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The effect of telemedicine management on type 2 diabetes mellitus: a systematic review and meta-analysis

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Corresponding author:
Ruhai Bai

ruhaibai@hotmail.com

Author Affiliation:
School of Public Affairs, Nanjing University of Science and Technology, China.

Qiu, YW; Tang, Y; Cheng, L; Bai, RH.

ADMINISTRATIVE INFORMATION

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 24 March 2025 and was last updated on 24 March 2025.

INTRODUCTION

Review question / Objective To assess the effectiveness of telemedicine interventions for the management of type 2 diabetes mellitus through systematic evaluation and meta-analysis[PICOS framework——P (Population): Adults with type 2 diabetes mellitus; I (Intervention): Telemedicine-based interventions; C(Comparison):Conventional face-to-face standard care; O (Outcomes):HbA1c、FBG、PBG、SBP、DBP、WC、BMI、TC、TG、HDL-C、LDL-C、Diet、Exercise、Self-Efficacy].

Condition being studied Diabetes is one of the most common and fastest growing diseases worldwide. A report released by the International Diabetes Federation 2021 shows that the number of people living with diabetes has reached 537 million globally and is expected to rise to 783 million globally by 2045. Diabetes is now a serious public health problem worldwide. Of the three types of diabetes, type 2 diabetes accounts for about 90 per cent of the total. The core of treatment for type 2 diabetes lies in glycaemic control. However, the current management of the disease faces a double dilemma: on the one hand, patients need to make long-term lifestyle adjustments and self-monitoring, but the traditional diagnosis and treatment model is difficult to follow up in time due to the short consultation time and the long interval between consultations; on the other hand, the medical team can not grasp the patient's real-time data, and it is difficult to make timely adjustments to the programme. This asynchronous phenomenon of doctor-patient information restricts the effectiveness of disease treatment, and the management of diabetes is facing challenges.

In recent years, telemedicine has been applied to the management of type 2 diabetes as an emerging healthcare service. Telemedicine uses communication technology to provide patients with

medical services, health education, and dynamic monitoring across geographical areas, which can overcome the limitations of the traditional treatment model to a certain extent. Several studies have shown that patients participating in telemedicine have improved glycaemic control and self-management, significantly reduced glycated haemoglobin levels, and produced positive psychosocial effects.
Several studies have examined the impact of telemedicine on diabetes self-management, with most focusing on a specific type of telemedicine, a specific outcome, or a specific population. Based on this, the present study aimed to comprehensively assess the effectiveness of telemedicine on type 2 diabetes management outcomes through systematic evaluation and meta-analysis.

METHODS

Participant or population Type 2 diabetes mellitus in patients ≥18 years of age.

Intervention The intervention group received telemedicine services delivered via mobile internet devices, including telephone, computer, smartphone, and web-based platform applications.

Comparator The control group received conventional offline face-to-face diagnosis and treatment.

Study designs to be included Eligible studies were restricted to randomized controlled trials (RCTs) that met all the following criteria: (1) prospective experimental design with documented random allocation methodology; (2) direct comparison between active telemedicine interventions and control conditions; and (3) reporting of at least one pre-specified primary outcome. Quasi-experimental studies, non-randomized trials, and studies lacking proper randomization procedures were systematically excluded.

Eligibility criteria Inclusion criteria for the literature were as follows:(1) patients with T2DM aged ≥18 years; (2) use of telemedicine in the intervention group, including application services provided by mobile Internet devices such as telephones, computers, smartphones, and Web-based platforms; (3) use of offline face-to-face forms of routine management in the control group; (4) improvement in one or more of the patient's indices after the intervention group's intervention; and (5) a randomised controlled trial.

Exclusion criteria for the literature were as follows: (1) duplication of literature; (2) unavailability of full text or extracted data; (3) absence of clinical data studies, including research reviews, conference abstracts, case reports, and editorial commentaries; (4) special populations, such as children with T2DM and pregnant women; and (5) HbA1c was not included as a primary or secondary outcome indicator.

Information sources PubMed、Web of Science、Cochrane Library、Embase、China National Knowledge Infrastructure、 Wanfang Data.

Main outcome(s) All 44 included studies reported HbA1c outcomes. 16,972 in the intervention group and 10,206 in the control group, with intervention durations ranging from 3-24 months. Results showed a significant reduction in HbA1c levels in the intervention group compared to the control group (MD = -0.27, 95% CI [-0.30, -0.23], $p < 0.001$; $I2 = 81\%$). Based on the HbA1c results of the post-intervention change from baseline, the results similarly showed a statistically significant reduction in HbA1c levels in the intervention group compared with the control group (MD = -0.30, 95% CI [-0.33, -0.26], $p < 0.001$; $I2 = 80\%$. There was significant heterogeneity in both parts of the analysis, with visual assessment of funnel plots indicating slight publication bias, and sensitivity analyses were stable and undifferentiated.

Quality assessment / Risk of bias analysis Researchers used the Cochrane Collaboration's Risk of Bias Tool to assess the risk of bias in included studies.The Cochrane tool covers seven areas of bias, including random sequence generation, allocation concealment, blinding of subjects and intervention providers, blinding of outcome evaluators, incomplete outcome data, selective reporting, and other sources of bias.

Strategy of data synthesis In this study, evidence-based analyses were performed using Review Manager 5.4 (Cochrane Collaboration, Oxford, United Kingdom). Continuous data were presented as mean and standard deviation as effect sizes, with estimates (MD) and 95% confidence intervals (CI) given for each effect size. Heterogeneity tests were used to assess heterogeneity between studies. The test was performed using a two-sided significance level ($P < 0.05$, statistically significant difference). Subgroup analyses were used to look at differences between the intervention and control groups after the intervention as well as differences in the changes between the intervention and control groups after

the intervention compared to their respective baselines.

Subgroup analysis The study used a two-tiered subgroup analysis strategy, focusing on between-group differences and time-dynamic changes in intervention effects. Cross-sectional comparisons were aimed at assessing the immediate effect of the telemedicine intervention compared to usual care; longitudinal change comparisons were aimed at assessing the net effect of the intervention by excluding interference from baseline differences.

Sensitivity analysis The meta-analysis was re-run after excluding each included study one by one to verify the stability of the overall results; fixed-effects and random-effects models were also used to compare the changes in effect sizes (MD) and heterogeneity (I^2), to ensure that the conclusions were not affected by the choice of statistical methods. The results showed that the direction of effect sizes and statistical significance of the primary outcomes such as HbA1c were not substantially altered after excluding any single study (e.g., the MD for HbA1c remained -0.27 to -0.30, $p<0.001$), and the level of heterogeneity ($I^2 \approx 80\%$) remained relatively stable, suggesting that the findings are robust.

Country(ies) involved China.

Keywords Telemedicine; type II diabetes; glycated haemoglobin; systematic evaluation; meta-analysis; effectiveness.

Contributions of each author
Author 1 - Yiwei Qiu.
Author 2 - Yao Tang.
Author 3 - Li Cheng.
Author 4 - Ruhai Bai.