

ARTIGO DE REVISÃO

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IMPACT OF TELEHEALTH AND TELEMEDICINE ON GLYCEMIC CONTROL IN ADULTS PATIENTS WITH DIABETES MELLITUS: A NARRATIVE SYNTHESIS

ABSTRACT

Effective DM management relies on patient education to promote self-care. With expanding access to digital technologies, Telemedicine and Telehealth offer promising tools to enhance education and glycemic control in DM patients. To evaluate the impact of Telehealth and Telemedicine interventions on glycemic control in patients with type 1 (DM1) and type 2 diabetes mellitus (DM2). This narrative review includes randomized controlled trials (RCTs) published between January 2016 and December 2021. Inclusion criteria comprised studies involving DM1 and DM2, comparing the impact of Telehealth interventions on glycemic control with conventional follow-up. Exclusion criteria encompassed duplicate or inaccessible articles, short communications, book chapters, single-arm clinical trials, and studies lacking a detailed description of the Telehealth intervention. The databases searched included PubMed, ScienceDirect, SciELO, LILACS, and Cochrane. A total of 38 studies involving 7,891 patients were assessed. The mean age of patients ranged from 44 to 73 years, and follow-up durations varied from 3 to 18 months. Ten studies evaluated web-based programs, mobile apps, and text messages; among these, seven (70%) showed significant reductions in A1c, ranging from 0.2 to 1.7%. Twelve studies assessed device use and telemonitoring, with nine (75%) showing significant A1c reductions from 0.4 to 1.6%. Sixteen studies examined teleconsultations alongside usual diabetes care; twelve (75%) demonstrated significant A1c reductions, ranging from 0.5 to 3.1%. The incorporation of Telehealth/Telemedicine strategies into standard diabetes management shows a positive impact on patient care.

Keywords: Diabetes Mellitus; Glycated Hemoglobin; Telemedicine; Telehealth.

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1 INTRODUCTION

Diabetes mellitus (DM) is a widespread metabolic disorder with various causes and is a major public health concern due to its strong links to increased mortality from cardiovascular and microvascular complications. Effective DM management relies heavily on patient education, which can improve glycemic control and reduce hospitalizations. Key areas of diabetes **education include proper insulin administration, physical activity, recognizing** hypoglycemia symptoms, and other essential self-care practices (Gross *et al.*, 2002).

With advances in health technology, Telemedicine and Telehealth have emerged as promising tools to strengthen diabetes education and patient self-management. Telemedicine has gained particular prominence as a safe and effective approach to managing chronic diseases, including DM. Remote consultations now allow patients, especially those in underserved areas, to access healthcare services regularly, facilitating consistent monitoring of their conditions (McDonnell, 2018; Faruque *et al.*, 2017). This study aims to review the impact of Telehealth and Telemedicine interventions on glycemic control in patients with DM.

2 METHODS

This narrative review includes studies published between January 2016 and December

2021, guided by two key research questions: “What is the impact of Telehealth/Telemedicine on A1c levels in patients with diabetes mellitus?” and “What specific Telehealth/Telemedicine strategies have been implemented in diabetes care, and what is their effect on glycemic control?”

The databases consulted were PubMed, ScienceDirect, SciELO, LILACS, and Cochrane. Following expert validation, search terms included: (diabetes mellitus OR diabetes OR diabete OR diabete melito) AND (Telemedicine OR Telehealth OR Mobile health OR eHealth OR mHealth). The search was conducted in January 2022.

A total of 894 articles were identified, with 38 randomized controlled trials meeting

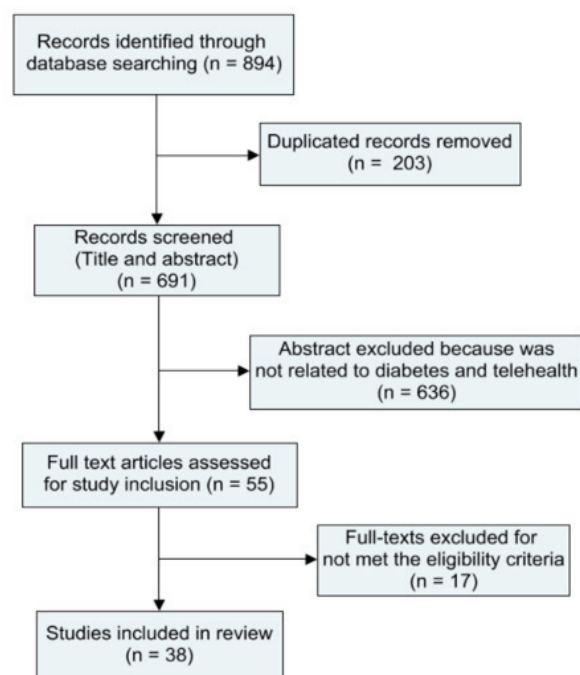
the selection criteria (see Figure 1). These processes are summarized in Table 1.

3 RESULTS

A total of 38 studies involving 7,891 patients were included, with 4,371 in the intervention group and 3,520 in the control group. The majority of studies targeted adult and elderly patients with DM2. The mean age of participants ranged from 44 to 73 years, with follow-up durations varying from 3 to 18 months ([Supplementary material 1](#)).

Regarding A1c reduction, 28 studies (73.7%) showed a greater A1c reduction in the intervention group. The interventions evaluated varied, including web-based programs,

► Figure 1 - Flowchart of the article selection process



Source: elaborated by the authors.

► Table 2 - Description of inclusion/exclusion criteria, data extraction, and synthesis

Inclusion criteria	Studies that evaluated patients with DM1 and DM2; randomized controlled trials comparing the impact on glycemic control in the intervention group (subjected to some Telehealth approach) versus the control group (followed conventionally); peer-reviewed articles and published in English, Portuguese, or Spanish.
Exclusion criteria	Duplicated or unavailable articles; abstracts and book chapters; clinical trials with only one arm; articles that did not describe the employed Telehealth strategy. All intervention groups maintained regular diabetes mellitus follow-up with physicians, nurses, and/or pharmacists.
Extracted data	Authors, year of publication, number of participants, age, gender, country, educational level, satisfaction evaluation, type of intervention, initial and final glycated hemoglobin levels, and duration of follow-up (Supplementary material).
Synthesis data	Type of intervention (patients undergoing regular teleconsultations, patients using devices for telemonitoring, and patients exposed to websites, applications, or mobile text messages). Additionally, the studies were also evaluated according to the type of diabetes, the target of the intervention (diet, physical activity, glycemic control, adherence), and the nature of the intervention (human-mediated or not).

Source: elaborated by the authors.

mobile health apps, text messaging, devices, telemonitoring, and teleconsultations. These strategies focused on education and self-management, emphasizing glycemic control, recognition of hypoglycemia symptoms, physical activity, healthy eating, weight control, and complication prevention ([Supplementary material 2](#)):

a) web-Based programs, apps, and text messages: Ten studies analyzed these strategies, and seven (70%) demonstrated A1c reductions. Educational interventions for diabetes utilizing mobile and web-based technology demonstrated significant reductions in A1c, ranging from 0.2 to 1.7%. Most interventions focused on lifestyle modifications and glycemic control, with some also supporting medication adherence. Follow-up periods ranged from less than six to more than 12 months, and a significant number of studies reported participant satisfaction;

b) device utilization and tele-monitoring: Twelve studies evaluated these methods, with nine (75%) showing significant A1c reductions. Telemonitoring approaches resulted in A1c reductions ranging from 0.4 to 1.6%. Mobile devices and remote monitoring systems were widely utilized, with human interaction incorporated into many interventions. Patient satisfaction was positively evaluated in several studies, and follow-up periods varied, with some interventions lasting more than 12 months;

c) teleconsultations in diabetes care: Sixteen studies investigated teleconsultations, with twelve (75%) demonstrating A1c reductions. Teleconsultation-based interventions exhibited the most significant impact on A1c, with reductions ranging from 0.5 to 3.1%. These strategies often combined remote support with clinical decision-making, addressing glycemic control, medication adherence, and insulin adjustments. Most

studies involved human interaction, reinforcing the importance of professional oversight in telemedicine. Follow-up durations varied widely, with some interventions extending beyond 12 months.

4 DISCUSSION

The review highlights Telehealth and Telemedicine potential to improve glycemic control among diabetes patients. Studies assessing web-based platforms, mobile apps, and automated messaging show promising outcomes. These remote-access tools provide patients with interactive, user-friendly support, extending essential resources to those in underserved or rural areas with limited in-person care access (Zhang *et al.*, 2019; Fortmann *et al.*, 2017).

Telemonitoring has also proven effective for glycemic control. This approach allows for real-time blood glucose monitoring, often with direct data transmission to healthcare providers who can intervene quickly as needed. Such continuous oversight enables timely adjustments in treatment and supports a more individualized approach to diabetes management (Franc *et al.*, 2020).

Additionally, teleconsultations have been shown to effectively lower A1c levels. Conducted remotely, these consultations provide patients with regular access to healthcare providers, enabling personalized treatment modifications and immediate

clarification of instructions. This accessibility reduces logistical barriers, ensuring that patients receive ongoing, individualized care. Evidence from diverse settings, including resource-limited environments, supports teleconsultations as a means to foster better adherence, enhance self-management skills, and ultimately improve glycemic outcomes (Lu *et al.*, 2021).

Telemedicine shows great promise in improving diabetes management in developing countries, particularly in areas with limited healthcare access. Studies in Brazil, India, and South Africa highlight the effectiveness of mobile apps, remote monitoring, and virtual consultations in enhancing treatment adherence and self-care education. Cost-effectiveness supports their integration into public health policies to optimize chronic disease care for vulnerable populations (Cancela *et al.*, 2016).

However, certain limitations deserve consideration. Long-term patient engagement with mobile apps and web programs can be challenging, and the lack of participant blinding in these studies may introduce bias. Future research should examine hybrid Telehealth models that blend teleconsultations, telemonitoring, and digital self-management apps, as these combined approaches may maximize support for diabetes management (Zhay *et al.*, 2014).

5 CONCLUSION

Telehealth and Telemedicine provide significant benefits as complementary tools in diabetes care, improving glycemic control, expanding healthcare access, and promoting self-management. Digital interventions, like web-based programs, apps, telemonitoring, and teleconsultations, consistently enhance A1c levels and integrate effectively with traditional practices. Future research should assess adherence, satisfaction, and cost-effectiveness to ensure scalability, particularly for underserved populations, reducing barriers to care.

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