

INPLASY

Effectiveness of mobile applications on glycemic control and medication adherence in diabetes management: an umbrella review and meta-analysis of HbA1c outcomes

INPLASY2026100083

doi: 10.37766/inplasy2026.10.0083

Received: 19 October 2026

Published: 19 October 2026

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ADMINISTRATIVE INFORMATION**Support** - None. This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.**Review Stage at time of this submission** - Risk of bias assessment.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY2026100083**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 19 October 2026 and was last updated on 19 October 2026.**INTRODUCTION**

Review question / Objective Review question: In people with type 1 or type 2 diabetes mellitus, what is the effect of mobile-application-based interventions, compared with usual care, standard education or non-app control, on glycated hemoglobin (HbA1c) and on medication adherence, as reported by published systematic reviews and meta-analyses of randomized controlled trials?

PICOS: Population: people with type 1 or type 2 diabetes. Intervention: mobile-application-based interventions targeting medication adherence and/or glycemic self-management. Comparator: usual care, standard education or non-app control. Outcomes: HbA1c (primary); medication adherence (secondary). Study design: systematic reviews and meta-analyses of RCTs, supplemented by primary RCTs where independently verifiable.

Objectives: (1) to pool review-level HbA1c effects; (2) to summarise the evidence on medication adherence; (3) to appraise the methodological

quality of the included reviews (AMSTAR-2) and the certainty of the evidence (GRADE); (4) to quantify overlap of primary trials among reviews (corrected covered area, CCA); (5) to describe app features that track with better outcomes.

Rationale Diabetes affects an estimated 537 million adults worldwide, and sustained medication-taking and self-management are central to glycemic control. Mobile applications are a scalable way to reach patients between clinic visits, combining reminders, self-monitoring, education and feedback from care teams. Many systematic reviews and meta-analyses of these tools have now been published and report effect sizes that differ. Several share the same primary trials, so their findings are not independent. An umbrella review that verifies each source, measures trial overlap, appraises review quality and grades certainty is therefore more appropriate than adding another overlapping primary review. The effect estimates reported across reviews have

not been verified against primary bibliographic records or adjusted for overlap.

Condition being studied Diabetes mellitus (type 1 and type 2), a chronic metabolic disease characterised by raised blood glucose. HbA1c is the standard measure of average glycemia over about three months and is associated with the risk of microvascular and macrovascular complications. Medication adherence is a key behavioural determinant of glycemic control.

METHODS

Search strategy Databases searched: PubMed, Web of Science Core Collection, Cochrane Library and Epistemonikos. Embase and Scopus could not be accessed by the authors. Citation tracking across recent reviews was also used. The original targeted search and citation tracking was in September 2026; the PubMed Boolean search was in October 2026; the other databases were searched on 19 October 2026.

PubMed: ("diabetes mellitus" OR "diabetes" OR "type 1 diabetes" OR "type 2 diabetes") AND ("mobile application" OR "mobile health" OR "mHealth" OR "smartphone application" OR "mobile app") AND ("medication adherence" OR "treatment adherence" OR "glycemic control" OR "HbA1c" OR "glycated hemoglobin") AND ("systematic review" OR "meta-analysis").

Web of Science Core Collection (publication years 2011–2026): TS=(diabet*) AND TS=("mobile app" OR mHealth OR smartphone OR "mobile health") AND TS=(HbA1c OR "glycated hemoglobin" OR "glycemic control" OR adherence) AND TS=("systematic review" OR "meta-analysis").

Cochrane Library: diabetes, mobile-application and review terms.

Epistemonikos: diabetes AND (app OR mHealth OR smartphone).

Participant or population Individuals with type 1 or type 2 diabetes mellitus, as defined by the included reviews. children and gestational diabetes were excluded.

Intervention Mobile-application-based interventions (smartphone or tablet apps) targeting medication adherence and/or glycemic self-management, alone or with other care. Features of interest: reminders, self-monitoring, education and provider feedback.

Comparator Usual care, standard education or non-app control.

Study designs to be included Systematic reviews and meta-analyses of randomized controlled trials. Primary RCTs were used only as supporting evidence where independently verifiable. Scoping reviews and network meta-analyses reporting only subgroup mean differences were excluded.

Eligibility criteria Published 2011–2026; English language; reports app-based interventions in diabetes; bibliographic existence and the reported effect size independently verified against PubMed, CrossRef or the publisher record. Sources that could not be verified were excluded. Reviews of multimodal mHealth interventions that were not app-specific were kept only as contextual references.

Information sources PubMed, Web of Science Core Collection, Cochrane Library, Epistemonikos, and citation tracking of recent reviews. Every candidate was checked against PubMed, CrossRef and/or the publisher record. Embase and Scopus were not accessible.

Main outcome(s) HbA1c, as the mean difference (MD) in percentage points with 95% confidence interval between app users and controls, as reported by each review. Where a review reported several follow-up times, the estimate used is stated in the Methods.

Additional outcome(s) Medication adherence, reported as odds ratios or standardized mean differences using any validated measure. Methodological quality (AMSTAR-2), overlap of primary trials (CCA) and certainty of evidence (GRADE).

Data management Records were logged in spreadsheets (screening log, overlap matrix, extraction sheets). Two reviewers screened independently, with disagreements resolved by discussion. Extracted data were cross-checked by a third reviewer. Records retrieved from Web of Science, the Cochrane Library and Epistemonikos on 19 October 2026 were screened by one screener; second-reviewer confirmation is pending.

Quality assessment / Risk of bias analysis Methodological quality of each included review is being appraised with AMSTAR-2 by two independent reviewers, with disagreements resolved by consensus or a third reviewer. Overall confidence is rated using the standard AMSTAR-2 rule (critical items 2, 4, 7, 9, 11, 13 and 15). Certainty of evidence for HbA1c and adherence is graded with GRADE, with trial overlap recorded as an additional consideration.

Strategy of data synthesis Reviews with a directly comparable HbA1c mean difference and 95% CI were pooled. Standard errors were derived as $(\text{upper} - \text{lower}) / (2 \times 1.96)$ and pooled by inverse-variance weighting, with fixed-effect and DerSimonian–Laird random-effects models. Heterogeneity was assessed with Cochran’s Q and I^2 . Reviews that did not report a between-group pooled MD were summarised narratively. Overlap of primary trials was quantified with a citation matrix and CCA, calculated as $(N - r) / (r \times c - r)$.

Subgroup analysis Where the data allowed, subgroup estimates reported within the included reviews (e.g. by follow-up period or intervention type) are described narratively. No new subgroup meta-analysis was planned.

Sensitivity analysis (i) Each review in the primary analysis taken alone. (ii) All reviews with a poolable estimate pooled together. (iii) Leave-one-out analysis. (iv) Substitution of alternative He 2022 estimates for its 3-month estimate. (v) Omission of Martos-Cabrera 2020 and Cui 2016 together. These were added after the primary analysis, so they are not pre-specified.

Language restriction Yes. English only.

Country(ies) involved Saudi Arabia, Malaysia.

Other relevant information This is a retrospective registration. The review was not registered prospectively. Searching, screening, extraction and quantitative analysis had been carried out before registration, and the AMSTAR-2 appraisal is being verified by two reviewers. Reporting follows the PRIOR statement for overviews of reviews, with the methodology guided by JBI umbrella-review guidance. Full PRIOR compliance was not achieved because the search was not exhaustive across databases; this is stated as a limitation.

Keywords diabetes mellitus; medication adherence; mobile health; mHealth; mobile applications; HbA1c; umbrella review; meta-analysis; GRADE.

Dissemination plans Submission to a peer-reviewed journal. Results will also be shared at conferences, and an update will be made here if the protocol changes.

Contributions of each author

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