Telemedicine has been promoted as an economical and effective way to enhance patient care but its acceptability among patients in low and middle income countries is poorly understood. This study aimed to explore the experiences and perspectives of people with type 2 diabetes mellitus who used telemedicine to manage their condition.

Design: We conducted in-depth and focus group interviews with participants who used telemedicine. Questions included participants' perception on program use, satisfaction as well as engagement with the telemedicine program. All interviews and focus groups were audio-recorded and transcribed verbatim. Data were analyzed using a thematic approach.

Participants and setting: People with type 2 diabetes (*n*=48) who participated in a randomized controlled study which examined the using telemedicine for diabetes management.

Results: Twelve focus groups and two in-depth interviews were conducted. Four themes emerged from the analysis: (1) Generational difference; (2) Independence and convenience, (3) Sharing of health data and privacy; and (4) Concerns and challenges. The main barriers to using telemedicine were related to the user friendliness of the devices as well as internet connectivity. Cost was also another significant concern raised by participants. However, participants were generally positive about the benefits of telemedicine, including its ability to provide real time data and disease monitoring and the reduction in clinic visits.

Conclusion: Despite the potential positive benefits of using telemedicine for diabetes care, several barriers could inhibit the sustained and effective use of this technology.

As such, collaboration between educators, health care providers, telecommunication service providers and patients is required to stimulate telemedicine adoption and use.

Strengths and limitations of this study

- Article followed the Standards for reporting qualitative Research (SRQR) recommendations on reporting
- Focus group discussion allowed the exchange of opinions about telemedicine, leading to richer information
- View and experiences of using telemedicine were captured from patients rather than that of healthcare providers
- The study was conducted in an urban setting in Malaysia and its applicability and transferability to other population remain unknown.

Introduction

Diabetes is a major health concern worldwide, and according to a recent report by the International Diabetes Federation, the global prevalence of diabetes will increase from 415 million in 2015 to 642 million in 2040.[1] The prevalence varies considerably between different regions, but the epicenter of the diabetes crisis is currently located in the Western Pacific and South-East Asia region, with 159 million and 82 million individuals with diabetes respectively.[2] In many individuals with diabetes, self-monitoring of blood glucose (SMBG) is considered as a key component of treatment, and widely recommended by clinical practice guidelines, irrespective of treatment strategy. [3-7] SMBG is often used as an early warning sign for detecting hypoglycaemia, for improving the recognition of severe hyperglycaemia, to encourage physical activities as well as improve diet control. The data are also used by the treating physicians to facilitate an individualized treatment regimen.

Despite these potential benefits, there is controversy on the efficacy of SMBG, especially in non-insulin dependent type 2 diabetes, due to its cost, uncertainty on frequency of testing as well as impact on patients general health and well-being.[8-10] Studies have shown that the use of enhanced SMBG (where there are high levels of engagement between patients and clinicians to interpret the SMBG values) has resulted in larger reduction in HbA1c compared to regular SMBG.[4 11-13]

The application of telemedicine, or technology to deliver various aspects of health information, prevention, monitoring and medical care in diabetes management has been suggested as an innovative solution to improve diabetes care.[14-16] Increasingly,

telemedicine is being viewed as a promising technology to assist patients in managing diabetes,[15 17 18] as it produces accurate and reliable data[19], empowers patients[14], improves glycaemic control and influences their attitude and behaviours[18 20], potentially leading to a better quality of life.[21] These telemedicine services can be categorized to either synchronous (real-time), asynchronous (whereby data is stored and forwarded subsequently) and continuous (remote monitoring). In diabetes care, various forms of telemedicine services have been examined and include the use of mobile phones, texting, emails, e-health portals, videoconferencing as well as remote monitoring devices.

However, implementation of a telemedicine service in conventional care is a complex process. While evidence has shown that telemedicine can expand the boundaries of care to a larger population and offers person-centred care,[22] examples of patients' resistance to change exist.[23 24] Nevertheless, one of the major limitations of existing literature is the lack of studies which have examined the perspective of patients from a low and middle income country, where telemedicine is now increasingly being used. Earlier work on this topic have mostly focused on the views of physicians and few studies have explored the patient's perspective.[25 26] There was a limited understanding on the drivers and barriers faced by patients using telemedicine; and most of these studies have focused on the telemedicine technology as well as utilization rates of telemedicine instead.[24 27] Furthermore, very little is known as to how empirically supported interventions can be transferred or implemented in resource-constraint countries, i.e., in most developing countries. Understanding the behaviours among various levels of stakeholders is an important component of successful implementation research.[28]

As patients' experience with telemedicine may be one of the reasons that will determine the success or failure of any intervention, we conducted a qualitative study to explore patients' views and experiences of telemedicine for diabetes management in Malaysia. The study focused on the end users' perspective in context which were necessary to ensure the successful delivery and implementation of a telemedicine program for diabetes.

Materials and Methods

Study design

The present qualitative study was part of a larger multi-centre cluster randomized controlled study (IDEAS) conducted between April 2015 and June 2017, which aimed to examine the impact of a telemedicine program for people with type 2 diabetes (Box 1).[29 30] This nested study design allowed the investigators to explore the facilitators and barriers to using telemedicine, as well as participants' view if telemedicine was implemented in routine practice.

Participants

Participants were recruited from eleven primary care clinics located within the Klang Valley, which is part of the Malaysian Ministry of Health's primary care clinic network. These clinics serve the districts of Klang and Petaling, which provides care for approximately 2.56 million individuals and can be considered to be nationally representative of primary care clinics in Malaysia.

In line with the qualitative nature of our study, we adopted a non-probability sampling approach, in which sampling was not guided by the idea of random selection or statistical representativeness. Nevertheless, we aimed to cover as broad a spectrum of participants who had experience using telemedicine, as possible. As such, we invited participants who had completed the IDEAS study to participate in the current qualitative study. Briefly, participants included those who: 1) had been diagnosed with type 2 diabetes for at least 6 months; 2) aged between 18-75 years; 3) had regular access to the Internet; 4) had HbA1c levels between 7.5% and 11.0%; and 5) were randomized into the intervention arm of the IDEAS study[29 30]. Participants were excluded if they had no experience in using any telemedicine devices or had dropped out of the IDEAS study. All potentially eligible participants were contacted by telephone and invited to participate in the study. Participants were briefed regarding the purpose, procedure and voluntary nature of the study and allowed to clarify their doubts. Separate information sheet and written informed consent were obtained prior to participation. To accommodate participants' schedules, all focus group interviews were conducted at the respective health clinics, when participants visited the clinics for their follow-up sessions with their physicians. In the event that a participant was not able to attend a focus group session, an individual in-depth interview was conducted at their own home. Study participants were incentivized with a RM50 (approximately USD$12) voucher for their participation.

Interview schedule

A semi-structured interview was used in all the focus groups, which was based upon an interview guide. Table 1 outlines the topic areas and key questions which were used during the discussions. The topic guide aimed to capture the experiences of patients in using telemedicine and was developed based on relevant literature.[10 12 23]

The interviews were facilitated by the first author (JYL) and conducted either in Malay or English language. Each interview lasted between 35 and 44 minutes in a private room in the clinic. All interview sessions were digitally recorded, transcribed verbatim immediately after each interview and checked for accuracy by SWHL. Interviews were conducted to explore for emerging themes with simultaneous analysis of data until data saturation was achieved, when no new themes or codes were identified.

Data analysis

The NVivo software version 11 (QSR International Pty Ltd) was used to organize and code the data for thematic analysis, using both an inductive and deductive approach.[31] All transcripts were read several times to familiarize with the data. Transcripts were translated from Malay language to English by an independent research assistant. The translated English transcripts were double checked by the first author (JYL) and any discrepancies were resolved via discussion with another author (SWHL). Firstly, transcripts were coded into an initial set of themes based on keywords or phrases that appeared to convey an opinion or perception regarding telemedicine guided by themes identified from previous literature[10 12 23]. These initial codes were further examined and refined, with codes combined to be main themes if they had similar contexts or split into subthemes via an inductive process. The final codes were summarized, cross checked and iteratively refined using paired analysis of transcripts by two researchers (JYL and SWHL). In the event that there was a divergent interpretation, the transcripts were reviewed again and discussed until consensus was achieved.

Ethics

The study was approved by the Monash University Research Ethics Committee (CF14/1977 – 2014001016 & CF15/1073 - 2015000502) and the National Medical Research Register (NMRR-14-177-19466 & NMRR-14-1368-22943). All participants provided written informed consent for participation in the research. This study was registered with ClinicalTrials.gov under the registration NCT0246680.

Patient and public involvement

The current study was designed to understand patients views, perception and experience of using telemedicine for type 2 diabetes management. Patients were not involved in the initial design of the study, development of interview questions or conduct of the study. All participants who participated in this qualitative study were not provided with the results but were informed that the results will be published in a peer-reviewed journal.

Results

Demographics of participants

A total of 48 participants were interviewed in the 12 focus group and 2 interview sessions. Each focus group had an average of between 3-4 participants, as we had difficulty arranging for larger groups due to different timing of clinic visits. The participants were mostly females (56.3%), with a mean age of 51.9 years, and have had diabetes for 5.6 years on average (Table 2). Four core themes emerged from the focus groups and the two in-depth interviews: (1) Generational difference (2) Independence and convenience, (3) Sharing of health data and privacy; and (4) Concerns and challenges.

Theme 1 – Generational differences

Our data suggest that there were generational differences with regards to participants' preference on how to record their blood glucose reading. Generally, older participants in this study (those aged 50 years and above) preferred to record their glucose readings manually, using pen and paper. They felt that the telemonitoring device required a lot of technical knowledge and was a challenging and complex process for them. As narrated by the participants:

> "I (prefer to) manually record (my blood glucose readings). I do not understand (how to operate the mobile) telephone especially operating (the software). To me manual (recording) is easier." [Patient 4, 59/F]

> "But I am an old lady. I like it (blood glucose results) to be written (down). I'm old (and) I need to write (the results) down. Anyway, as long as someone shows me how to do it, I can do it. Of course (using telemedicine) is easier because you bring your hand phone everywhere you go." [Patient 5, 57/F]

These participants felt that the use of telemedicine was more suited for younger individuals with diabetes who were more technology savvy. As explained by one participant, "Maybe for the young ones. Technology (is) for youngsters (and) is more suitable since they like to sit at home and like the thing called Internet." [Patient 41, 67/M]

Some participants also expressed their preference to meet their health care providers in person and reported that travelling to the clinic was not an onerous task.

> "I don't mind coming to the clinic and have a chat with the doctor. We (can) discuss (my medical condition) and sometimes we can ask questions and doctors can show (my problem to me) physically. For me to use the Internet is difficult to learn (as) my children are not here." [Patient 6, 60/M]

Conversely, younger participants were more inclined to learn and use new technologies if sufficient training and guidance were given. Additionally, they were optimistic about using telemedicine to manage their conditions, as they knew the various benefits that technology would provide, including data tracking ability and convenience.

Theme 2 – Independence and convenience

Participants expressed that the use of a mobile phone which was connected to a glucometer was a convenient alternative to manage diabetes. Participants viewed it as a more convenient option in the event of time constraint or when they had issues commuting to the clinic for their appointment. Participants also mentioned that having a telemonitoring device encouraged them to monitor their glucose levels regularly compared to the quarterly check-ups at the clinic. As expressed by participants:

> “It’s good to use especially over the Internet. It’s so much easier we do not have to come to the clinic and can stay at home” [Patient 12, 60/M].

> “Digitals way (is the preferred choice). Everyday you can see (your blood glucose results) in the software so (there is) no need to record like manual. Sometimes even you record manual the paper will go wherever (or) missing. (Using) digital you have a backup.” [Patient 8, 35/F]

> “I like this because you can transfer (your blood glucose results) directly to your phone. It’s useful to me as an indication. I prefer (using technology so) that I can use it to check how my medicine affects my glucose. I think that this is the best tools because you can monitor by the Internet everywhere you go.” [Patient 9, 44/M]

> "It's even more convenient since we do not have the time to come (to the clinic) and sometimes some people do not have transport." [Patient 10, 44/F]

Most participants were generally enthusiastic as they saw the potential benefits of telemedicine. Participants described how the use of a web-based glucometer was useful as it could provide them with reminders and alerts as well as the ability to connect with their healthcare providers without going to the clinic. Nevertheless, they expressed the desire and need to have more training and assistance, especially when they had not used the device for some time, since they would have forgotten the functions on the device.

> "For me it's not difficult … just need to teach (me) that's all. See the learning condition first (and perhaps I need more training), maybe need two or three times. I'm over fifty (years old) so (the) first time will be a problem ……need to teach a few times before I understand. First time might be difficult to understand" [Patient 7, 56/M].

Theme 3 – Sharing health data and privacy

Our analysis showed that there were conflicting perspectives with data sharing. Several participants expressed that they were willing to share their monitoring results with family members, as they felt that the family member would make them accountable for their diabetes management, which was a significant motivation for them to meet their daily goals.

> "The use of this what you call it (web-telemonitor)……… (I feel) my health is better since my family members (also) monitor (my) sugar levels as well" [Patient 11, 54/F].

> "The good part (of telemedicine is) you can do it at home. If (you check your blood glucose levels) at the clinic you get pricked (but) nobody knows (the results)… but when you do it at home you children will be informed as well" [Patient 5, 57/F].

Conversely, some participants expressed concern on the sharing of medical information with their family members, which they felt their personal space was infringed and could potentially lead to conflicts between family members.

> "That thing (Telemonitoring device) is okay (to use) but what I am afraid of is (that the use of telemonitoring may) sometimes (cause) conflicts because it feels like you are being monitored by others. But it is beneficial, at least there is somebody remind you" [Patient 1, 45/M].

Participants also expressed concern about the presence of malware in telemonitoring devices that could compromise their personal information.

> “(What happens when we have a) problem with the Internet (connection). Occasionally we (may) receive the reading, but occasionally (we will be) unable to (do so). (This can be) very inconvenient” [Patient 11, 54/F].

Some participants felt that meeting or contacting their health care providers was a simpler and faster way to solve their queries as the health care practitioner would be able to explain their clinical measures in a more concise manner. As explained by one participant “Face-to face (consultation) is more important (as) its better. (With) face-to face (consultation), information is clearer and more satisfying to me.” [Patient 2, 67F].

Theme 4 – Concerns and challenges

Participants in this study emphasized the importance of having a user-friendly technology. Most participants in this study reported minor technical difficulties especially with Internet connectivity and availability in rural areas, which limited their ability to utilize the telemonitoring device effectively. Participants also expressed concerns regarding the stability of Internet connection at their homes.

> “I think depending on the situation.. whether you live in a village where (I feel) it will be very difficult….. because (in) certain villages you don't have (Internet) line so you (will) still need have (to record the blood glucose results) manually” [Patient 8, 35/F].

Participants suggested the need to have a robust system which is user-friendly, with good technical support which they felt were essential to ensure the successful implementation of telemedicine.

> “Okay but what happens when there is a virus? It is a problem for one week my handphone “hang”. After one week it hangs (again)….that is a problem” [Patient 13, 54/F].

Another aspect which participants were worried of was the costs involved compared to conventional care and that telemonitoring would only be suitable for affluent patients.

> “All this (telemedicine) is for people who are wealthy. Of course this is a good system.” [Patient 14, 63/M]

Discussion

In our study, we present the conditions for the success of a telemonitoring health device for the management of managing type 2 diabetes, from the perspective of patients. We identified a set of distinctive but interrelated conditions which were and would be central to the success of such programs in the context of a developing country. Firstly, participants' demographic characteristics were crucial factors in ensuring the acceptability of telemedicine. We noted that younger participants between the ages of 29 and 50 years old preferred to use a web-based glucometer compared to older participants who preferred to record their results manually. Such outcome is not surprising, as younger individuals who grew up in this digital era were usually more technologically savvy compared to their older counterparts. This was noted in the IDEAS study where the average SMBG uploads were only 1 reading a week instead of the recommended 6 readings a week in the study.[30] Participants cited various reasons for being not being able to use a web-based glucometer. This included the lack of Internet connectivity especially in the rural areas. Concerns about the stability of Internet connections were the main barrier in using telemedicine in the management of diabetes in this study. The need for a simple, user friendly technology was also consistently highlighted, to encourage acceptability among participants on the use of a remote telemonitoring system.

As technology continues to advance, participants expressed enthusiasm on the potential added value of telemedicine. Potential benefits which ignited participants' enthusiasm towards telemedicine included the ability to receive alerts, access to SMBG readings with advice from a health care professional; as well as reduced opportunity cost incurred. Most participants were willing to incorporate technology as part of their diabetes management, but only if they were confident in using the device or if they can seek help and support easily. Our study also offers an additional perspective and insight into the importance of patient-provider relationship. Our results support previous research which indicated that personal interaction with health care practitioners was important to support people with type 2 diabetes, especially when it involved SMBG.[14 32] These views were also expressed by most participants in the present study, and the lack of emotional support especially when communicating through remote telemonitoring led to participants dropping out of the study.

Living with diabetes can be difficult, especially with the need to comply with a demanding and often confusing set of self-care directives. Many individuals encounter diabetes-related conflict with family members, which results in strained relationships. As noted in this study, some participants expressed reservation on the feedback and monitoring features of the telemonitoring device, as they felt that the device intruded into their personal space, as well as gave them the feeling of being “watched”. Consequently, some patients opted not to participate in the IDEAS[29] randomized controlled trial. Findings of this study identified several issues which are salient in the literature. For example, like many others noted that patients accepted telemedicine due to its ability to reduce travel time[33-35], increase self-awareness[36 37] and increase access to care[38 39].

The present study also found several additional barriers that have not been reported in literature, such as tension between operational practicality versus patient’s privacy and health security. As privacy and security risk may undermine the potential of telemedicine, it is important that software developers consider this aspect as information security is crucial to support a trusting relationship between patients and providers. Therefore, collaboration with researchers in the field of security, especially those specializing in network security and cryptography.

Our study offers several strengths. By exploring the insights of patients, we illustrate how family values and technology literacy could influence participants' opinion on telemonitoring. This method also allowed us to gain an in-depth understanding and broader views of participants' behaviours when managing diabetes. Our study was also culturally specific to an Asian context. There were some limitations to our study. Firstly, although we had included a diverse sample of participants and reached thematic saturation in our focus groups and in-depth interviews, these participants were only limited to one geographical location in Malaysia. Participants in this current study were recruited from suburban districts in Selangor where connectivity and technology literacy were moderate. Future studies should include patients from both urban as well as rural locations and among participants with high technology literacy, as this could potentially influence the uptake and acceptability of telemedicine. While published literature suggests that these trends are likely to be transferable to other regions in Malaysia, the context may differ in other countries and settings. The views expressed here are solely from the patients' point and does not represent the views of health care providers or policy makers. Finally, our results cannot draw definitive conclusion regarding differences in provider practices, patient knowledge as well as attitudes from different clinic sites other than those examined in this study.

Implications for practice

The continual development and improvement in technology will facilitate the use of telemedicine in the future. The largest potential of telemedicine will be its ability to reduce logistical barriers and hence saves time. However, before any telemedicine programs are introduced, there is a need to consider the economic standing of patients and their access to technology. Those living in rural areas may have limited internet connectivity and hence efforts must be made to ensure that the expectations of patients are met. In addition, there is also a need to invest in capacity building, especially in human resource. Specifically, the creation of training programs on the functionalities of telemedicine for both the general public as well as health care workers, are particularly important, especially among the non-IT savvy groups.

Conclusion

Findings from this study indicate that the implementation of telemonitoring in diabetes management requires strategic planning with inputs from various stakeholders including, educators, health care providers, telco service providers and patients. The patient's personal and contextual factors, which could have a positive or negative effect on the uptake of the service should be taken into consideration. As such, health care providers need to discuss and consider the perspective of patients to ensure the optimal use of telemedicine to improve patients clinical parameters and quality of life.

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Author Disclosure Statement

The authors report no conflict of interest.

Author Contributions

All authors named contributed substantially to the document. JYL conducted and transcribed the interview, interpreted the results and wrote the draft manuscript. SWHL obtained the funding, designed the study and provided support in editing the manuscript. CKYC, SSC, TP, KKCL, NHN and CSST contributed to the study design and critical review of the manuscript. All authors approved the final version.

Data sharing statement

All data generated or analyzed during this study are included in this published article. They can be made available from the corresponding author on reasonable request.

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Table 1: The interview guide topic areas and key questions

Topic area	Key questions used in interviews
Diabetes	• How would you describe your experience so far with diabetes? • How have you been coping with diabetes so far? Describe some of the ways you have been coping • Who and how much support do you have to cope with your conditions now • What are some of the most important treatment needs for a patient with diabetes
Telemedicine	• Describe and tell us your experience with using the web-enabled glucometer so far. • How do you think the system was able to affect your diabetes management? • How do you think other will accept this system? • What would you think are some areas where the system was good and where are the areas we can improve? • What do you think about using this system for the long term?

	- What would be some of your concerns (if any) if this was to be used? - How was your interaction with your healthcare professional with the device?

Table 2: Baseline demographics of participants who participated in the focus group

Patients (n= 48)	Men (n = 21)	Women (n = 27)
Age (years)	54.19	50.15
Range	29-62	31-69
Duration of diabetes (years)	4.06	6.88
Range	0.83-24	0.5-15
No. of oral hypoglycaemic agents used, n (%)		
1-2	18 (85)	27 (100)
≥3	1 (4)	0 (0)
No. of antihypertension drugs used, n (%)		
1-2	9 (42)	11 (40)
≥3	3 (14)	7 (25)
Insulin use, n (%)		
Yes	4 (19)	2 (7)
No	17 (81)	25 (93)

Data are expressed as mean, unless otherwise stated.

Box 1: IDEAS study

The Intervention for Diabetes with Education, Advancement and Support (IDEAS) study is a cluster randomized controlled study to evaluate the use of telemedicine to improve diabetes care. Participants in the telemedicine group were instructed to measure their blood glucose at least twice weekly (one fasting and one non-fasting) or more frequent as recommended by physician. These blood glucose readings will be transmitted via a Bluetooth technology to the participants' mobile phone to a remote secure server. Participants and their physicians were able to access the records on the server. Advice on lifestyle modification, any potential changes in medication, who and how to contact their healthcare providers were also given monthly during the study. A researcher also checked participants' results weekly and initiate intervention if needed (e.g. medication changes, counselling) with the consent of the attending physician.

Standards for Reporting Qualitative Research (SRQR)*

http://www.equator-network.org/reporting-guidelines/srqr/

Page/line no(s).

Title and abstract

Title - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	1
Abstract - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	3-4

Introduction

Problem formulation - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	6-7
Purpose or research question - Purpose of the study and specific objectives or questions	8

Methods

Qualitative approach and research paradigm - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale**	10
Researcher characteristics and reflexivity - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	10
Context - Setting/site and salient contextual factors; rationale**	9
Sampling strategy - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**	9
Ethical issues pertaining to human subjects - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	11
Data collection methods - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**	9-10

Data collection instruments and technologies - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	10-11 & Table 1
Units of study - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	12
Data processing - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	10
Data analysis - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale**	11
Techniques to enhance trustworthiness - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale**	11

Results/findings

Synthesis and interpretation - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	13-19
Links to empirical data - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	13-19

Discussion

Integration with prior work, implications, transferability, and contribution(s) to the field - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	20-22
Limitations - Trustworthiness and limitations of findings	22

Other

Conflicts of interest - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	25
Funding - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	25

*The authors created the SRQR by searching the literature to identify guidelines, reporting standards, and critical appraisal criteria for qualitative research; reviewing the reference lists of retrieved sources; and contacting experts to gain feedback. The SRQR aims to improve the transparency of all aspects of qualitative research by providing clear standards for reporting qualitative research.

**The rationale should briefly discuss the justification for choosing that theory, approach, method, or technique rather than other options available, the assumptions and limitations implicit in those choices, and how those choices influence study conclusions and transferability. As appropriate, the rationale for several items might be discussed together.

Reference:

O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. **Standards for reporting qualitative research: a synthesis of recommendations.** *Academic Medicine*, Vol. 89, No. 9 / Sept 2014
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Using telemedicine to support care for people with type 2 diabetes mellitus: A qualitative analysis of patients' perspectives

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Using telemedicine to support care for people with type 2 diabetes mellitus: A qualitative analysis of patients' perspectives.

Short running title: Patients’ perspective of telemedicine

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Abstract

Objective: Telemedicine has been promoted as an economical and effective way to enhance patient care, but its acceptance among patients in low and middle income countries is poorly understood. This study is aimed to explore the experiences and perspectives of people with type 2 diabetes mellitus that used telemedicine to manage their condition.

Design: In-depth and focus group interviews were conducted with participants who have engaged in telemedicine. Questions included were participants' perception on the programme being used, satisfaction as well as engagement with the telemedicine programme. All interviews and focus groups were audio-recorded and transcribed verbatim. Data were analyzed using a thematic approach.

Participants and setting: People with type 2 diabetes (*n*=48) who participated in a randomized controlled study which examined the use of telemedicine for diabetes management were recruited from eleven primary care clinics located within the Klang Valley.

Results: Twelve focus groups and two in-depth interviews were conducted. Four themes emerged from the analysis: (1) Generational difference; (2) Independence and convenience, (3) Sharing of health data and privacy; and (4) Concerns and challenges. The main obstacles found in patients using the telemedicine systems were related to to internet connectivity and difficulties experienced with system interface. Cost was also another significant concern raised by participants. Participants in this study were primarily positive about the benefits of telemedicine, including its ability to provide real time data and disease monitoring and the reduction in clinic visits.

Conclusion: Despite the potential benefits of telemedicine in the long term care of diabetes, there are several perceived barriers that may limit the effectiveness of this technology. As such, collaboration between educators, health care providers, telecommunication service providers and patients are required to stimulate the adoption and the use of telemedicine.

Strengths and limitations of this study

- The study followed the Standards for Reporting Qualitative Research (SRQR) recommendations
- Focus group discussion allowed for the exchange of opinions relating to the use of telemedicine
- The views and experiences with telemedicine were documented from the patients' perspectives instead of the healthcare providers' perspective
- The study was conducted in an urban setting in Malaysia. The implications related to other populations is unknown.

Introduction

Diabetes is a major health concern worldwide with a global prevalence of 415 million in 2015 rising to 642 million in 2040.[1] The prevalence of diabetes varies considerably between different global regions, but the epicentre of the disease is currently in the Western Pacific and South-East Asia regions, with 159 million and 82 million individuals with diabetes respectively.[2] Self-monitoring of blood glucose (SMBG) is considered to be a key component in the treatment of diabetes, and is widely recommended in clinical practice guidelines, irrespective of subsequent treatment strategy.[3-7] SMBG is often used as an early indicator for detecting hypoglycaemia, monitoring severe hyperglycaemia and encouraging physical activity as well as improving diet control. The long term individualised patient data are often used to inform treatment regimens.[8]

Despite these potential benefits, there is controversy regarding the efficacy of SMBG, especially in non-insulin dependent type 2 diabetes, due to its cost, uncertainty with frequency of testing as well as the impact on patient's general health and well-being.[9-11] Studies have shown that the use of enhanced SMBG (where there are high levels of engagement between patients and clinicians when interpreting a patient's SMBG values) has resulted in better maintenance of glycated haemoglobin (HbA1c) levels when compared to regular SMBG.[4 12-14]

The application of telemedicine in delivering various aspects of health information, from the information on the prevention of disease, to the monitoring of medical conditions as well as regular medical care for diabetes management has been suggested as an innovative solution to improve diabetic patient care.[15-17] Telemedicine is being viewed as a useful tool to assist patients in managing diabetes,[16 18 19] as it facilitates the communication of accurate and reliable data[20] between patients and their healthcare providers. It also empowers patients[15] attitude and behavior[19 21] towards a healthier lifestyle while providing them with an outlook for better glycaemic control.[22] These telemedicine services can be categorized into either synchronous (real-time), asynchronous (whereby data is stored and forwarded subsequently) and continuous (remote monitoring). In diabetes care, various forms of telemedicine services have been examined. These include the use of mobile phones, text messages, email, e-health portals, videoconferences as well as remote monitoring devices.

Implementation of a telemedicine service in conventional care is a complex process. While evidence has shown that telemedicine may expand the boundaries of healthcare to a larger population and may offer person-centred care,[23] there are still examples where patients' resist these changes.[24 25] One of the major limitations of existing literature is the lack of studies which have examined the perspectives of patients in low to middle income countries such as Malaysia, where telemedicine is now being used. Earlier published work on this topic has focused primarily on the views of physicians rather than the patient's perspective.[26 27] There was a limited understanding of the key factors faced by patients using telemedicine as most of these studies have focused primarily on its utilization rates.[25 28] Furthermore, very little is known as to how empirically supported interventions can be transferred or implemented in resource-constrained countries, i.e., in most developing countries.

Understanding the behaviour among various levels of stakeholders is an important component of successful implementation research.[29]

As patients' experience with telemedicine may be a major reason in determining the uptake of this system, we conducted a qualitative study to explore patients' views and experiences of telemedicine for diabetes management in Malaysia. The study focused on the patient's ' perspective in context which was necessary to ensure the successful delivery and implementation of a telemedicine programme for diabetes.

Materials and Methods

Study design

The present qualitative study was part of a larger multi-centre cluster randomized controlled study (IDEAS) conducted between April 2015 and June 2017, which examined the impact of a telemedicine programme for people with type 2 diabetes (Box 1).[30 31] This nested study design allowed the investigators to explore the perceived obstacles and incentives patients experienced when using telemedicine in the management of their type 2 diabetes.

Participants and Setting

Participants were recruited from 11 primary care clinics located within the Klang Valley, which is part of the Malaysian Ministry of Health's primary care clinic network. These clinics serve the districts of Klang and Petaling, which provide care for approximately 2.56 million individuals. These individuals are considered to be representative of primary care clinics in Malaysia.

This qualitative study adopted a non-probability sampling method, where sampling was not guided by the idea of random selection or statistical representation. Nevertheless, we aimed to cover as broad a spectrum of participants who had experienced using telemedicine. We invited participants who had completed the IDEAS study to participate in the current qualitative study. Participants included those who: 1) had been diagnosed with type 2 diabetes for at least 6 months; 2) aged between 18-75 years; 3) had regular access to the Internet; 4) had HbA1c levels between 7.5% and 11.0%; and 5) were randomized into the intervention arm of the IDEAS study[30 31]. Participants were excluded if they had no experience in using telemedicine devices or had dropped out of the IDEAS study[31]. All potentially eligible participants were contacted by telephone and invited to participate in the study. Participants were briefed on the purpose, procedure and voluntary nature of the study and were allowed to clarify their concerns. A separate information sheet was given to the participants and written informed consent was obtained prior to the start of the study. To accommodate participants' schedules, all focus group interviews were conducted when participants visited the clinics for their follow-up sessions (at weeks 4,12,24 or 48) with their physicians. In the event a participant was not able to attend a focus group session, an individual in-depth interview was conducted at their home. Study participants were given a RM50 (approximately USD$12) voucher for their participation.

Interview schedule

A semi-structured interview was used in all the focus groups, and this was based on the topic areas and key questions outlined in Table 1. The topic guide aimed to capture the experiences of patients in using telemedicine and was developed based on relevant literature.[11 13 24]

The interviews were facilitated by the first author (JYL) and conducted either in Malay or English. Each interview lasted between 35 and 44 minutes in a private room in the clinic. All interview sessions were digitally recorded, transcribed verbatim immediately after each interview and checked for accuracy by SWHL. Interviews were conducted to explore for emerging themes with simultaneous analysis of data until data saturation was achieved, when no new themes or codes were identified.

Data analysis

The NVivo software version 11 (QSR International Pty Ltd) was used to organize and code the data for thematic analysis, using both an inductive and deductive approach.[32] All transcripts were read several times to familiarize with the data. Transcripts were translated from Malay language to English by an independent research assistant. The translated English transcripts were double checked by the first author (JYL) and any discrepancies were resolved via discussion with another author (SWHL). Firstly, transcripts were coded into an initial set of themes based on keywords or phrases that appeared to convey an opinion or perception regarding telemedicine guided by themes identified from previous literature[11 13 24]. These initial codes were further examined and refined, with codes combined to be main themes if they had similar contexts or split into subthemes via an inductive process. The final codes were summarized, cross checked and iteratively refined using paired analysis of transcripts by two researchers (JYL and SWHL). In the event that there was a divergent interpretation, the transcripts were reviewed again and discussed until consensus was achieved.

Ethics

The study was approved by the Monash University Research Ethics Committee (CF14/1977 – 2014001016 & CF15/1073 - 2015000502) and the National Medical Research Register (NMRR-14-177-19466 & NMRR-14-1368-22943). All participants provided written informed consent for participation in the research. This study was registered with ClinicalTrials.gov under the registration NCT0246680.

Patient and public involvement

The current study was designed to understand patients' views, perceptions and experiences in using telemedicine for type 2 diabetes management. Patients were not involved in the initial design of the study, development of interview questions or conduct of the study. All participants in this qualitative study were not provided with the results but were informed that the results will be published in a peer-reviewed journal.

Results

Demographics of participants

A total of 48 participants were interviewed in 12 focus group and two interview sessions. Each focus group had an average of between 3-4 participants, as we had difficulty arranging for larger groups due to different timing of clinic visits. The participants were mostly females (56.3%), with a mean age of 51.9 years, and have had diabetes for 5.6 years on average (Table 2). Four core themes emerged from the focus groups and the two in-depth interviews: (1) Generational difference (2) Independence and convenience, (3) Sharing of health data and privacy; and (4) Concerns and challenges.

Theme 1 – Generational differences

Our data suggests that there were generational differences with regards to participants' preference on how to record their blood glucose reading. Generally, older participants in this study (those aged 50 years and above) preferred to record their glucose readings manually, using pen and paper. They felt that the telemonitoring device required technical knowledge and was a challenging and complex process for them. As narrated by the participants:

> "I (prefer to) manually record (my blood glucose readings). I do not understand (how to operate the mobile) telephone especially operating (the software). To me manual (recording) is easier." [Patient 4, 59/F]

> "But I am an old lady. I like it (blood glucose results) to be written (down). I'm old (and) I need to write (the results) down. Anyway, as long as someone shows me how to do it, I can do it. Of course (using telemedicine) is easier because you bring your hand phone everywhere you go." [Patient 5, 57/F]

These participants felt that the use of telemedicine was more suited for younger individuals with diabetes who were more familiar with technology utilisation. As explained by one participant, "Maybe for the young ones. Technology (is) for youngsters (and) is more suitable since they like to sit at home and like the thing called Internet." [Patient 41, 67/M]

Some participants also expressed their preference to meet their health care providers in person and reported that travelling to the clinic was preferred.

> "I don't mind coming to the clinic and have a chat with the doctor. We (can) discuss (my medical condition) and sometimes we can ask questions and doctors can show (my problem to me) physically. For me to use the Internet is difficult to learn (as) my children are not here." [Patient 6, 60/M]

Conversely, younger participants were more inclined to learn and use new technologies if sufficient training and guidance were given. Additionally, they were optimistic about using telemedicine to manage their conditions, as they knew the various benefits that technology would provide, including the data analytics ability and convenience.

Theme 2 – Independence and convenience

Participants expressed that the use of a mobile phone connected to a glucometer was a convenient method that contributed to the improved management of their diabetes. Participants considered this to be a convenience when time constraints or logistical issues prevented them from attending the clinic for their appointment. Participants also mentioned that having a telemonitoring device encouraged them to monitor their glucose levels regularly compared to the quarterly check-ups at the clinic. As expressed by participants:

> "It's good to use especially over the Internet. It's so much easier we do not have to come to the clinic and can stay at home" [Patient 12, 60/M].

> "Digitals way (is the preferred choice). Everyday you can see (your blood glucose results) in the software so (there is) no need to record like manual. Sometimes even you record manual the paper will go wherever (or) missing. (Using) digital you have a backup." [Patient 8, 35/F]

> "I like this because you can transfer (your blood glucose results) directly to your phone. It's useful to me as an indication. I prefer (using technology so) that I can use it to check how my medicine affects my glucose. I think that this is the best tools because you can monitor by the Internet everywhere you go." [Patient 9, 44/M]

> “It’s even more convenient since we do not have the time to come (to the clinic) and sometimes some people do not have transport.” [Patient 10, 44/F]

Most participants were generally enthusiastic as they saw the potential benefits of telemedicine. Participants described how the use of a web-based glucometer was useful as it could provide them with reminders and alerts as well as the ability to connect with their healthcare providers without going to the clinic. Nevertheless, they expressed the desire and need to have more training and assistance, especially when they had not used the device for some time, since they would have forgotten the functions on the device.

> “For me it’s not difficult … just need to teach (me) that’s all. See the learning condition first (and perhaps I need more training), maybe need two or three times. I’m over fifty (years old) so (the) first time will be a problem ……need to teach a few times before I understand. First time might be difficult to understand” [Patient 7, 56/M].

Theme 3 – Sharing health data and privacy

Our analysis showed that there were conflicting perspectives with data sharing. Several participants expressed that they were willing to share their monitoring results with family members, as they felt accountable for their diabetes management, which was a significant motivation for them to meet their daily goals.

> “The use of this what you call it (web-telemonitor)……… (I feel) my health is better since my family members (also) monitor (my) sugar levels as well” [Patient 11, 54/F].

> “The good part (of telemedicine is) you can do it at home. If (you check your blood glucose levels) at the clinic you get pricked (but) nobody knows (the results)… but when you do it at home you children will be informed as well” [Patient 5, 57/F].

Conversely, some participants expressed concern with the sharing of medical information with their family members, whereby they felt that their privacy was infringed and could potentially lead to conflicts between family members.

> “That thing (Telemonitoring device) is okay (to use) but what I am afraid of is (that the use of telemonitoring may) sometimes (cause) conflicts because it feels like you are being monitored by others. But it is beneficial, at least there is somebody remind you” [Patient 1, 45/M].

Participants also expressed concern about the presence of malware in telemonitoring devices that could compromise their personal information.

> “(What happens when we have a) problem with the Internet (connection). Occasionally we (may) receive the reading, but occasionally (we will be) unable to (do so). (This can be) very inconvenient” [Patient 11, 54/F].

Some participants felt that meeting or contacting their health care providers was a simpler and faster way to solve their queries as the health care practitioner would be able to explain their clinical measures in a more concise manner. As explained by one participant “Face-to face (consultation) is more important (as) its better. (With) face-to face (consultation), information is clearer and more satisfying to me.” [Patient 2, 67F].

Theme 4 – Concerns and challenges

Participants in this study emphasized the importance of having a user-friendly technology. Most participants in this study reported minor technical difficulties especially with internet connectivity and availability in rural areas, which limited their ability to utilize the telemonitoring device effectively. Participants also expressed concerns regarding the stability of internet connection at their homes.

> “I think depending on the situation.. whether you live in a village where (I feel) it will be very difficult….. because (in) certain villages you don't have (Internet) line so you (will) still need have (to record the blood glucose results) manually” [Patient 8, 35/F].

Participants suggested the need to have a robust system which is user-friendly, with good technical support which they felt were essential to ensure the successful implementation of telemedicine.

> "Okay but what happens when there is a virus? It is a problem for one week my handphone "hang". After one week it hangs (again)….that is a problem" [Patient 13, 54/F].

Another aspect which participants were worried of was the costs involved compared to conventional care and that telemonitoring would only be suitable for affluent patients.

> "All this (telemedicine) is for people who are wealthy. Of course this is a good system." [Patient 14, 63/M]

Discussion

In our study, we present the conditions inthe success of a telemonitoring health device for managing type 2 diabetes from the perspectives of patients. We identified a set of distinctive but interrelated conditions which were and would be central to the success of such programmes in the context of a developing country. Firstly, participants' age were crucial in ensuring the success of telemedicine. We noted that younger participants between the ages of 29 and 50 years old preferred to use a web-based glucometer compared to older participants (aged 50 and above) who preferred to record their results manually. This outcome is not surprising, as younger individuals are more familiar with technology and its use. This was noted in the IDEAS study where the average SMBG uploads were only one reading per week instead of the recommended six readings a week.[31] Participants cited various reasons for being not being able to use a web-based glucometer. These included the lack of internet connectivity especially in the rural areas. Concerns about the stability of internet connections were the main barrier in using telemedicine in the management of diabetes in this study. The need for a simple, user friendly technology was also consistently highlighted in order to encourage acceptance and adoption among participants on the use of a remote telemonitoring system.

Participants expressed enthusiasm with the potential added value of telemedicine with to their medical conditions. The perceived benefits of telemedicine included the ability to receive alerts, access to SMBG readings with advice from a health care professional; as well as reduced cost ion their treatments. Most participants were willing to incorporate technology as part of their diabetes management, but only if they were confident in using the device or if they could seek help and support easily. Our results support previous research which indicated that personal interaction with health care practitioners was important to support people with type 2 diabetes, especially when it involved SMBG.[15 33] These views were also expressed by most participants in the present study, and the lack of clinical support especially when communicating through remote telemonitoring led to participants dropping out of the study.

Living with diabetes can be difficult, especially with the need to comply with a demanding and often confusing set of self-care directives. Many individuals encounter diabetes-related conflicts with family members, which results in strained relationships. As noted in this study, some participants expressed reservation on the feedback and monitoring features of the telemonitoring device, as they felt that the device intruded into their privacy, as well as gave them the feeling of being “watched”. Consequently, some patients opted not to participate in the IDEAS[30] randomized controlled trial. The findings of this study identified several salient issues which are reflected in the literature. For example, many others noted that patients accepted telemedicine due to its ability to reduce travel time[34-36], increase self-awareness[37 38] and increase access to care[39 40].

The present study also found several additional barriers that have not been reported in previous literature, such as conflict between operational practicality versus patient’s privacy and healthcare data security. As privacy and security risk may undermine the potential of telemedicine, it is important that software developers must consider this aspect as information security is crucial to support a trusting relationship between patients and providers. Therefore, collaboration with researchers in the field of cybersecurity, especially those specializing in network security and cryptography is necessary.

Our study offers several strengths. By exploring the insights of patients, we illustrate how family values and technology literacy could influence participants' opinions on the use of telemonitoring in their medical condition. This method also allowed us to gain an in-depth understanding and broader views of participants' behaviour when managing diabetes. Our study was also culturally specific in an Asian context.

There were some limitations to our study. Firstly, although we included a diverse sample of participants and reached thematic saturation in our focus groups and in-depth interviews, these participants were only limited to one geographical location in Malaysia. Participants in this current study were recruited from suburban districts in Selangor where connectivity and technology literacy were moderate. Future studies should include patients from both urban and rural locations and also include participants with high technology literacy, as this could potentially influence the uptake and acceptability of telemedicine. While published literature suggests that these trends are likely to be transferable to other regions in Malaysia, the context may differ in other countries and settings. The views expressed here are solely from the patients' and do not represent the views of health care providers or policymakers. Finally, our results cannot draw a definitive conclusion regarding differences in provider practices, patient knowledge as well as attitudes from different clinic sites other than those examined in this study.

Implications for practice

The continued development and improvement in healthcare technology will hopefully facilitate the use of telemedicine in the future. The largest potential use of telemedicine will be its ability to reduce logistical barriers and hence save time. However, before any telemedicine programs are introduced, there is a need to consider the economic standing of patients and their access to technology. Those living in rural areas may have limited internet connectivity and hence efforts must be made to ensure that the expectations of patients are met. Also, there is a need to invest in capacity building, especially in human resource. Specifically, the creation of training programs on the use of telemedicine for both the general public and health care workers, are particularly important, especially among the non-IT competent groups of users.

Conclusion

Results from this study indicate that the implementation of telemonitoring in diabetes management requires strategic planning with input from various stakeholders including, educators, health care providers, telecom service providers and patients. The patient’s personal and contextual factors, which could have a positive or negative effect on the uptake of the service should be taken into consideration. As such, health care providers need to discuss and consider the perspective of their patients to ensure the optimal use of telemedicine to improve patients' clinical parameters and quality of life.

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Author Disclosure Statement

The authors report no conflict of interest.

Author Contributions

All authors named contributed substantially to the document. JYL conducted and transcribed the interview, interpreted the results and wrote the draft manuscript. SWHL obtained the funding, designed the study and provided support in editing the manuscript. CKYC, SSC, TP, KKCL, NHN and CSST contributed to the study design and critical review of the manuscript. All authors approved the final version.

Data sharing statement

All data generated or analyzed during this study are included in this published article. They can be made available from the corresponding author on reasonable request.

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Table 1: The interview guide topic areas and key questions

Topic area	**Key questions used in interviews**
Diabetes	• How would you describe your experience so far with diabetes? • How have you been coping with diabetes so far? Describe some of the ways you have been coping • Who and how much support do you have to cope with your conditions now • What are some of the most important treatment needs for a patient with diabetes
Telemedicine	• Describe and tell us your experience with using the web-enabled glucometer so far. • How do you think the system was able to affect your diabetes management? • How do you think other will accept this system? • What would you think are some areas where the system was good and where are the areas we can improve? • What do you think about using this system for the long term?

	• What would be some of your concerns (if any) if this was to be used? • How was your interaction with your healthcare professional with the device?

Table 2: Baseline demographics of participants who participated in the focus group

Patients (n= 48)	Men (n = 21)	Women (n = 27)
Age (years)	54.19	50.15
Range	29-62	31-69
Duration of diabetes (years)	4.06	6.88
Range	0.83-24	0.5-15
No. of oral hypoglycaemic agents used, n (%)		
1-2	18 (85)	27 (100)
≥3	1 (4)	0 (0)
No. of antihypertension drugs used, n (%)		
1-2	9 (42)	11 (40)
≥3	3 (14)	7 (25)
Insulin use, n (%)		
Yes	4 (19)	2 (7)
No	17 (81)	25 (93)

Data are expressed as mean, unless otherwise stated.

Box 1: IDEAS study

The Intervention for Diabetes with Education, Advancement and Support (IDEAS) study is a cluster randomized controlled study to evaluate the use of telemedicine to improve diabetes care. Participants in the telemedicine group were instructed to measure their blood glucose at least twice weekly (one fasting and one non-fasting) or more frequent as recommended by physician. These blood glucose readings will be transmitted via a Bluetooth technology to the participants' mobile phone to a remote secure server. Participants and their physicians were able to access the records on the server. Advice on lifestyle modification, any potential changes in medication, who and how to contact their healthcare providers were also given monthly during the study. A researcher also checked participants' results weekly and initiate intervention if needed (e.g. medication changes, counselling) with the consent of the attending physician.

Standards for Reporting Qualitative Research (SRQR)*

http://www.equator-network.org/reporting-guidelines/srqr/

Title and abstract

	Page/line no(s).
Title - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	1
Abstract - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	3-4

Introduction

Problem formulation - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	6-7
Purpose or research question - Purpose of the study and specific objectives or questions	8

Methods

Qualitative approach and research paradigm - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale**	10
Researcher characteristics and reflexivity - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	10
Context - Setting/site and salient contextual factors; rationale**	9
Sampling strategy - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**	9
Ethical issues pertaining to human subjects - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	11
Data collection methods - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**	9-10

Data collection instruments and technologies - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	10-11 & Table 1
Units of study - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	12
Data processing - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	10
Data analysis - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale**	11
Techniques to enhance trustworthiness - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale**	11

Results/findings

Synthesis and interpretation - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	13-19
Links to empirical data - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	13-19

Discussion

Integration with prior work, implications, transferability, and contribution(s) to the field - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	20-22
Limitations - Trustworthiness and limitations of findings	22

Other

Conflicts of interest - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	25
Funding - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	25

*The authors created the SRQR by searching the literature to identify guidelines, reporting standards, and critical appraisal criteria for qualitative research; reviewing the reference lists of retrieved sources; and contacting experts to gain feedback. The SRQR aims to improve the transparency of all aspects of qualitative research by providing clear standards for reporting qualitative research.

**The rationale should briefly discuss the justification for choosing that theory, approach, method, or technique rather than other options available, the assumptions and limitations implicit in those choices, and how those choices influence study conclusions and transferability. As appropriate, the rationale for several items might be discussed together.

Reference:

O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. **Standards for reporting qualitative research: a synthesis of recommendations.** *Academic Medicine*, Vol. 89, No. 9 / Sept 2014 DOI: 10.1097/ACM.0000000000000388