

Review Article

Effect of telemedicine on diabetic treatment and complications

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ABSTRACT

Investigations have also reported that the efficacy of telemedicine in the easy delivery of information and provision of regular patient-doctor interaction and therefore, enhancing the quality of care of diabetics and reducing the risk of developing severe complications. In the present study, we aimed to discuss telemedicine use in the management of diabetic complications, depending on information from studies within the literature. Overall, telemedicine assists patients to properly maintain basic and adequate levels of blood glucose levels through continuous reminders. Therefore, the application of this modality requires patients to have home-based assessment devices for the regular monitoring of the blood glucose levels. Moreover, the modality also enhances the connection between the patient and the physicians which make the patient at an ease of being able to communicate with the doctor whenever necessary and therefore, this might have a positive psychological impact on these patients. Moreover, telemedicine can provide patients with adequate treatment schedules that might help patients comply with their drugs. Additionally, it can provide the most appropriate dietary components that can also help in achieving the best intervention, with the necessary supervision. Although there is good evidence about the efficacy of telemedicine as an efficacious modality in the treatment of diabetes and management of complications, the evident application in the healthcare settings is still poor. The main reason behind such lack of proper application is the potential lack of adequate financial support, lack of experienced staff dealing with the modalities and maintaining the best quality of care for the patients.

Keywords: Diabetes, Telemedicine, Care, Management, Complications

INTRODUCTION

Reports have shown that diabetes mellitus (DM) nearly affects more than 30 million patients within the United States in 2015 and 415 million globally, which is expected to increase to 642 million by 2040.¹ The chronic

condition mainly has two types, including type 1 (T1DM) and type 2 (T2DM), with two different pathophysiological pictures. In T1DM, which usually occurs in childhood, patients suffer from absolute insulin deficiency, while in T2DM, which usually occurs in the older population, patients usually suffer from insulin resistance and deficiency may usually occur later on.² As

a result of either of these mechanisms and the subsequent increase in the serum glucose levels or hyperglycemia, many complications can affect many organs within the body and cause life-disabling manifestations that may end up with death. The affected organs might include the cardiovascular organs, kidneys, skin, eyes and nerves. It has been estimated that diabetes-induced mortality is a leading cause of global deaths owing to secondary amputations, kidney failure and blindness.³⁻⁵ Accordingly diabetic patients are advised to undergo routine checkups for the proper management and interventions against these complications.

The management of DM complications is exhaustive as patients are required to perform many examinations and stick to strict treatment modalities. Based on these challenges, researchers have aimed at developing novel approaches for the easy delivery of the management modalities and to encourage patients to adopt the self-care approach to reduce the burdens of the exhaustive management procedures and thus, enhancing the quality of life for these patients and the quality of care for the diabetic complications.

Among the suggested modalities, telemedicine has been proposed as an efficacious approach that can help achieve these aims. The idea behind this approach is to increase the interaction between the patients and their physicians and enhance the quality of information exchange between the two parties, which therefore, can enhance the quality of care and is cost and effort-effective.^{6,7} Telemedicine has been previously reported in the management of many disorders, to increase the patients' compliance to treatment, as in hypertension and other cardiovascular diseases.⁸⁻¹⁰ In DM, it has been used to routinely follow-up the status of the affected patients and the regular check-up of their blood glucose levels to obtain the best outcomes.^{11,12} Previous relevant investigations have also reported the efficacy of the modality in the easy delivery of information and provision of regular patient-doctor interaction and therefore, enhancing the quality of care of diabetics and reducing the risk of developing severe complications.^{13,14} In the present study, we aimed to discuss telemedicine use in the management of diabetic complications, depending on information from studies within the literature.

METHODS

A systematic search was conducted to identify relevant studies in the following databases: pubmed, medline, web of science, embase, google scholar, and scopus. The following search terms were used (telemedicine or telemedicine), (diabetes or diabetes mellitus), (treatment), (effect or outcome) and (complications). The reference lists were manually searched to identify additional relevant studies meeting inclusion criteria. We included any study that reports the telemedicine effect on diabetic treatment or complication. No restrictions were applied.

DISCUSSION

Telemedicine in diabetic treatment and complications

Telemedicine has been extensively reported in the literature for many purposes regarding the management of diabetes. Studies showed that previous diabetes management modalities can be used to increase the knowledge about the disease and management modalities, enhance the perception about the disease and the potential complications, strengthening the relationship between the patient and his family and facilitation of the management approaches to increase the compliance to these modalities over the long term.¹⁵⁻²² However, many challenges should be considered to alleviate the quality of care. Previous investigations reported that it can overcome the poor access to these modalities in low socio-economic and rural areas might limit the benefits of the modality. Moreover, some studies reported that it is not cost-efficacious and is associated with poor compliance among diabetic patients.^{23,24} Therefore, telemedicine has been proposed as an efficacious modality for the management of complications and treatment of diabetes.²⁵ Currie et al also reported that clinical and face-to-face regular assessments might be potentially better than telemedicine because patients that usually comply less with the medical regimens are more likely to adhere to this new modality and therefore, continuous guiding is encouraged.²⁶ Therefore, telemedicine applications should be carefully approached on a regular basis.

Self-monitoring and assessment of complications

The main of applying telemedicine modalities is to provide the patient with the necessary information about the best ways to achieve the prevention and prevent the possible complications and to enhance the frequency of communication between the patient and his doctor. As advances have emerged within these modalities, innovative approaches have been created to facilitate the modality and obtain the best clinical outcomes. Previous studies have demonstrated that mobile-based interventions are promising and efficacious modalities in obtaining good interventional outcomes and improving the quality of life for the potential patients that have been using them.^{27,28} Based on the findings of these various investigations, mobile-based interventions for the treatment and management of diabetic complications are currently validated for the easy delivery and enhancement of these outcomes.^{29,30} However, the availability of mobile phones and the ability to afford them by many individuals might be a potential holdback in achieving these outcomes, as previous research reported that 9% and 22% of the adults and adolescents, respectively, cannot have mobile phones and therefore, the modality is not applicable for this large proportion of the population. Besides, evidence from previous studies also showed that applying telemedicine for children and adolescents was not significantly associated with any improvements in the primary outcomes of glycemic control, including

maintaining normal blood glucose levels, although it has been noticed that the modality was associated with increased adherence and compliance, in addition to the increased knowledge and communication between the patients, families, and doctors.³¹⁻³³ Therefore, future investigations should be continued and should focus on addressing these challenges to further enhance the outcomes.

To overcome the limited availability of mobile phones among adults and adolescents, previous investigations have proposed internet-based interventions as an alternative modality as the availability of internet among the population is more common than mobile phones within the United States. Moreover, another reason that may favor the use of internet-based approaches is the easy-accessibility to diabetes-related information, especially in the younger population.³⁴ Previous investigations have reported a significant enhancement in all aspects of glycemic control and management of diabetic complications and related adverse events in both adults and children.³⁵⁻⁴⁰ However, it should be noted that internet-based approaches also face some challenges that might limit the results. The main challenge is the less frequent access to the internet and the limited time spent on it, as reported by previous investigations that reported a variable rate of participation in the intervention programs that ranges between 11.5% and 37%.^{36,39}

Self-management interventional approaches for DM are now validated and efficacious modalities with variable-related techniques that can be applied to suit the patients' needs and circumstances. These include text messaging, web-based portals, internet texting and e-mails, voice calls, conducting video conferences and seminars.^{41,42} The previous meta-analysis by Holtz et al.,³⁰ which included articles before 2011 reported that most of the included articles showed that telemedicine application in the treatment and management of diabetic complications was effective in obtaining favorable outcomes, as per the findings from 21 articles that investigated patients with T1DM and other with T2DM. Another meta-analysis by Farmer et al which was published in 2005 also reported that in addition to being efficacious in managing diabetic complications and enhancing compliance to treatment, telemedicine approaches are also feasible for the patient and the doctor and are time and cost-effective.¹³ In 2019, another scoping review was conducted by Borris et al to discuss the effect of telemedicine on self-management and clinical complications in patients with T1DM and T2DM.⁴³ The authors managed to include 45 articles from the literature, however, they depended on only 10 of them to discuss the relevant outcomes. The authors reported that based on the most commonly assessed modality in these studies (HbA1c levels), telemedicine application was associated with enhanced self-management behaviors and enhanced clinical outcomes. However, it appears that neither of the included studies assessed the long-term complications of diabetes and the effect of telemedicine

on reducing the risk of developing organ damage and mortality.

Overall, telemedicine assists patients to properly maintain basic and adequate levels of blood glucose levels through continuous reminders. Therefore, the application of this modality requires patients to have home-based assessment devices for the regular monitoring of the blood glucose levels. Moreover, the modality also enhances the connection between the patient and the physicians which make the patient at an ease of being able to communicate with the doctor whenever necessary, and therefore, this might have a positive psychological impact on these patients. Moreover, telemedicine can provide patients with adequate treatment schedules that might help patients comply with their drugs. Additionally, it can provide the most appropriate dietary components that can also help in achieving the best intervention, with the necessary supervision.

The previous scoping review by Borris et al reported that although no significance was found in the findings, studies showed that improved clinical and physical outcomes were associated with the application of telemedicine devices in diabetes care.⁴³ Moreover, the blood glucose and lipid profiles were significantly enhanced in these patients. On the other hand, Borris et al reported that the effect on vascular diseases and long-term complications was not clear at this time due to the lack of evidence and long-term investigations that reported this outcome.⁴³ Moreover, it is worth mentioning that the telemedicine modalities might be also limited to the lack of adequate examination by the doctors. These are only useful in the monitoring of the blood glucose levels and reporting of the main physical complications and adverse events. However, complex procedures and clinical assessment modalities are usually limited as a result of the limited face-to-face interactions between the doctor and physician. Therefore, most studies in the literature are not directed to assess such outcomes, which might be illogical to be assessed for judging the efficacy of telemedicine that has been designed for another purpose.

Current challenges for telemedicine in diabetes

Although there is good evidence about the efficacy of telemedicine as an efficacious modality in the treatment of diabetes and management of complications, the evident application in the healthcare settings is still poor. The main reason behind such lack of proper application is the potential lack of adequate financial support, lack of experienced staff dealing with the modalities and maintaining the best quality of care for the patients. Financial compensations for these services have been a huge obstacle for the providers of the service since it was suggested.^{44,45} Another obstacle for using telemedicine in healthcare settings is the legal issues that require solid paperwork and many ethical considerations before it was legalized.⁴⁴ Moreover, the attrition of patients that are

supposed to engage in making the modality successful, has also been reported to be low among studies in the literature as previously mentioned.^{36,39} Additionally, even in patients that have been reported to engage in the procedures of telemedicine, the compliance was not adequate due to the lack of adequate necessary face-to-face supervision. This was supported by a previous review by Guljas et al that reported that patients, that were being followed using telemedicine modalities, did not adequately upload the supposedly-regularly assessed blood glucose levels to the system for maintaining adequate regular monitoring procedures.⁴⁶

CONCLUSION

In the present study, we have reviewed the literature to study the effect of telemedicine on diabetic treatment and complications. Self-management interventional approaches for DM are now validated and efficacious modalities with variable-related techniques that can be applied to suit the patients' needs and circumstances. These include text messaging, web-based portals, internet texting and e-mails, voice calls, conducting video conferences and seminars. Although there was good evidence about the efficacy of telemedicine as an efficacious modality in the treatment of diabetes and management of complications, the evident application in the healthcare settings was still poor. The main reason behind such lack of proper application was the potential lack of adequate financial support, lack of experienced staff dealing with the modalities and maintaining the best quality of care for the patients.

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